Driver Drowsiness Detection System using Facial Analysis

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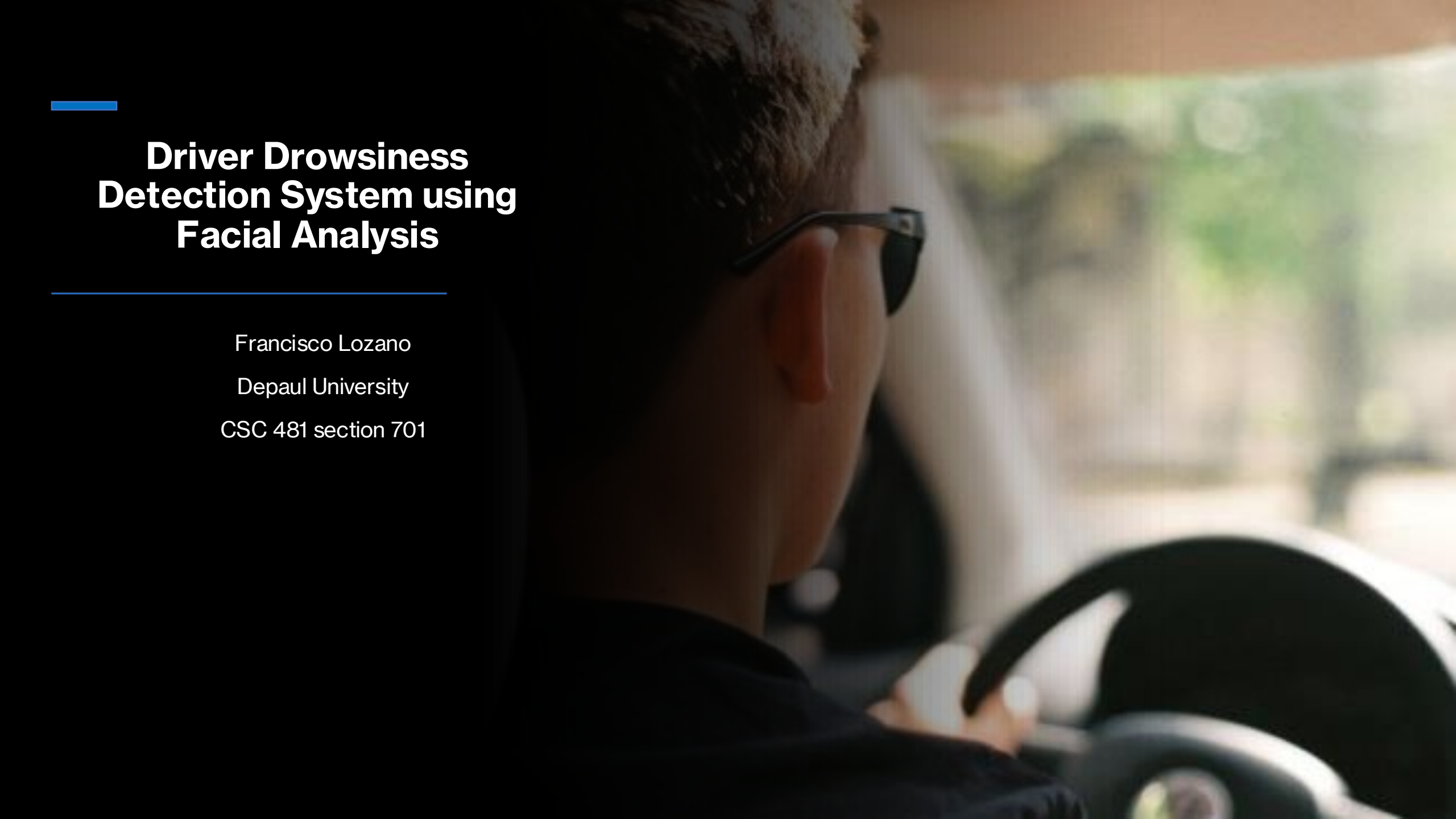
CSC 481 section 701



Bio

- Masters in Data Science, Computational Methods Concentration
- I love the Outdoors
  - climbing/hiking mountains
  - Camping
  - Etc.
- I am a Software Engineer for a Research project called SAGE
- Socials
  - GitHub: https://github.com/FranciscoLozCoding
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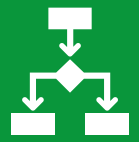
Introduction

Problem Statement: Develop an automated driver drowsiness detection system that uses facial analysis to identify signs of drowsiness, such as “droopy” eyes.

