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DRIVER DROWSINESS DETECTION SYSTEM

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ABSTRACT...

These days, an ever-increasing number of professions require long time focus. Drivers should watch out for the street, so they can respond to abrupt occasions right away. Driver exhaustion regularly turns into an immediate reason for some car crashes. Therefore, what we need is a system which will detect and notify a driver of his bad sleep deprived condition, which can then significantly lessen the number of car accidents related to fatigue. However, for the development and making of such a good system, we will encounter many difficult situations which will be mostly related to fast and proper recognition of a driver's fatigue and sleep deprived symptoms. One of the possible ways, in which we can implement driver drowsiness detection systems is by a vision-based approach. In this report, we will also discuss the technical modalities to detect driver's drowsiness. Drowsiness, Sleepiness and Exhaustion of drivers are among the most significant causes of road accidents in India and abroad. Every year, exhaustion results in increased amounts of deaths and serious injuries globally. In this report, a module for Driver Drowsiness Detection is presented which will provide a way reduce the number of accidents due to drivers fatigue and will also increase the safety while travelling. This system will deal with driver drowsiness detection system which will be based on visual information and Machine Learning. We also present an algorithm to locate, track, and analyze both the drivers face and eyes, a scientifically supported measure of drowsiness associated with slow eye closure.

INTRODUCTION

Driver Drowsiness and sleep deprivation is one of the major causes for a lot of road accidents. Driver in drowsy state are a danger to road safety and can cause serious injuries sometimes, resulting in death of the victim and also economical loss. Drowsiness means a state where person feels lethargic, has difficulty concentrating and tiredness in eyes of the drivers while he's driving vehicles.

Most of the accidents happen in India due to the lack of concentration of the driver. Driving ability of the driver deteriorates with time owing to drowsiness. To avoid these situations, we developed a system which will detect the drowsiness nature of the driver and will also alert him immediately.

Lot of people drive on the highways all day and all night. This includes bus drivers, truck drivers, taximen and people who are traveling long-distance, they suffer from lack of sleep. Because of sleep deprivation, it becomes very dangerous to drive when feeling fatigued.

According to a database study conducted by the Australian Transport Bureau about fatality crashes, it is found that 16.6% of fatal crashes were caused by sleep deprivation and based on the report submitted by Ministry of Transportation of Ontario, 25.5% of injury causing crashes and 17.8% of crashes with fatality related to sleep deprivation. In India, in 2015 only 148,00+ people died due to vehicle related accidents. Of these 1.4 lac, at least 21 percent were caused due to fatigue causing drivers to make erroneous errors. This is still a relatively smaller number, as among the multiple reasons that can lead to an accident, the involvement of fatigue as a cause is generally highly underestimated. Fatigue when combined with bad roads and bridges in developing countries like India is a recipe for disaster.

Fatigue can't be measured unlike alcohol and drugs, which can be clearly measured and tests that are also available easily to do it. One of the best solutions to this problem of drowsiness and fatigue-related accidents is to raise awareness and promoting drivers to admit fatigue when needed. The first is not easy and much more expensive to achieve, and the other is not possible without the former as driving for long hours is very good pay based for drivers. When the job lucrativeness associated with a sector goes up, the wage associated with it also tends to shot up. It is also the case for driving transport trucks at night.

Money also leads to drivers making unwise decisions like driving all night even with fatigue. This is because of the reason that the drivers themselves are not aware of the huge risk associated with driving when fatigued. Some countries have also imposed restrictions on the number of hours that a driver can drive at a one go, but it is still not enough to solve this problem as its implementation is very difficult and costly.

LITERATURE REVIEW

In this section, we discuss various technologies that have been proposed by researchers for drowsiness detection during the recent years.

