CS-6384
Real-time Alertness assessment using CNN and Viola-Jones Algorithm

Group-14

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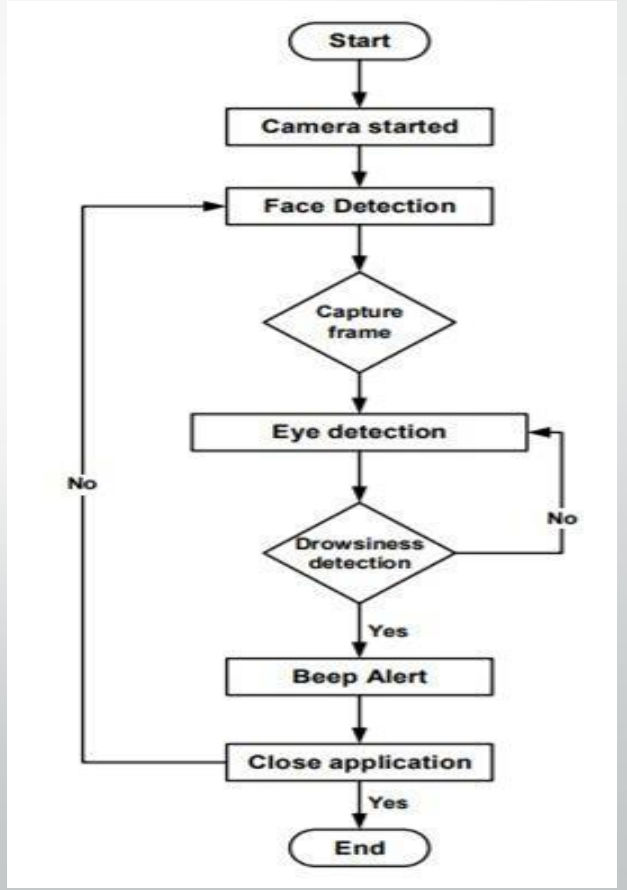
Introduction

- This project aims to address the issue of traffic collisions caused by drowsy driving, which is a global problem that results in numerous fatalities and injuries every year.
- The project proposes a solution using a drowsiness position system that identifies a driver's condition with greater precision by analyzing visual cues, particularly the attribute of eyes as awake, narrowed, or resting.
- The system utilizes neural networks, including Residual network and Viola-Jones algorithm, to accurately determine the driver's situation as either vigilant or sleepy.
- The project's reliability is tested on a 300-w dataset which contains 300 Indoor and 300 Outdoor in-the-wild images, resulting in a 91.3% accuracy rate for motorist perception and a 92.1% accuracy rate for eye movement analysis.
- The system is implemented using Python scripts, and the input is the web camera of the computer.
- The project's primary goal is to enhance road safety and reduce the incidence of drowsy driving accidents.

Architecture

The proposed system for the project consists of two essential components:

- Face detection : The face detection component uses the Viola-Jones algorithm to detect faces and extract facial landmarks, which are then used to crop and normalize the face region for further analysis.
- Drowsiness detection : The drowsiness detection component analyzes the eye movement patterns and eye closure rate to determine the driver's drowsiness level using a CNN (ResNet) that classifies eye states as awake, partially closed, or closed.



Implementation

Face detection

Facial landmarks plays important role for identifying difficult aspect of drowsiness detection.

- STEP-1

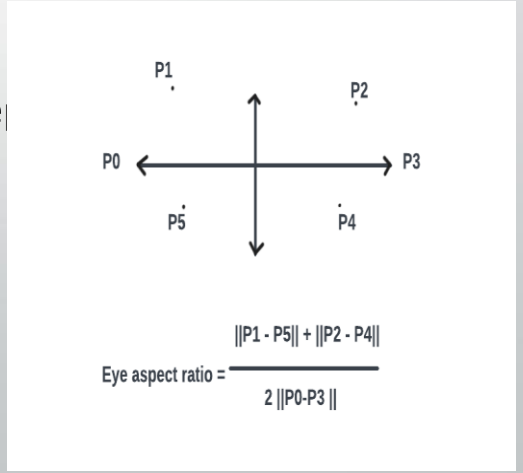
  Locating the face in the image is the initial step.

