Driver Drowsiness Detection System

CS 570 Fall 2023
Final Project Presentation

Karthik Eluri
Nipun Davasam
Nipuni Senani De Silva Rammini

Content

- Problem Overview
- Practical Application of the System
- Dataset
- Method and Procedure
- Results
- Conclusion
- Reference

Problem Overview

- Globally, driver fatigue is a pressing issue, causing approximately 100,000 accidents annually in the US according to the NHTSA. Drowsy driving, a leading factor in accidents, results in fatalities and injuries.
- The lack of effective detection systems poses a serious risk to road safety.

❑ Our proposed CS 570 final project introduces a driver drowsiness detection system, utilizing literature. This system alerts drivers to drowsiness by analyzing eye blink rates through a camera.

Practical Applications

- **Vehicle Safety Systems**

  This model can be integrated into vehicle safety systems to alert drivers when they show signs of drowsiness, helping prevent accidents due to drowsiness.

- **Fleet Management**

  Companies with fleet operations could use this model to monitor the alertness of their drivers during long-haul trips, ensuring they take necessary rest breaks.

- **In-Car Entertainment System Development**

  Developers of in-car entertainment or assistance systems could incorporate this model to turn off distractions when the driver begins to drowse, reducing accident risks.

Dataset

- Kaggle Dataset -4 th version

This dataset comprises 4,000 gray images , with 2,000 closed eye images and 2,000 open eye images.
The images were captured under diverse conditions, including varying lighting conditions, distances, resolutions, face angles, and eye angles.

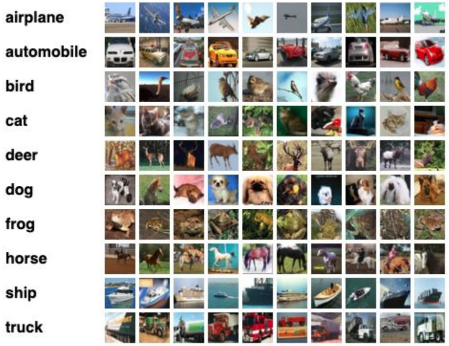
Closed eye

Open eye

- CIFAR 10

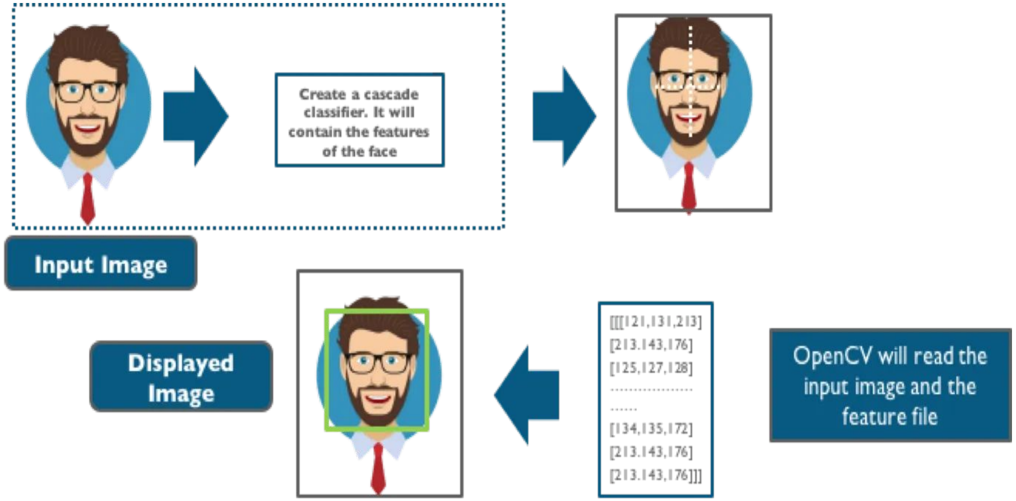
The CIFAR-10 dataset is renowned and consists of 60,000 32x32 color images across 10 classes, with 6,000 images per class.

The dataset comprises 50,000 training images and 10,000 test images



CIFAR 10

ML models used in the system-Haar Cascade model



- The face detector we use is made using the classic Histogram of Oriented Gradients (HOG) feature combined with a linear classifier, an image pyramid, and sliding window detection scheme.