DIFFERENT APPROACHES TO DETECTING DROWSINESS: There are a lot of approaches to identify drowsiness state of the driver. Techniques in drowsiness detection can be classified in to three main categories:

- Physiological Parameters-based Techniques: Measuring the drowsiness of the driver on the physical conditions of the driver will fall under this category. It involves measuring cerebral and muscular signals and cardiovascular activity. These techniques are invasive and not commercially viable.
- Vehicular Parameters-based Techniques: Measuring the fatigue nature of the driver based on the vehicle driving patterns comes under this category. Example of this method include monitoring the vehicles position in a particular lane, monitoring steering pattern. These measurements need to take in to account many parameters such as vehicle type, driver experience, condition of the road. Measuring most of these parameters requires significant amount of times and user data. These techniques do not work with microsleeps-when the driver falls asleep for a few seconds without causing any significant changes in the driving patterns.
- Behavioral Parameters-based Techniques: Measuring the driver's fatigue without using non-invasive instruments will come under this category. Analyzing the behavior of the person based on his eye closure ratio, yawning, blink frequency, position of the head and facial expressions. The current parameter used in this system is the eye-closure ratio of the driver.

SURVEY OF LITERATURE ON NON-INTRUSIVE WAYS Here we present a survey of literature on non-intrusive detection using computer vision and machine learning. Alshaqaqi et al. have presented a detection system based on edge detection and exploiting the symmetry of facial features for extracting the eyes. The state of the eyes is determined as open or closed by taking the Hough transform for circles and comparing the intersection of the Hough transform

and the edge image with a threshold. The state of drowsiness is then determined by using Percentage of Eyelid Closure (PERCLOS)- a scientifically associated measure of drowsiness associated with slow eye closure. Grace et al. have presented two drowsiness detection methods. In this method they developed a camera by taking into account the fact that the retina reflects different amount of infrared light at different frequencies. Two images of the driver's face are taken at fixed wavelengths. The difference of these images is then used to measure percentage eye closure. The second method although in its infancy uses a neural network to predict PERCLOS by finding the right combinations of driver performance variables. Malla et al. have built a system for detecting microsleep. The system uses a remotely placed camera with near infra-red illumination to acquire the video. Haar object detection algorithm is then used to detect a face. The eyes Region of interest (ROI) is then detected using anthropomorphic parameters. Eye closure is then detected by taking ratio of the closed portion of the eye to the average height of the open portion. Under the light of what has been mentioned above, methods for drowsy detection have involved detection of face, eyes and(or) facial features.

METHODOLOGY

FUNCTIONAL REQUIREMENTS

A Functional prerequisite is described as one portion or an element of a product, in the entire methodology of programming building that the end user specifically demands as basic facilities that the system should offer.

- Recording the driver's behaviour, the moment the trip begins.
- Continuous evaluation of driver's facial features over the course of long trip.
- Raising an alarm if driver feels drowsy.

NON-FUNCTIONAL REQUIREMENTS

Non-functional requirements are basically the quality constraints that the system must satisfy according to the project contract. These are also called non-behavioral requirements.

- Camera capturing the video should be of high resolution.
- System should work even in low light conditions.
- Alarm raised should be of high volume to wake the driver up.

SYSTEM CONFIGURATION

Software Requirements

- Operating system: Windows 10/8 (incl. 64-bit), Mac OS, Linux
- Language: Python 3
- IDE: Visual Studio Code

3.3.2 Hardware Requirements

- Processor: 64-bit, quad-core, 2.5 GHz minimum per core
- RAM: 4 GB or more
- Display:1024 x 768 or higher resolution monitors
- Camera: A webcam

LIBERARIES USED

- SciPy – SciPy is a scientific python open-source library. It depends on NumPy, which provides convenient and fast N-dimensional array manipulation. The SciPy. Spatial package is used for calculating Euclidean distance between the eyelids and lips. 16
- NumPy - It is a Python library that provides a multidimensional array object, various derived objects (such as masked arrays and matrices), and an assortment of routines for fast operations on arrays
- Datetime - Python Datetime module supplies classes to work with date and time. These classes provide a number of functions to deal with dates, times and time intervals. It is used for fetching current time and for calculating time intervals
- Dlib - Dlib is an open-source C++ library implementing a variety of machine learning algorithms, including classification, regression, clustering, data transformation, and structured prediction.