  Viola Jones method utilised Haar-like properties to identify patterns of faces.

- STEP-2

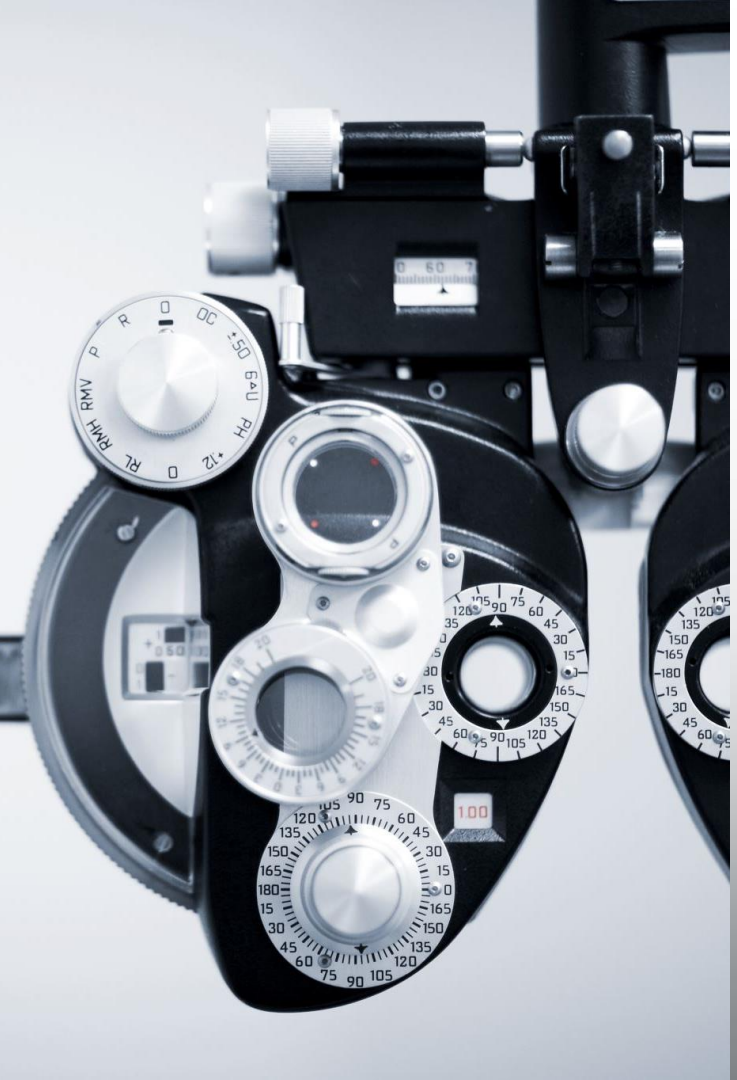
  Identifying the essential facial structures in the face area is the last ste

This detection procedure starts by using: CNN training data consists of a set of images that have been tagged with face landmarks.
We have used ResNet approach for CNN.