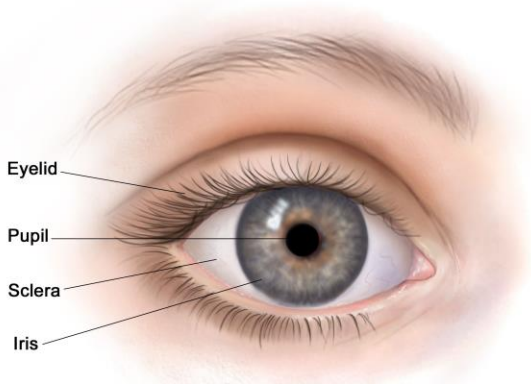


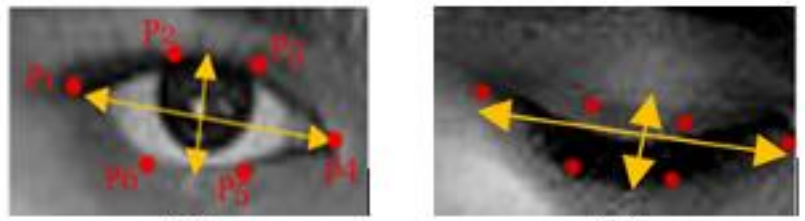
Objective: Create a classification system to determine Drowsy/Non-Drowsy based on one image.

Importance: Most driver drowsiness detection systems rely on video; using a single image for classification could speed up computation.

Background & Context

- In this project we will be looking at the Pupil, Sciera, Iris, and Eyelid
- Assuming when someone is drowsy their eyelid will cover more of their Pupil, Sciera, etc. (aka ”Droopy” eyes)
- The Eye Aspect Ratio (EAR), closed eye has an EAR of 0





(a) (b)

Fig. 5. The coordinates of an (a) opened eye and (b) closed eye

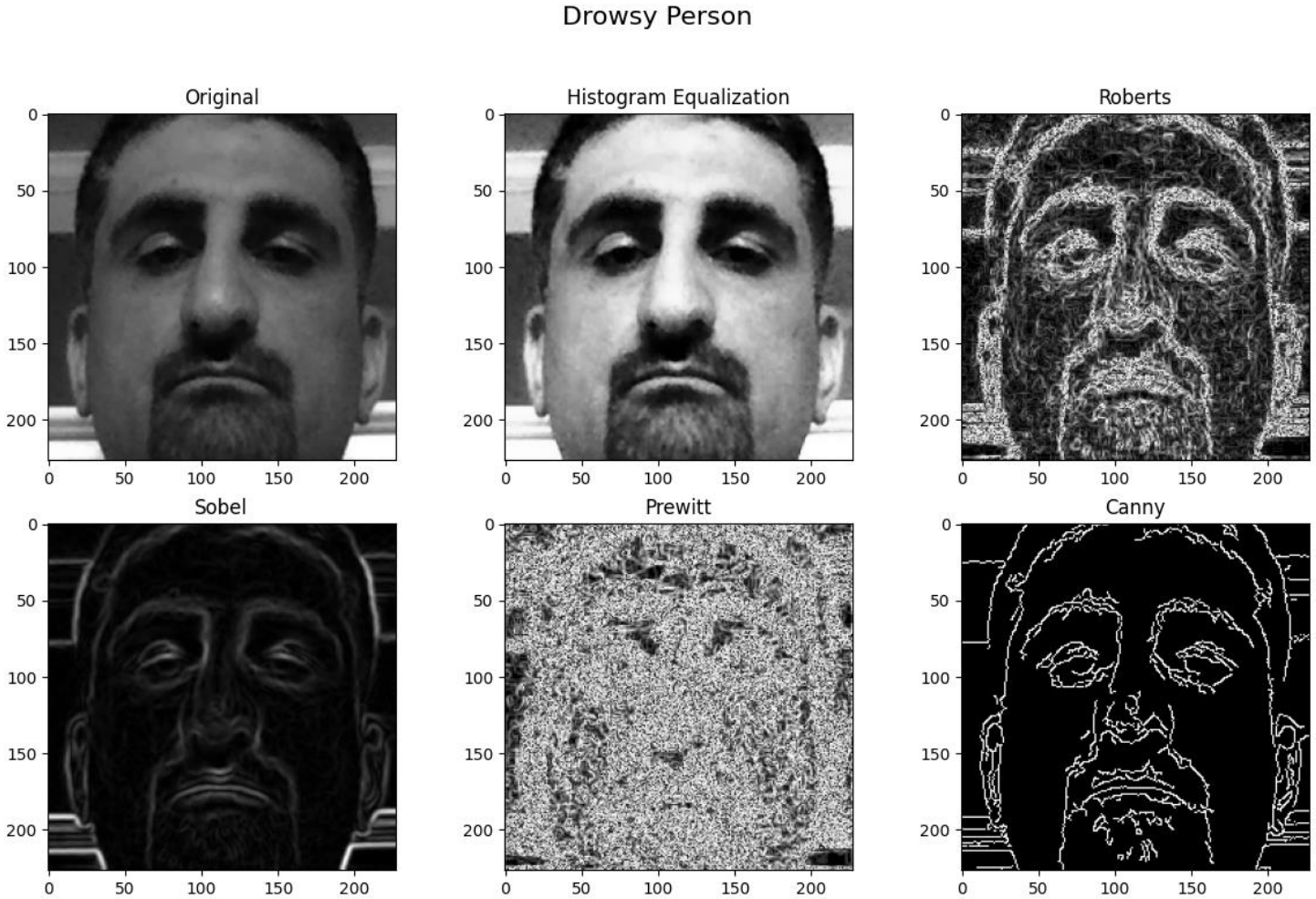
$$EAR = \frac{||P2 - P6|| + ||P3 - P5||}{2||P1 - P4||}$$