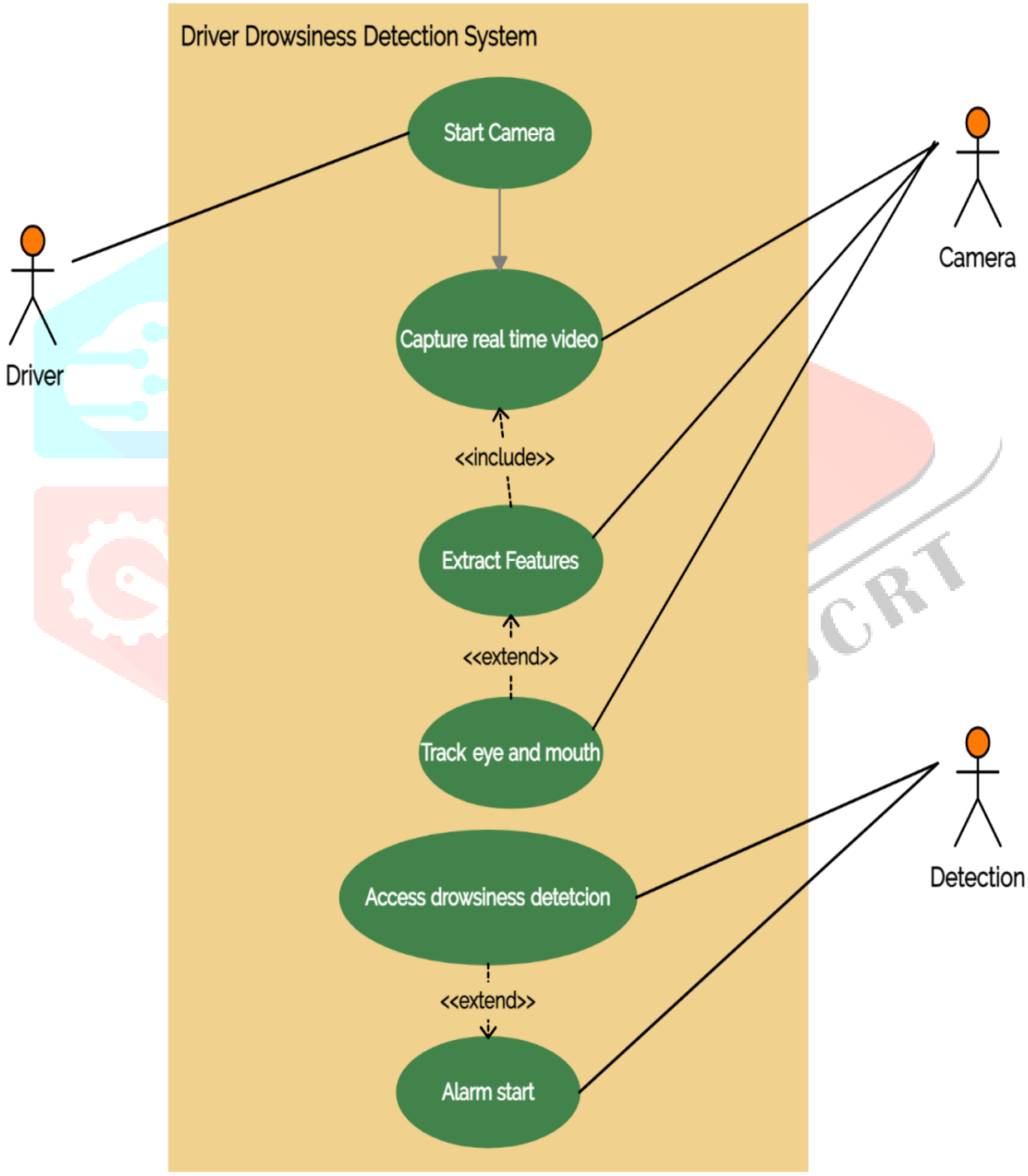
• OpenCV - OpenCV is an open-source computer vision library accessible in python coding language to code for visionary capabilities of our smart pc. It is used for doing pre-processing on images that we receive from webcam before supplying them for further calculation.

• TensorFlow - TensorFlow is a free and open-source software library for machine learning and artificial intelligence. It can be used across a range of tasks but has a particular focus on training and inference of deep neural networks. It is used to get Keras in our project.