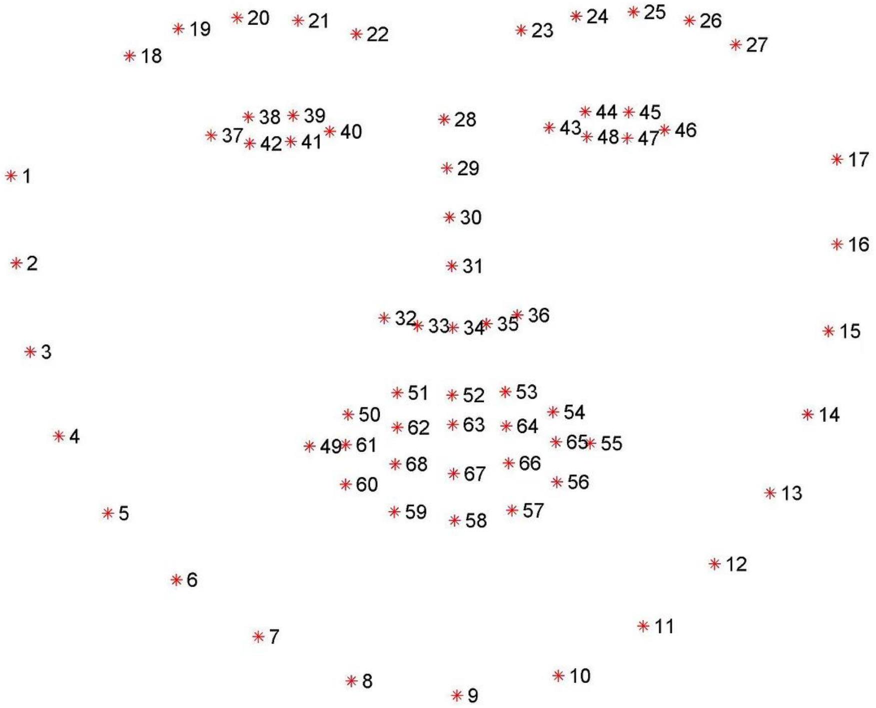
- Fastest algorithm to use if we cannot afford to use more computationally expensive object detectors

- Faster than SSDs, Faster R-CNN, YOLO.

- First published by Paul Viola and Michael Jones in their 2001 paper, **Rapid Object Detection using a Boosted Cascade of Simple Features.**

https://medium.com/geeky-bawa/face-identification-using-haar-cascade-classifier-af3468a44814

ML models used in the system-Facial Landmarks



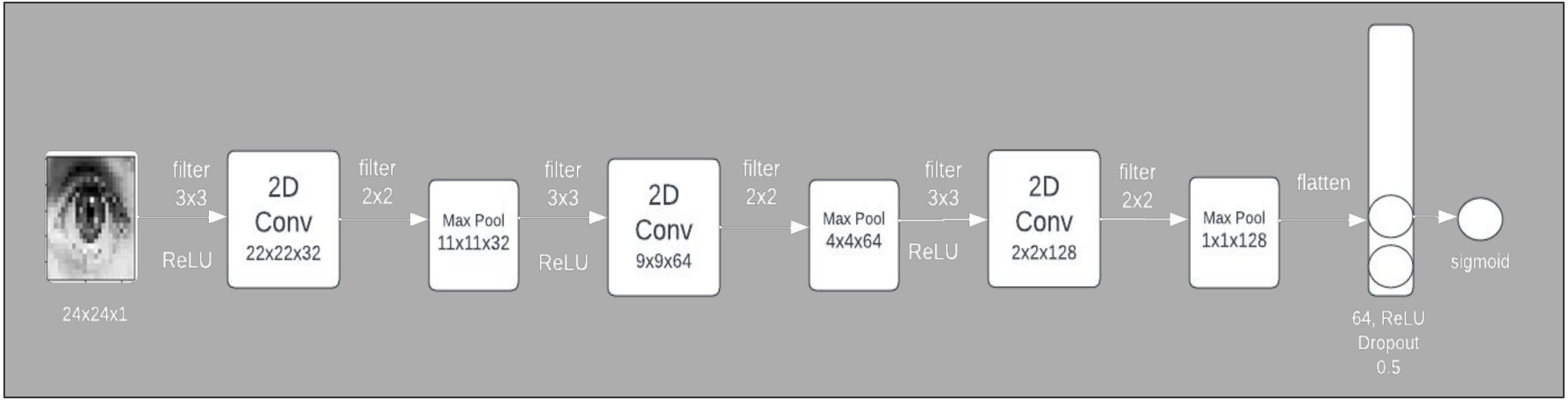
- Dlib library’s implementation of the paper

