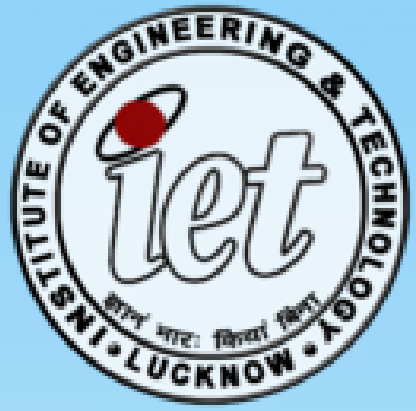
Driver Drowsiness Detection System



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Motivation

- The attention of drivers degrades of lower sleep, long distance driver or any other condition like brain disease etc.

- Several checks on road accidents says that around 30% of accidents are caused by fatigue of the motorist.

Source - Google

Motivation

(Continued..)

- Drowsiness causes drop in cautions and conscious situations of the driver.
- Driver drowsiness and fatigue are among the important causes of road accidents.
- Though there is no direct measure to descry the drowsiness but several other indirect approaches can use for this purpose.

Source - Google

Motivation

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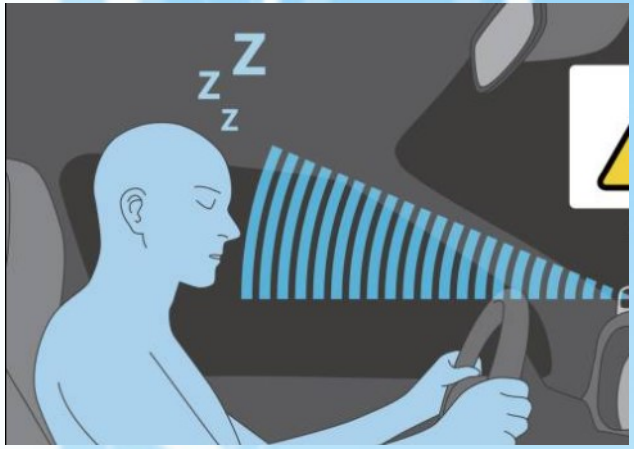


Source - Google

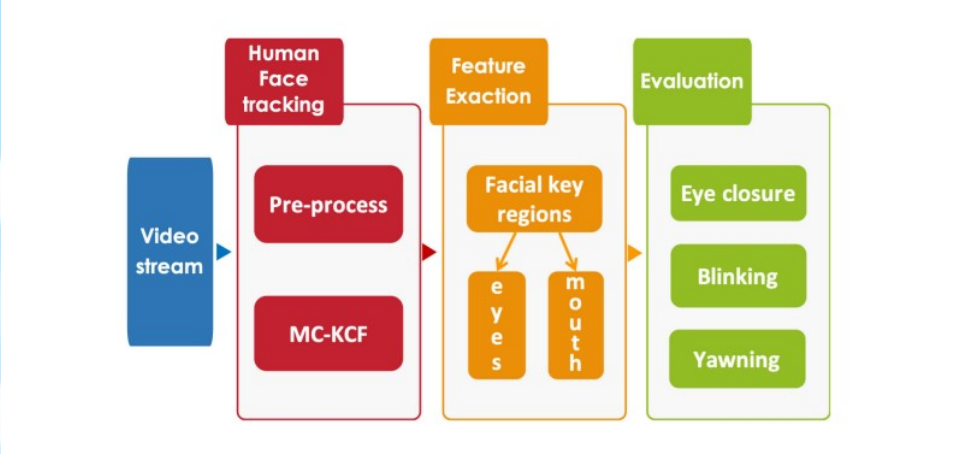
Driver Drowsiness Detection System is presented in order to reduce the number of accidents caused by driver fatigue.

Problem Statement

- To distinguish the simulated drowsy or sleepy states from the normal state of driving.
- The high resolution images of faces and eye observed from an oblique viewing angle.
- Effectively monitor driver's attention level without extra requirement for cameras.