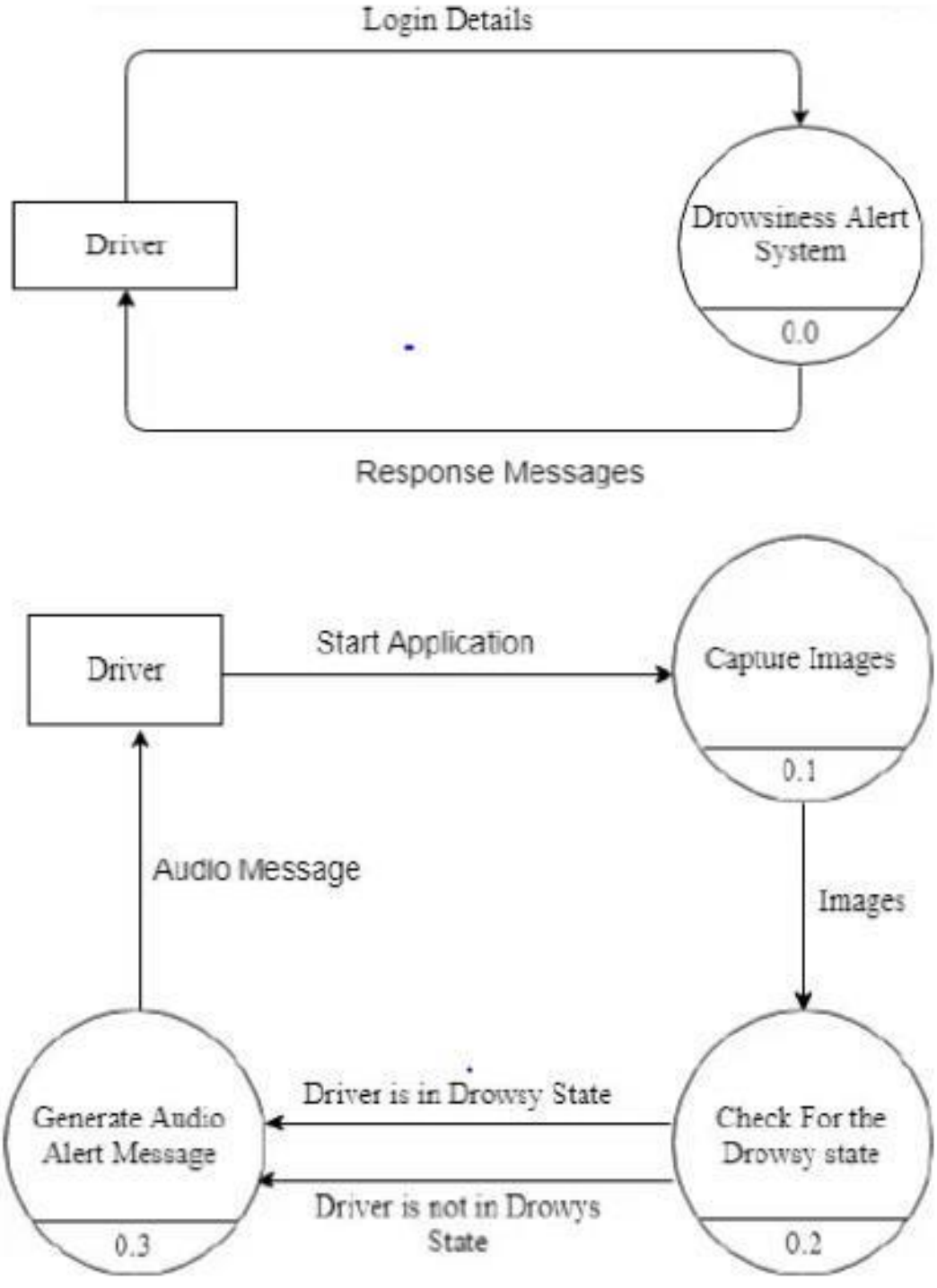
• Keras - Keras is an open-source software library that provides a Python interface for artificial neural networks.