One Millisecond Face Alignment with an Ensemble of Regression Trees by Vahid Kazemi and Josephine Sullivan, CVPR 2014

- Trained on the iBUG 300-W face landmark dataset
- Trained model can represent features of the face using 68 landmarks

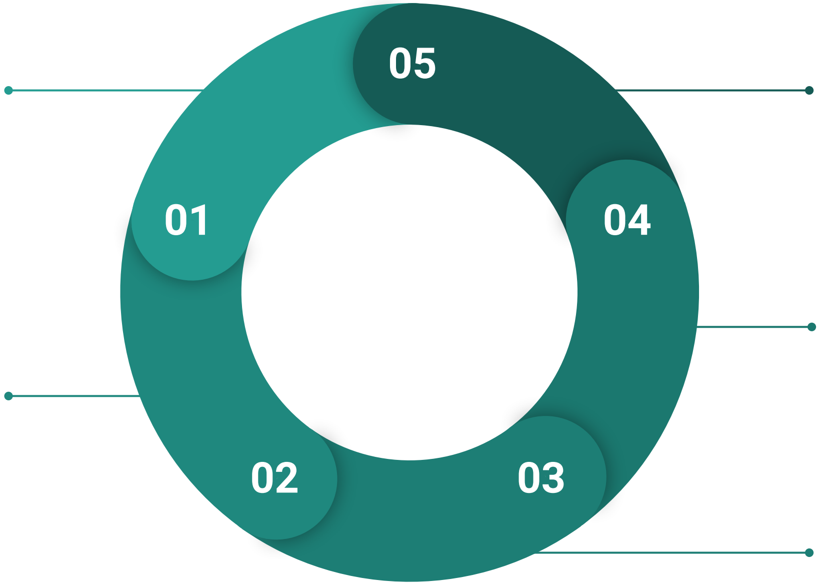
https://aanilkayy.medium.com/extract-eyes-in-face-i%CC%87mages-with-dlib-and-face-landmark-points-c45ef480c1

ML models used in the system-CNN model

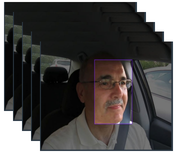


- Optimizer: Adam
- Loss function: Binary cross-entropy
- Measure: Accuracy

System

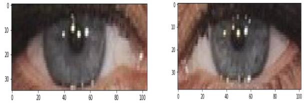


Capturing frames from a video stream



Detect driver face using Haar Cascade

Detect eyes using 68 points face landmarks

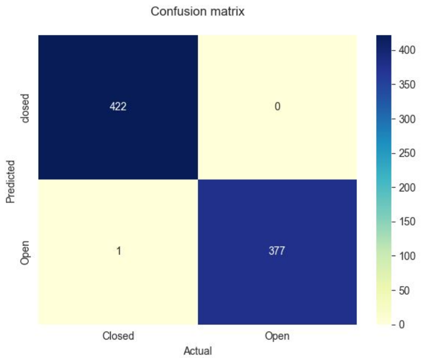


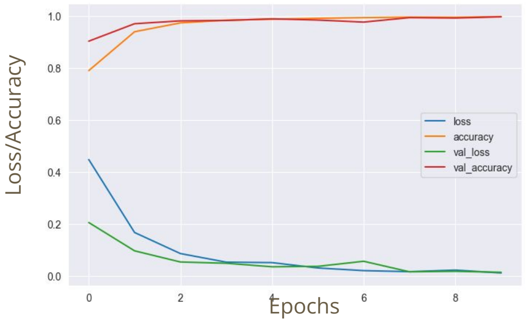
Check eye is open or close using CNN model and count number of eye flips