Methodology

- **Tools and Technologies**: Python, Kaggle, OpenCV, Dlib, NumPy, SciPy, and others
- **Phases:**

Dataset & Data Prepocessing

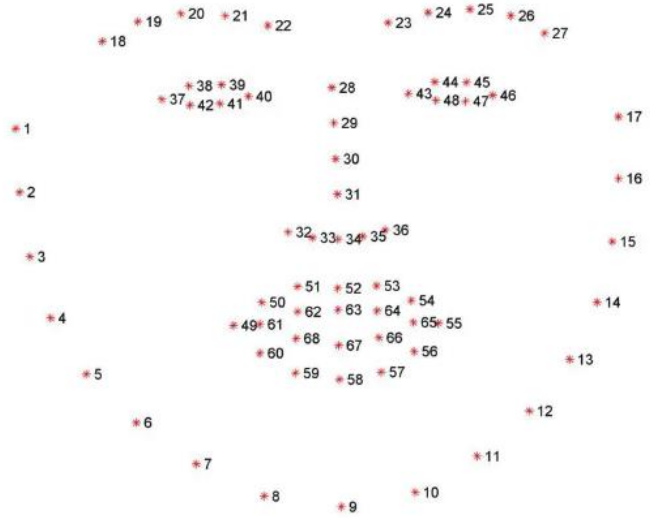
- **Dataset Overview**: Driver Drowsiness Dataset (DDD) Included 41,790 RGB Images of cropped driver faces with two classes [“Drowsy”, “Non-Drowsy”]
- **Data Processing**: Used Histogram Equalization and increased the images to 61.8k by adding images with Gaussian or Salt & Pepper noise. (Dataset Generated)
    - Before deciding to use Histogram Equalization I played around with Edge Filters but they gave bad results.

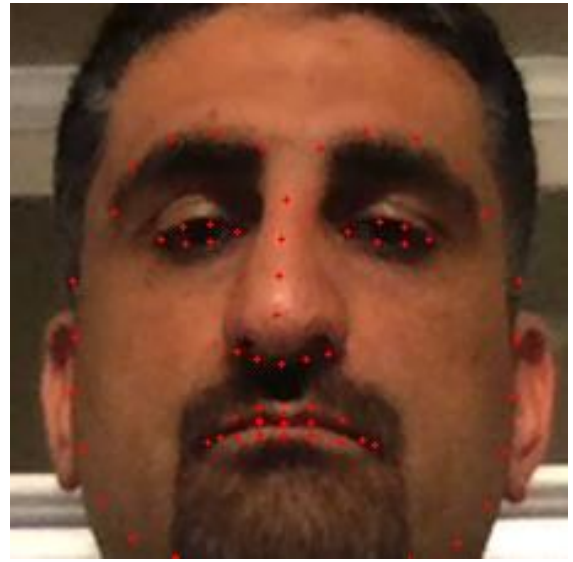


Algorithm 1

- **Model/Algorithm Choice**: Facial landmark can detect eyes, mouth, nose, etc.
- **Why This Model**: This algorithm can capture eye closure, so lower eye closure meant the eyes are starting to droop.
- **Special Techniques**: EAR calculation using Facial landmarks

Image Captured → Facial landmark detection → EAR Calculated → Classification based on EAR





Algorithm 2

- **Model/Algorithm Choice**: When eyes are “droopy” eyelids are more visible
- **Why This Model**: This algorithm can capture eye closure and how much of the eye is covered by the eyelid more eyelid coverage meant the driver is drowsy.
- **Special Techniques**: Calculating Eyelid Coverage using Sobel and Contours.