SYSTEM DESIGN

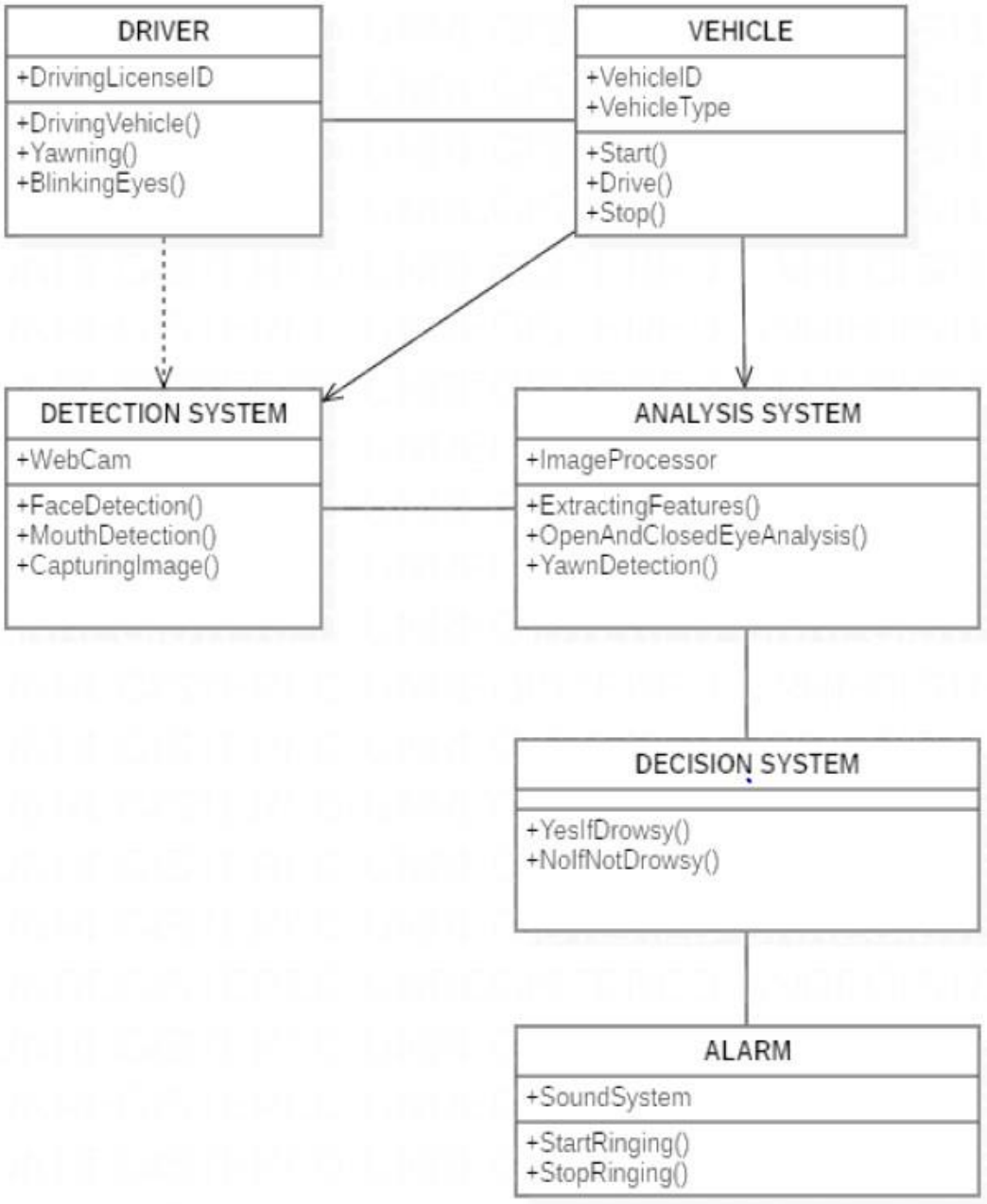
1. USE CASE DIAGRAM



DATA FLOW DIAGRAMS

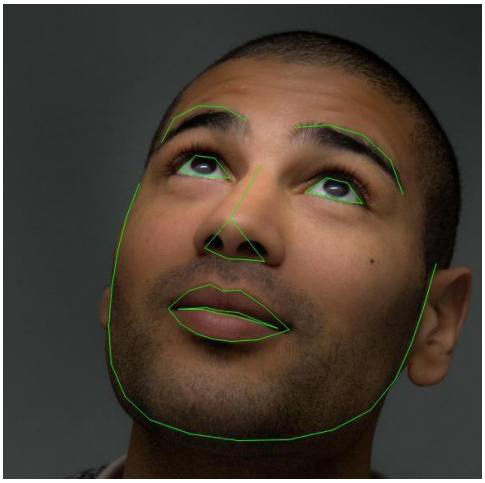


CLASS DIAGRAM

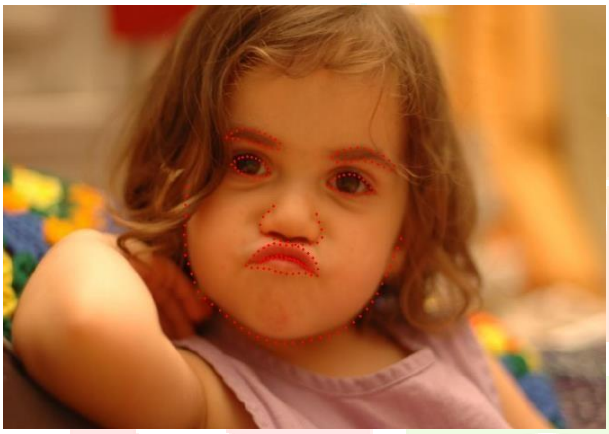


IMPLEMENTATION

- System will capture the video directly from the webcam.



– Landmarked image of a person with Dlib

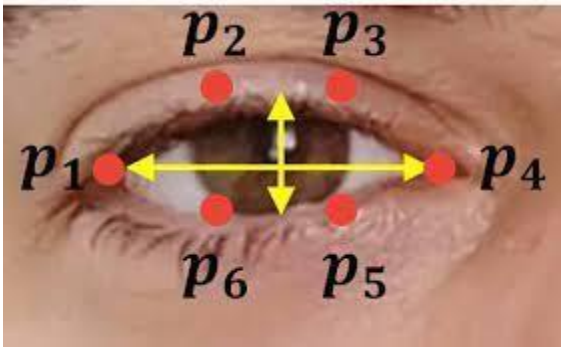


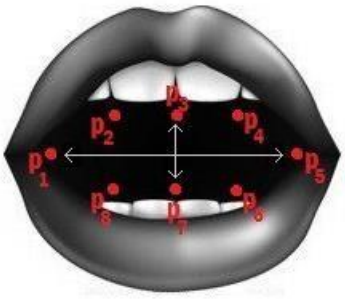
– Dataset samples

- After passing the feed of our video directly to the dlib frame by frame, we are able to detect left eye and right eye features of the face.
- Now, we draw contours around it using OpenCV.
- Using SciPy's Euclidean function, we calculate "Eyes aspect Ratio" E.A.R. and "Mouth Aspect Ratio" M.A.R.

EAR and MAR ratio

- The deep learning model will also be trained for detecting blink and its output will be ensembled with EAR for detecting blink.
    - If person is detected as yawning and blinking less than a threshold value, then the alarm is sounded and user is warned.





$$\mathrm{MAR} = \frac{\|p_2 - p_8\| + \|p_3 - p_7\| + \|p_4 - p_6\|}{2\,\|p_1 - p_5\|}$$

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

SYSTEM TESTING

Software testing is defined as an activity to check whether the actual results match the expected results and to ensure that the software system is Defect free. It involves execution of a software component or system component to evaluate one or more properties of interest. It can be either done manually or using automated tools.