Drowsiness Detection

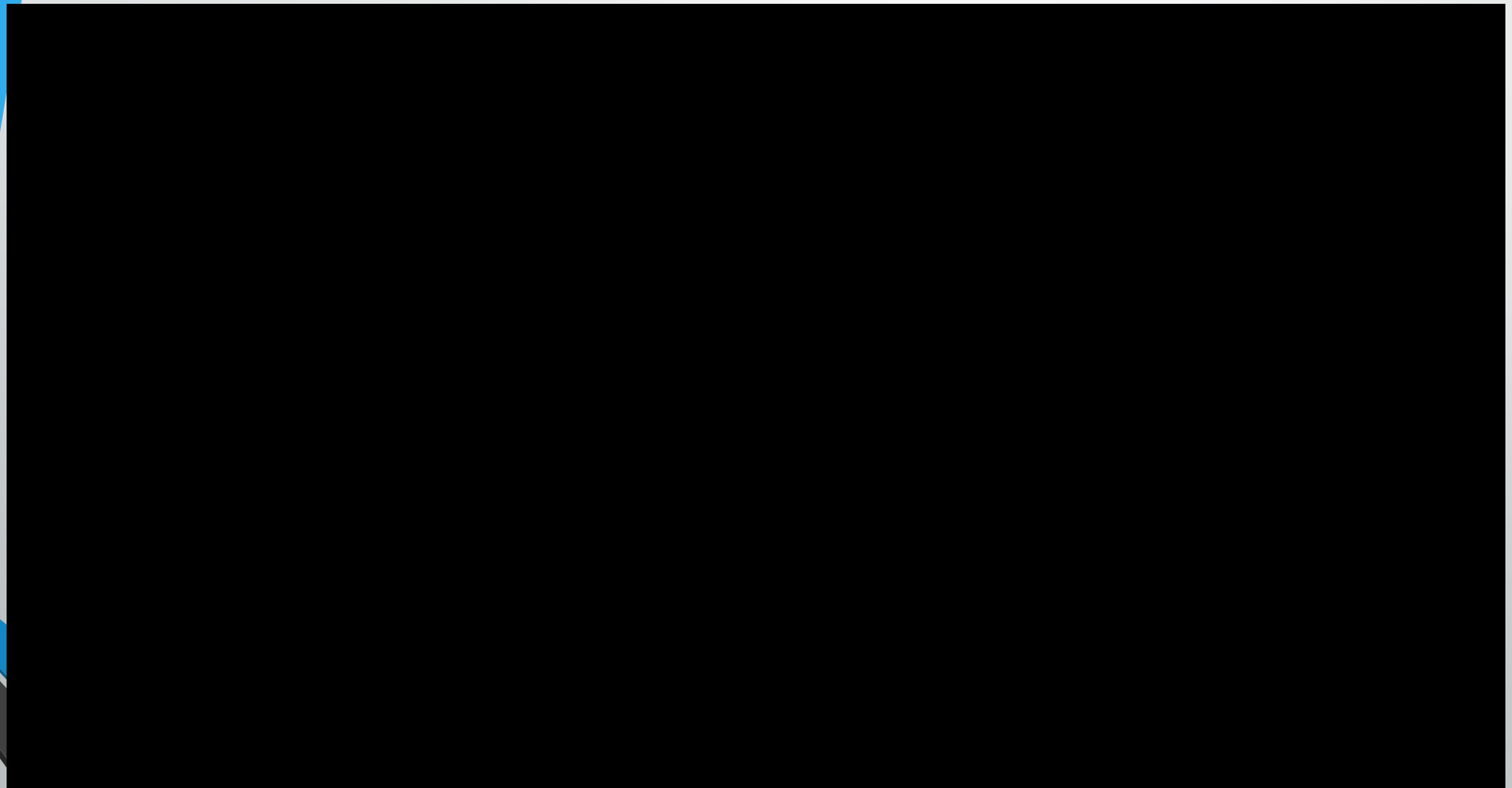
The eye aspect ratios for two eyes is evaluated in each frame.