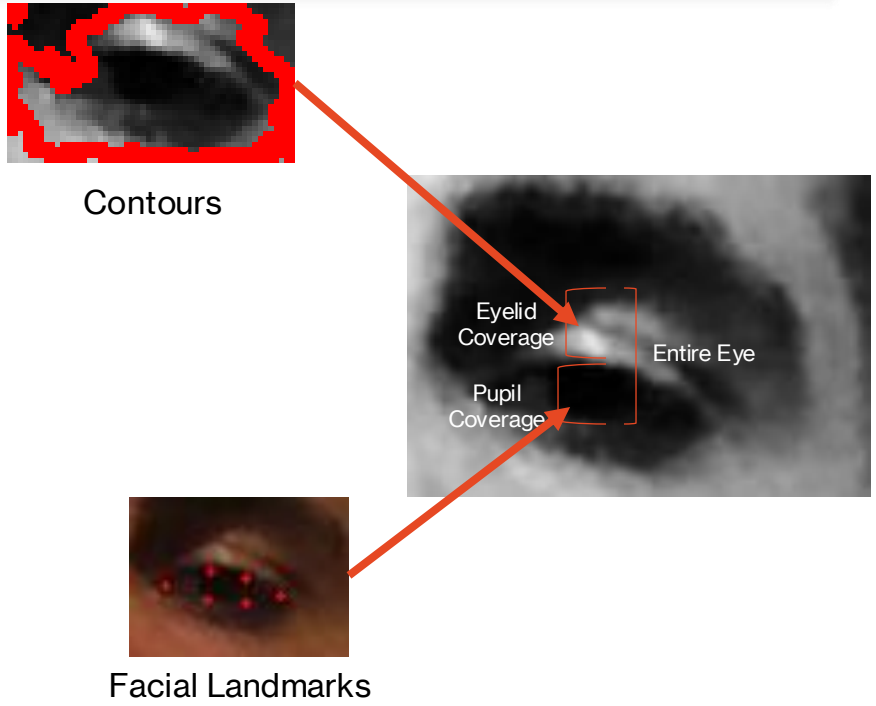
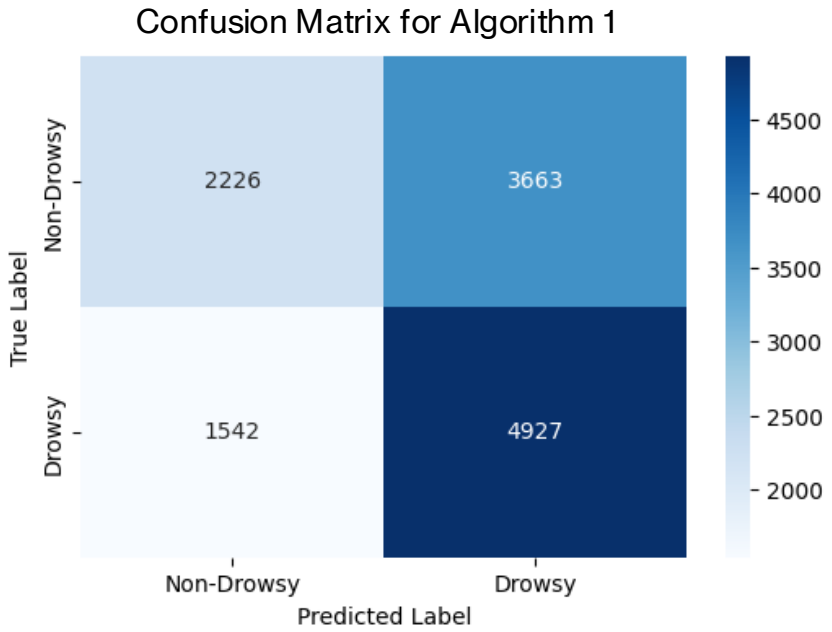