If Eye flip rate < threshold per minute,
send an alert

Results: CNN eye classification model

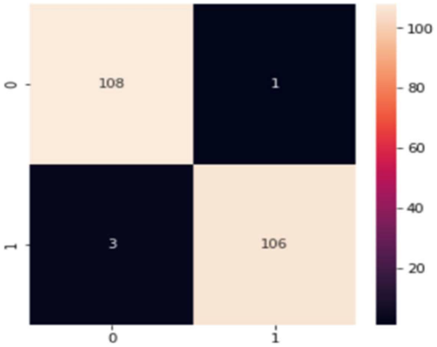
Rebuilt model



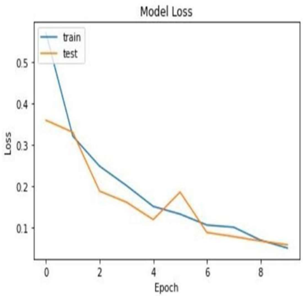


Accuracy : 0.998

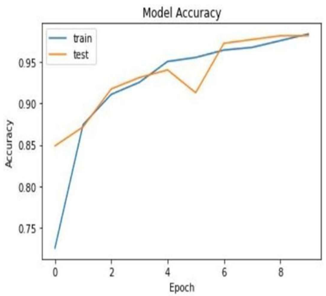
Literature



Test and train loss values



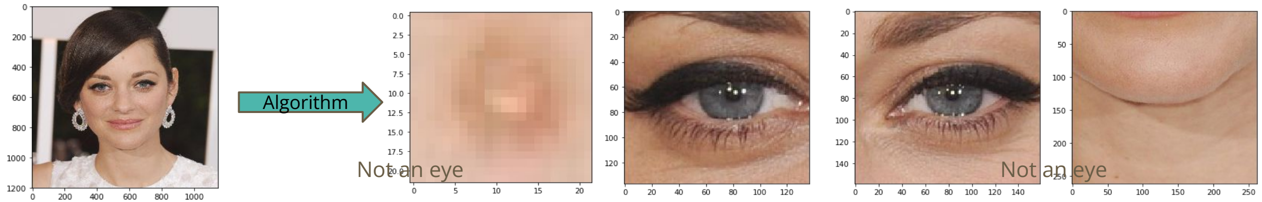
Test and train accuracy



accuracy : 0.98>

Results: What we tried so far and what worked so far

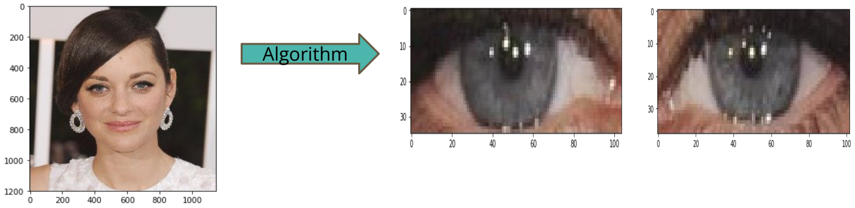
- Tried : Haar cascade eye detection algorithm to detect eye ROI.



- Tried : Haar cascade eye detection algorithm to detect eye ROI and pre-trained MobileNetV2 to classify detected ROI is an eye or not.

  Resizing of open eye and closed eye images to work on MobileNetV2 model.
  Resizing of images from cifar 10 dataset to make it compatible with MobileNetV2 due to computation constraints.

- Worked : Eye detection using dlib library 68 facial landmarks model



Conclusion

- Implemented a model that captures frames from a video feed. Haar Cascade then detects face of the driver
- Clip out estimated eye region from the frame captured and check if the clipped region is of eye or not
- Frames are captured for an interval of time to determine eye flips and alert the driver based on set criteria for drowsiness
- Used dlib to estimate the location of 68 coordinates that map the facial points on a person's face. And regioning out left and right eye to determine the eye blinks
- This system was built with minimum computational power
- Person’s distance from camera, lighting conditions have impact on model
- Used more accurate Dlib facial landmark model instead of OpenCV haar cascade eye classification model in literature

Future Steps

- Detecting face with other classification models
    - YOLO model
    - SSD model
    - Fast R -CNN

- Compare efficiency and accuracy with these models.

References

[1] Pasaribu, Novie Theresia Br, et al. "Drowsiness detection according to the number of blinking eyes specified from eye aspect ratio value modification." *1st International Conference on Life, Innovation, Change and Knowledge (ICLICK 2018)*. Atlantis Press, 2019.

[2] Verma, Harshit & Kumar, Amit & Gouri, Shankar & Mishra, Gouri & Deep, Ujjwal & Mishra, Pradeep & Nand, Parma. (2023). DRIVER DROWSINESS DETECTION. Shu Ju Cai Ji Yu Chu Li/Journal of Data Acquisition and Processing. 38. 1527. 10.5281/zenodo.776772.