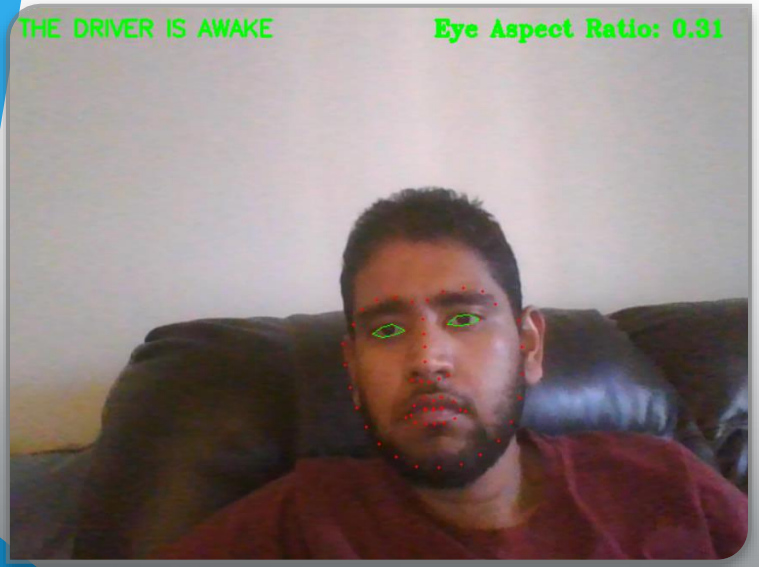
Evaluation metrics

- The main objective of our project is to calculate the Eye aspect ratio (EAR) of a human being. By using the Eye aspect ratio, we can conclude whether the person is drowsy or not. Usually, if the eye aspect ratio is above 0.25 it indicates that the eye is open i.e., the person is not drowsy. In another case, the system will play an alarm/beep sound to indicate the driver is drowsy (eye aspect ratio decreases to close to 0 – 0.25).The eye aspect ratio is simply faster compared to other techniques to determine the eye state.
- Eye aspect ratio is a computer vision technique that is used to calculate the face presence and whether the eyes of a person are closed or open. The ratio of eyes is calculated by the distance between the eyes divided by the distance between the top of the eyes and the bottom of the chin. (Divide the height of the eye region in the facial image by the eye region's width).
- Blink Time: Along with the Eye Aspect Ratio, We have considered accidental trends due to drowsiness across the US and detect driver as drowsy is the blink time is greater than 5 seconds. It is the maximum amount of time the driver closes their eyes.