Literature Review

- Real-Time Driver-Drowsiness Detection System Using Facial Features
  - combining the features of the eyes and mouth
  - used the MC-KCF algorithm to track and recognize the facial key regions based on key-point detection [1]

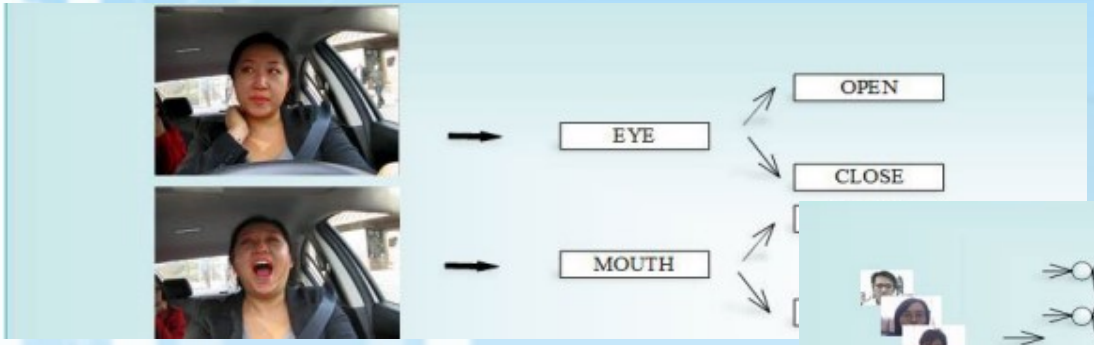


[1]

Literature Review

(Continued..)

- Real Time Driver Fatigue Detection System Based on Behavioral Monitoring Technique.
  - Designed a two-label (fatigue/not fatigue) system for driver fatigue detection
  - SVM and CNN algorithms were used for classification



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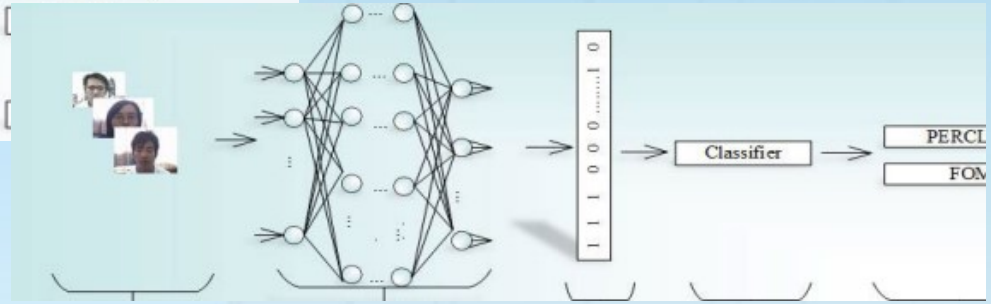


Literature Review

(Continued..)

- Real Time Driver Fatigue Detection System Based on Physiological Monitoring Technique.
  - Li et al.[3] proposed a system that classifies drowsiness states using EEG signals and an SVM-based model.
  - Lee et al.[4] utilized HRV signals from wearable PPG or ECG sensors and a CNN classifier, achieving improved accuracy.

Literature Review

(Continued..)

- Real Time Driver Fatigue Detection System Based on Environmental Monitoring Technique.

  – McDonald et al. [5] developed a method to analyze driver state by Lane departure analysis using steering wheel angle and using a computer algorithm called random forest (RF).

  – Mac et al.[6] proposed detection of the distance from the side using wavelet transform and neural network. Used SVM and neural network algorithms achieved detection accuracy of more than 90%.