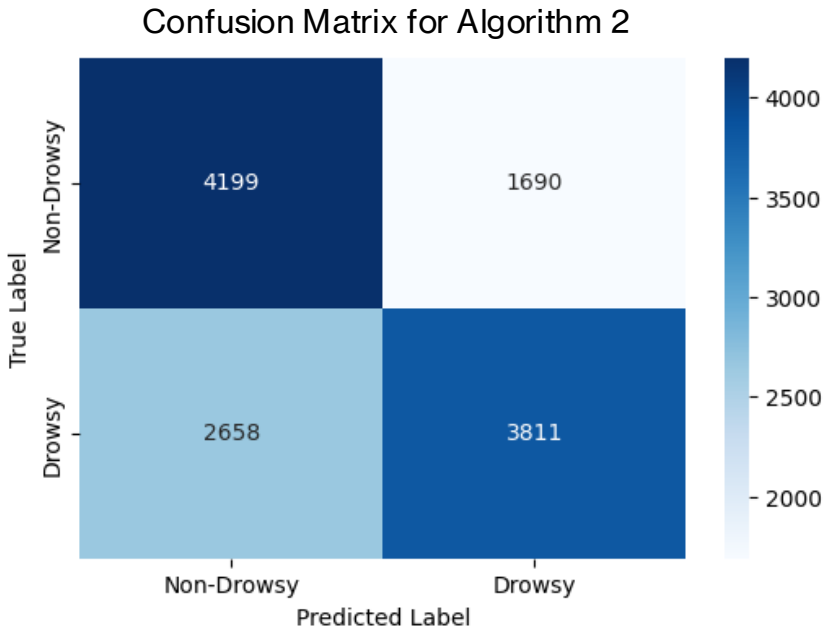
Image Captured → Facial landmark detection → Crop the eyes with padding → Apply Sobel Filter → Find Contours → Determine Eyelid Coverage → Classification based on Eyelid Coverage

- To identify entire Eyelid
- Taking into fact the Entire Eyelid

Evaluation

- Algorithm 1 had an accuracy of 0.58, and performed better at identifying "Drowsy" instances
  - Hyper Parameters:
    - EAR Threshold of 0.30
- Algorithm 2 had an accuracy of 0.65 and was equally good in identifying “Drowsy” and “Non-Drowsy” instances.
  - Hyper Parameters:
    - Eyelid Coverage Threshold of 0.55
    - Eye Padding of 5 pixels
    - kernel size of 7 for Sobel Filter



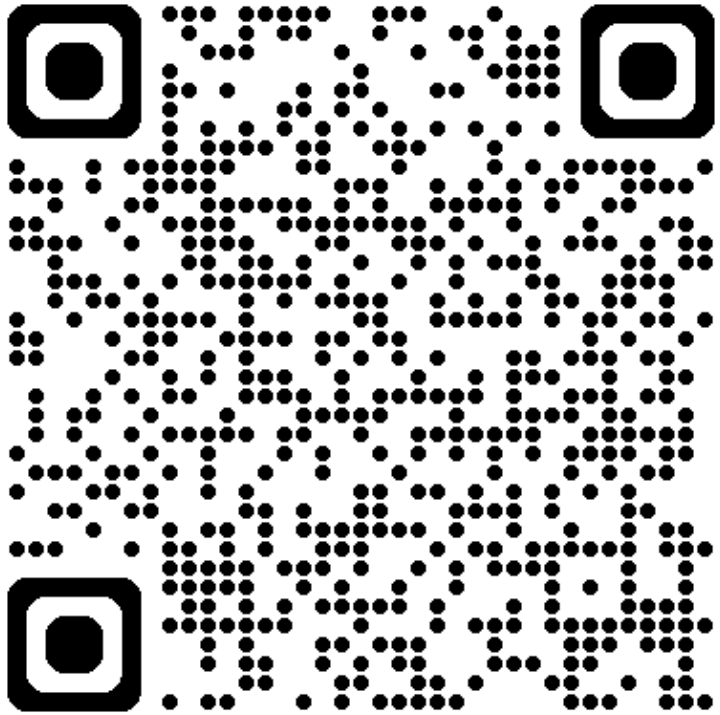


Analysis & Future Work

- Analysis
  - Algorithm 1 performed worse; it is better used with a video stream to detect how long EAR stayed lower than the threshold
  - Taking into factor eyelid coverage was able to increase the accuracy of the drowsiness classification
- Future Work
  - Other Body languages can be taken into factor to detect drowsiness in a single image such as head bending.
  - Training A Support Vector Machine (SVM) on the Facial Landmark features and the Eyelid contours

For More Information

- GitHub Repo: https://github.com/FranciscoLozCoding/csc481_Project/tree/main
- Kaggle Dataset: https://www.kaggle.com/datasets/franciscolozdatasci/csc481-project-dataset



GitHub Repo

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