DEMO VIDEO

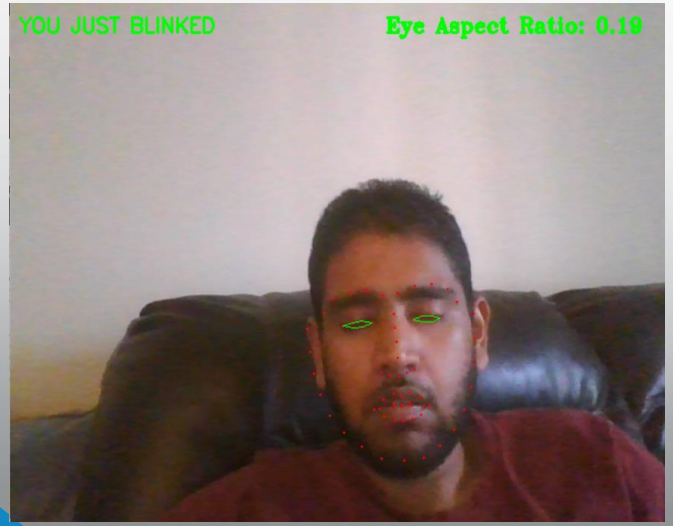


Results

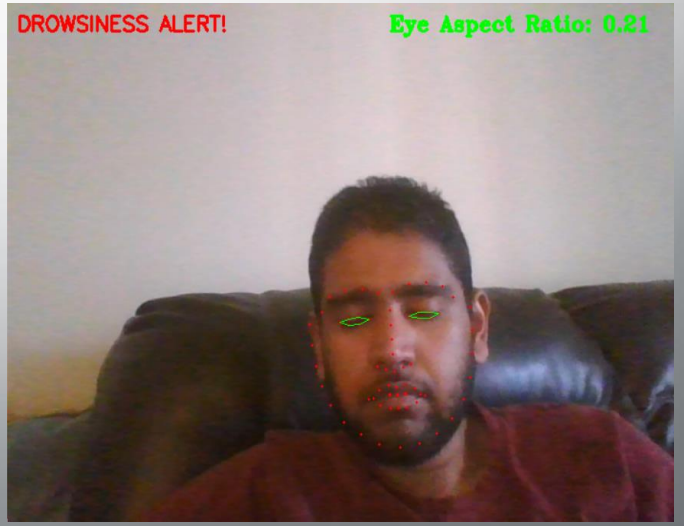


- Our team tested the algorithm in various situations like closed eyes, half-opened eyes, full opened eyes, and one eye open and one eye closed. We ensured its accuracy and reliability and created a demo video showcasing its success in these scenarios. The attached video highlights our project's capabilities. Scenarios that we tested our system are explained below.
- Scenario-1: When driver is awake.
  - In this situation, the calculated Eye Aspect Ratio is 0.31, Below is the implementation snippet.

- Scenario-2: When driver blinks their eyes:
  - In this situation, the calculated Eye Aspect Ratio is 0.19, blink time is 0.8s. Below is the implementation snippet.



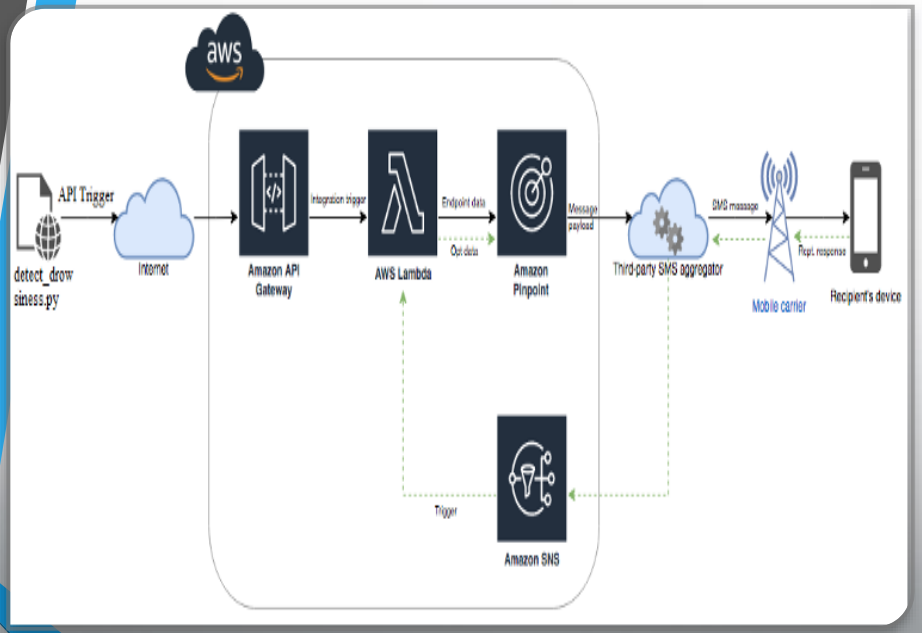
- Scenario-3: When driver is drowsy:
  - In this situation, the calculated Eye Aspect Ratio is 0.21, blink time > 5s. Refer evaluation metrics for more info. Below is the implementation snippet.



Conclusion

- This study reveals the fact that semi-closed state has an important role in detecting drowsiness and defining three states instead of two states increases the accuracy of the drowsiness detection method proposed.
- The proposed system can be used for variety of applications. One of them is heavy duty vehicles for example trucks. Another application is passenger vehicles. Many people use public transport facility for travelling.

Future Work



- We plan to implement the strategy in the cloud, integrating the application with AWS services such as lambda and SNS.
- The lambda function triggers when the driver closes their eyes for more than 2-3 seconds, sending a text message to emergency contacts via SNS.
- The neural network's performance will be enhanced by adding more training datasets, optimizing time and space complexity, and performing exploratory data analysis. Our high-level AWS architecture is outlined below.

THANK YOU

QUESTIONS?