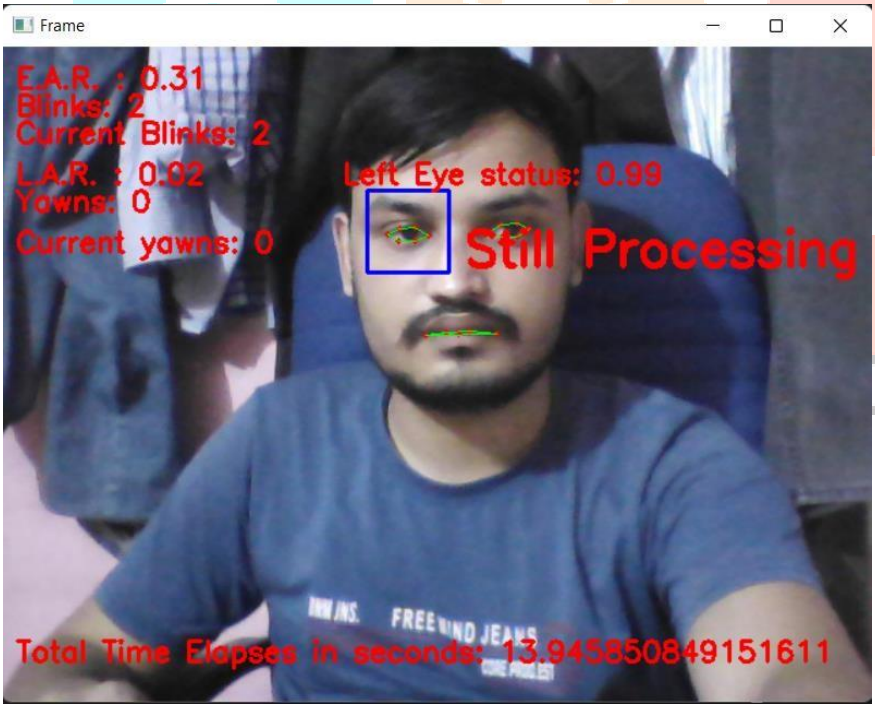
TEST CASES & TEST RESULTS

Test ID	Test Condition	System Behavior	Expected Result
T01	Straight face, good light, no glasses	Still Processing	Still Processing
T02	Straight face, good light, no glasses	Not Sleepy	Not Sleepy
T03	Straight face, good light, no glasses	Little Sleeping	Little Sleeping
T04	Straight face, good light, no glasses	Sleeping	Sleeping