Methodology

IMAGE

NOISE REDUCTION

FACE DETECTION

ROI EXTRACTION

SHAPE PREDICTION AND PLOTTING POINTS

TRACKING

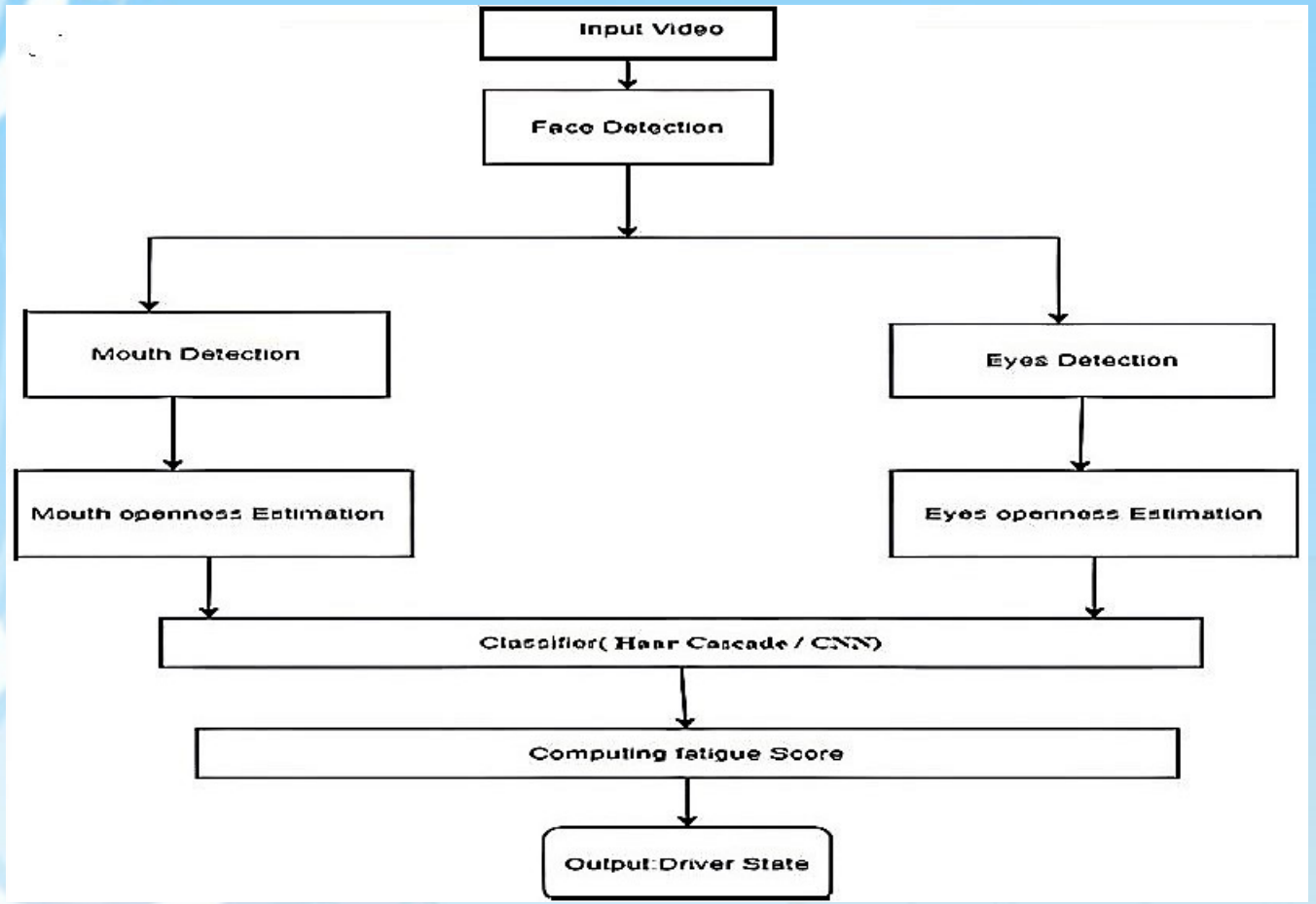
DISTANCE LESS THAN THRESHOLD

ALERT

Methodology

(Continued..)