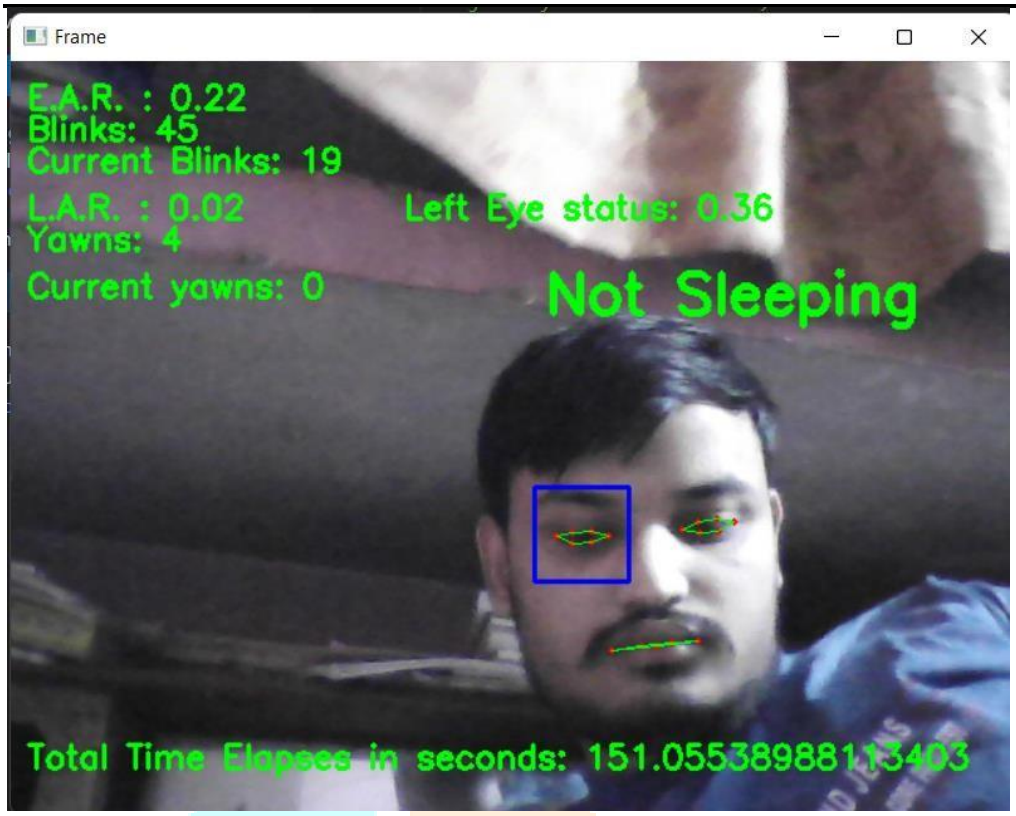
Table 1 – Test case table

l TEST SCREENSHOTS

T01: For first 60 seconds system is processing and analyzing the information

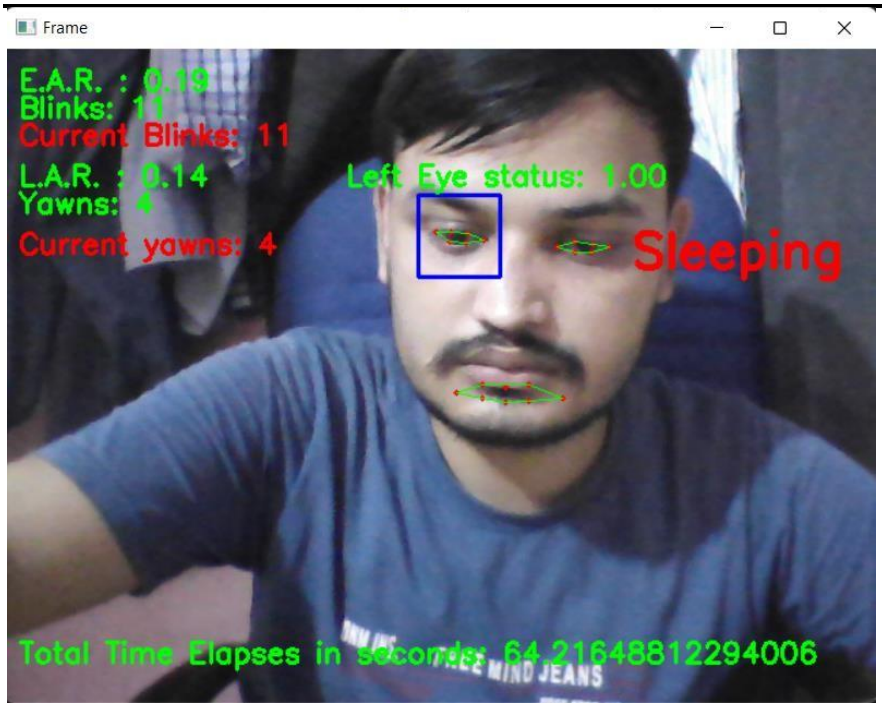


T02: When blinks >=12 and yawns <1 then output is “Not sleeping”



T03: When Blink>=12 and yawns>1, then output is “Little Sleepy”

T04: When blink<12 and yawns>0 then output is “Sleeping”



CONCLUSION

Our current project develops a system for detecting drowsiness of the driver. This project is built using Python, OpenCV, ML model, Dlib and other open-source libraries. The system uses eye aspect ratio and mouth aspect ratio to detect blinks and yawning respectively and also a ML model is trained to draw the result based on them to achieve the main objective of project i.e., Driver's Drowsiness. The framework has reached a stable state in which all bugs have been eliminated. The results are discussed in testing section and are found satisfactory.

Our project, provides a way through which a number of road accidents might be avoided if an alert is sent to a driver that is deemed drowsy.

Our model is not only useful to the person who will installs it in their vehicle but also for the other cars, trucks, buses and humans moving around it.

Future Scope:

- The system can be made more accurate using various other parameters such as State of the Car, Detecting Foreign Substances on Face etc.
- An application can be developed where it can alert or prevent the user from sleeping.
- It can be used to develop an IOT device that can be installed in the car to detect driver's drowsiness.
- Similar models and techniques can be used for various other uses such as Netflix, Hotstar and other streaming service platforms can detect whether the person is sleeping and stop the video accordingly

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