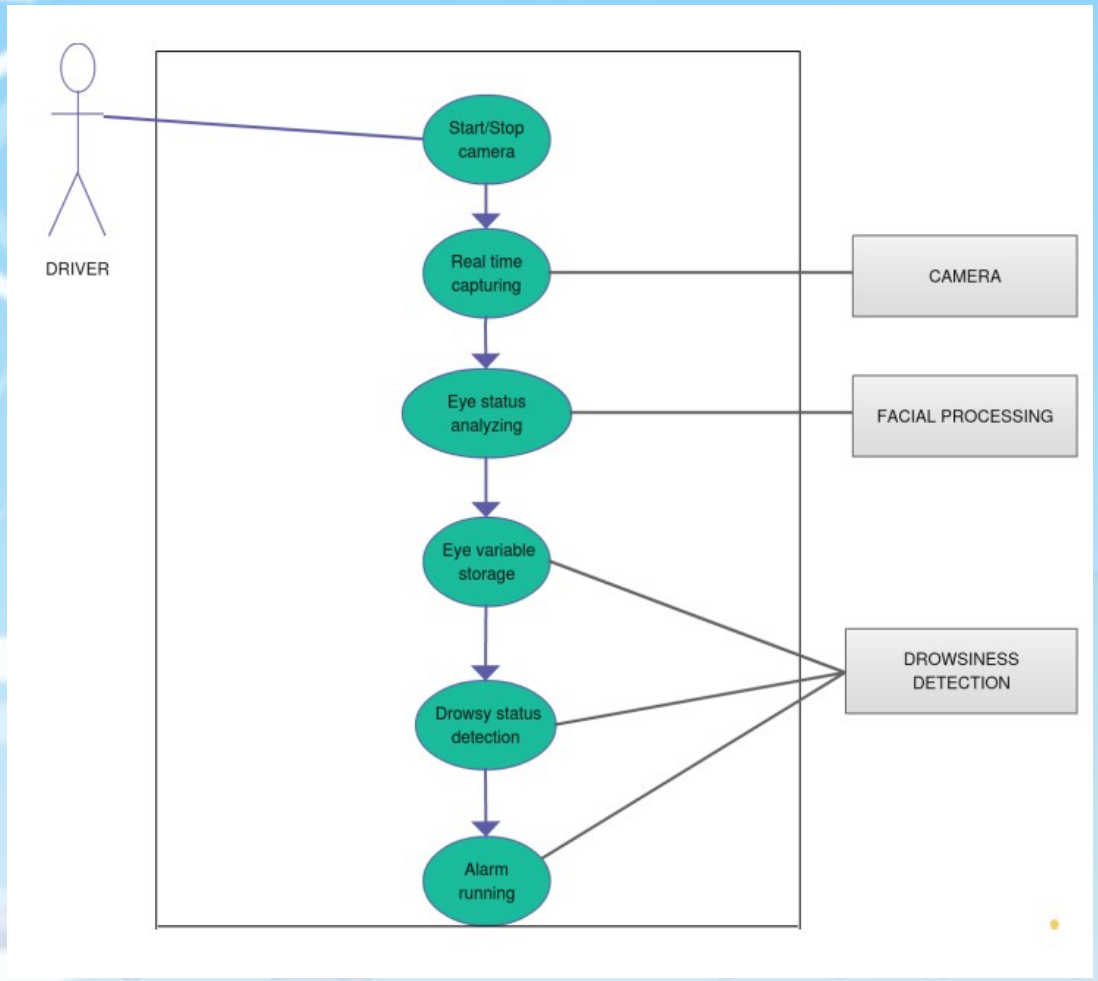
Flow Chart



Methodology

(Continued..)

Use Case Diagram



Methodology

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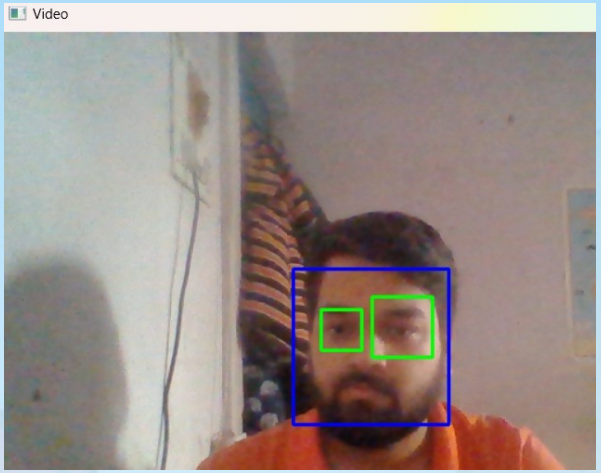
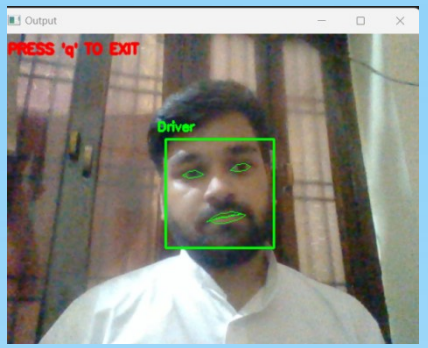
Basics working of project

- Take image as Input from a camera.
- Perform image pre-processing and filter noise.
- Detect face in image and create a region of interest (ROI)



Methodology

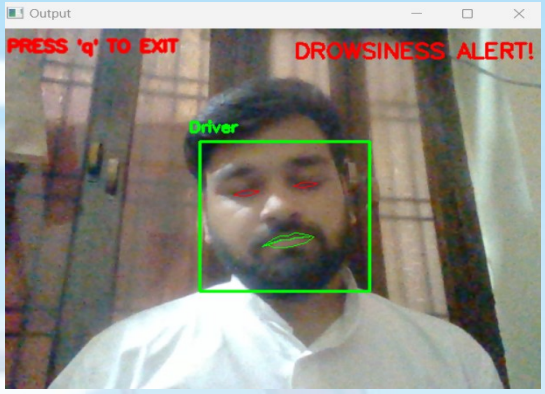
(Continued..)



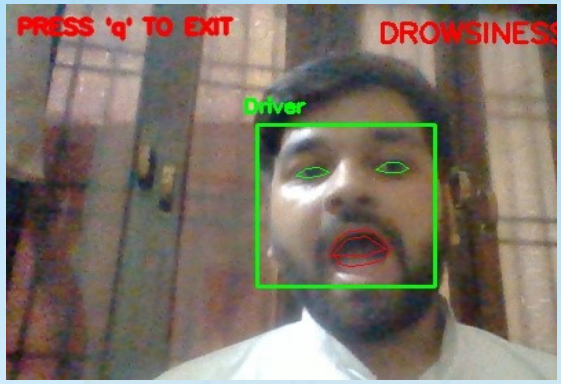
- Detect the eye and mouth shape, then plot the landmarks points on boundary.

- Calculate distance among these plotted points.

- If distance become less than threshold, turn on alarm else continue monitoring.



Drowsiness Alert



Yawning Alert

Methodology

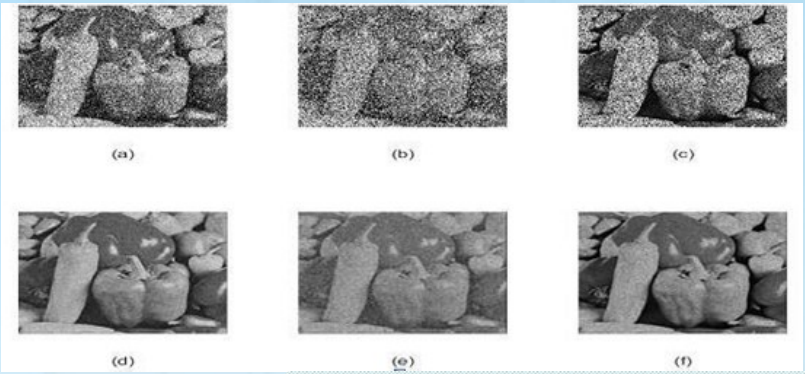
(Continued..)

Noise reduction

- Image pre-processing
  - Hue, saturation and intensity (HSI)
  - Grey scale image
  - Filtering

- Filtering
  - Gaussian noise
  - Salt and pepper noise

Source - Google



Methodology

(Continued..)

Face Detection and ROI Extraction

- HAAR Algorithm
  - feature extraction for an object in an image, with the help of edge detection, line detection, center detection for detecting eyes, nose, mouth, etc. in the picture.
  - Detects facial features(Eye) by scanning the image pixel by pixel, from top-left to bottom right.

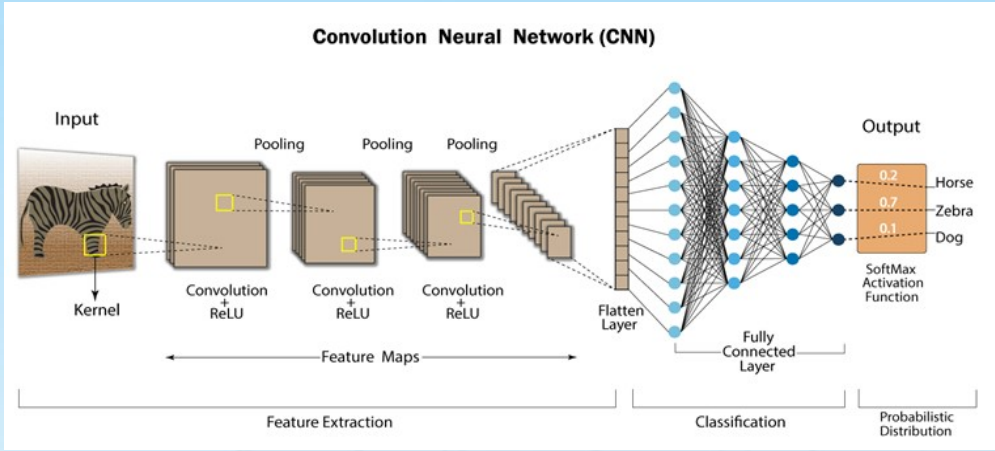
Methodology

(Continued..)

SHAPE PREDICTION AND PLOTTING POINTS

- Convolutional Neural Network(CNN)
  - To predict the shape of eye.
  - Plot point on predicted shape.

[3]



Methodology

(Continued..)

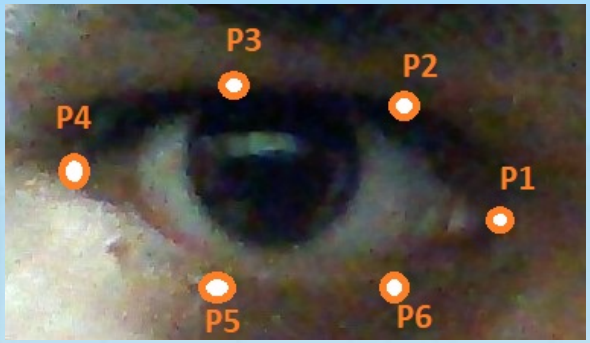
Adopted Algorithm

- Calculation of EAR and MAR:

➢ Eye Aspect Ratio (EAR): ratio of distances between specific eye landmarks. It is typically computed using the following formula.

$$EAR = \frac{|P_2 - P_6| + |P_3 - P_5|}{2 \cdot |P_1 - P_4|}$$

```
def eye_aspect_ratio(eye):
        # Vertical eye landmarks
        A = dist.euclidean(eye[1], eye[5])
        B = dist.euclidean(eye[2], eye[4])
        # Horizontal eye landmarks
        C = dist.euclidean(eye[0], eye[3])

        # The EAR Equation
        EAR = (A + B) / (2.0 * C)
        return EAR
```



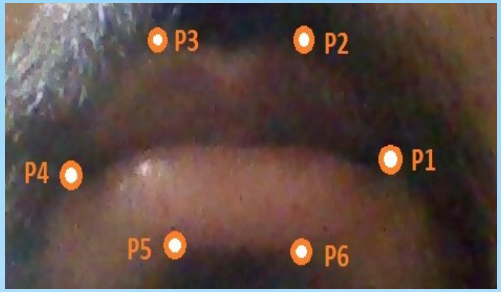
Points plotted along eye

Methodology

(Continued..)

➢Mouth Aspect Ratio (MAR): ratio of the distance between the top and bottom lip to the width of the mouth. The formula for calculating MAR is as follow.

$$MAR = \frac{|P_2 - P_6| + |P_3 - P_5| + |P}{3}$$



Points plotted along mouth

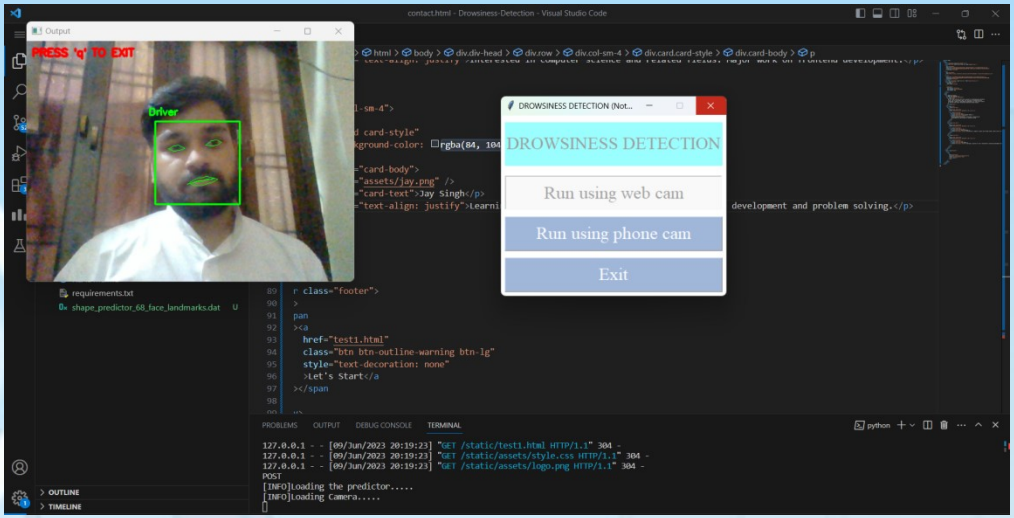
```
def mouth_aspect_ratio(mouth):
        A = dist.euclidean(mouth[13], mouth[19])
        B = dist.euclidean(mouth[14], mouth[18])
        C = dist.euclidean(mouth[15], mouth[17])

        MAR = (A + B + C) / 3.0
        return MAR
```

Technologies used

- **Frontend**
  - HTML
  - CSS
  - JavaScript
- **Backend**
  - Python
  - Flask
- **Library Used**
  - OpenCV
  - NumPy
  - Scipy
  - Pandas
  - Dlib

Expected Result

- When user would sit in front of camera in presence of sufficient light the following outcomes are expected.
  - Without any drowsiness features (such as closed eyes or yawning) the system would constantly monitor the driver and eye outline and mouth outline would be in green color.



Expected Result

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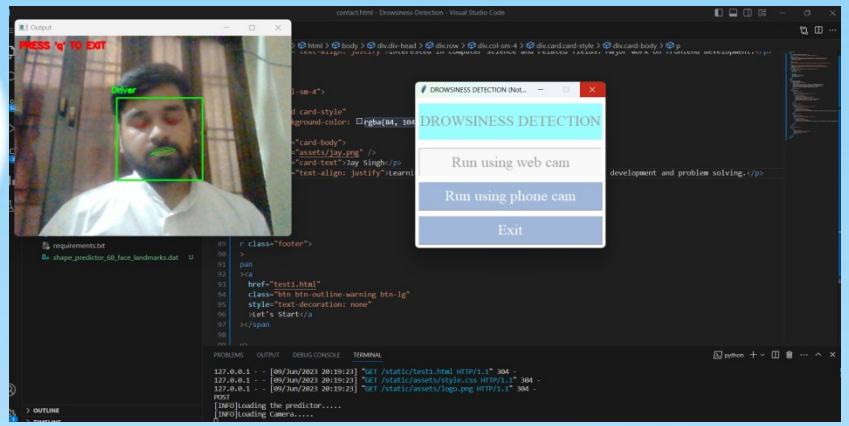
- With eye closed and EAR value is less than the threshold the drowsiness alert is shown. The eye outline is shown is red color.



- In case of yawning, MAR value is more than the threshold the yawning alert is shown. In this case mouth outline is shown is red color.

CONCLUSION

- The Driver Drowsiness Detection System (DDDS) uses Machine Learning (ML) techniques like OpenCV, Mouth Aspect Ratio (MAR), and Eye Aspect Ratio (EAR), and to effectively detect driver drowsiness with promising results.

- The system effectively extracts EAR and MAR features from facial landmarks detected by OpenCV, enabling reliable drowsiness detection. The real-time performance of the system ensures timely alerts and interventions to prevent potential accidents.

CONCLUSION

(continued..)

- By training the ML model on diverse datasets, the system can generalize well to different individuals and driving scenarios, making it applicable in real-world environments.

- Factors like extreme lighting conditions, sudden facial movements, or partial occlusions can affect the accuracy of drowsiness detection. Future improvements can focus on addressing these challenges and exploring more sophisticated ML models to enhance the system's performance.

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[2] BURCU KIR SAVAŞ AND YAŞAR BECERİKLİ et al., Real Time Driver Fatigue Detection System Based on Multi-Task ConNN,8949469,Availablehttps://ieeexplore.ieee.org/stamp/stamp.jsp?arnum ber=8808931

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[4] Lee H., Lee J., Shin M. Using wearable ECG/PPG sensors for driver drowsiness detection based on distinguishable pattern of recurrence plots. Electronics. 2019;8:192. doi:10.3390/electronics8020192

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[5] McDonald A.D., Schwarz C., Lee J.D., Brown T.L. Real time detection of drowsiness related lane departures using steering wheel angle; Proceedings of the Human Factors and Ergonomics Society Annual Meeting; Boston, MA, USA. 22–26 October 2012; pp.2201–2205.

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Thank You