Real-Time Driver Drowsiness Detection Using Facial Action Units

Malaika Vijay

Netrakanti Vinayak Nandagopal

Maanvi Nunna

Subramanyam Natarajan

PES UNIVERSITY

PROBLEM STATEMENT

To develop a vision based method of detecting driver drowsiness using Facial Action Units with the following features -

- Robust to illumination conditions and occlusions
- Not intrusive
- High inference accuracy
- Real-time
- Low training data requirement

FACIAL ACTION UNITS

What are Facial Action Units?

- Movements of a particular muscle or a group of muscles in the face

Why use Facial Action Units to Detect Drowsiness?

- High correlation with EEG signals - a reliable indicator of drowsiness

(a) Jaw Drop

(b) Upper Lid Raiser

(c) Outer Lid Raiser

Fig. 1 : Facial Action Units [1]

[1] "Facs - facial action coding system." https://www.cs.cmu.edu/~face/facs.htm.

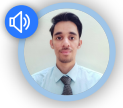
MOTIVATION

Challenges

- End-to-end models like CNNs do not necessarily perform well on unseen subjects
- Subject-specific training not practical

Two Stage Representation Learning based Pipeline

- **Subject Independent** - Generic feature extraction from subject, common across all subjects
- **Subject Specific** - Classify drowsiness based on computed features for each subject



METHODOLOGY

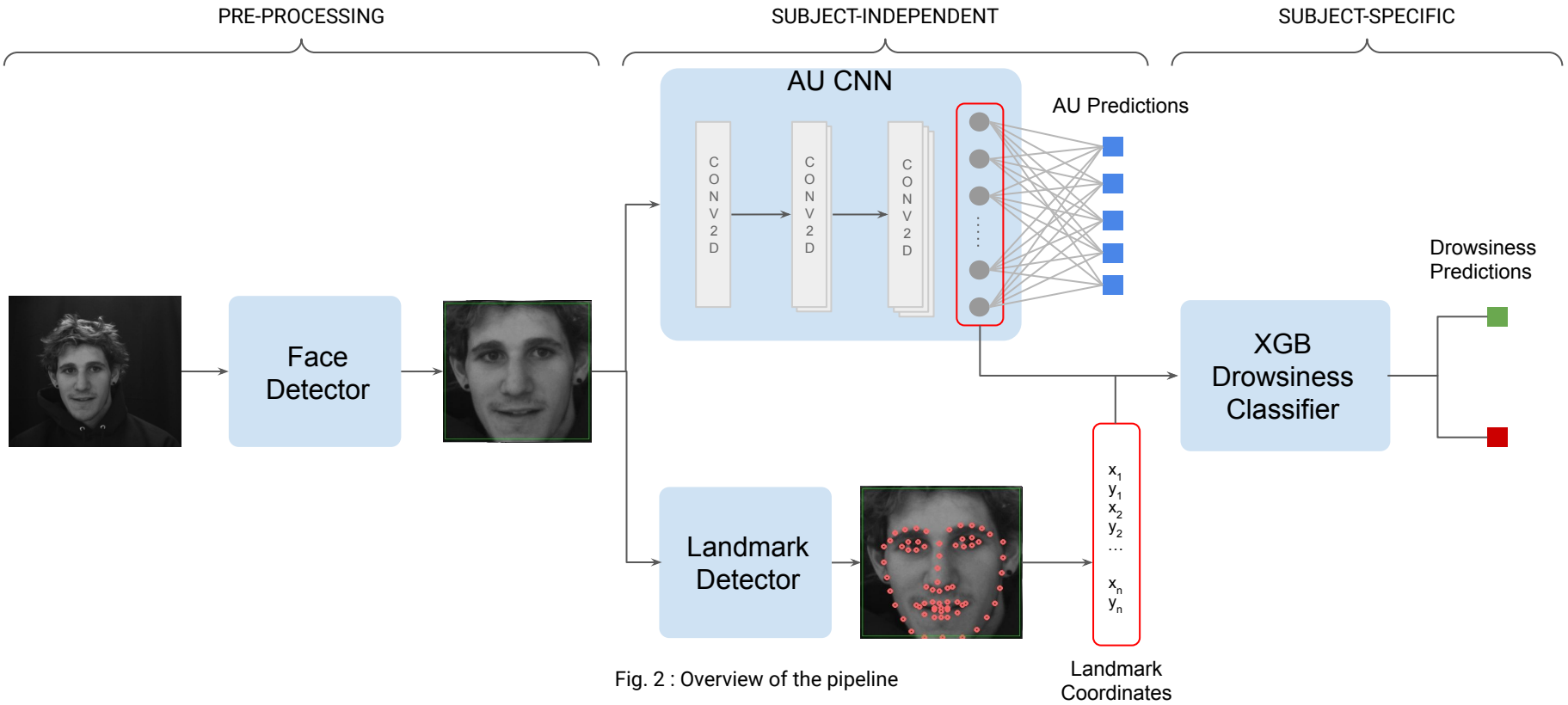


Fig. 2 : Overview of the pipeline

DATASETS

DISFA

- **D**enver **I**ntensity of **S**pontaneous **F**acial **A**ction **D**atabase [2]
- Non-Posed Videos of 27 subjects exhibiting various FAUs
- 12 FAU Annotations for each frame
- Used for FAU detection

NTHU-DDD

- **NTHU** **D**river **D**rowsiness **D**etection **D**ataset [3]
- Videos of 22 subjects performing a driving simulation
  - Drowsy/Non Drowsy Behaviour
  - Night/Day time illumination
  - Glasses/Sunglasses/No Glasses
- Used for Drowsiness detection

[2] S. M. Mavadati, M. H. Mahoor, K. Bartlett, P. Trinh, and J. F. Cohn,"Disfa: A spontaneous facial action intensity database,"IEEE Transactions on Affective Computing, vol. 4, no. 2, pp. 151–160, 2013.
[3] C.-H. Weng, Y.-H. Lai, and S.-H. Lai, "Driver drowsiness detection via a hierarchical temporal deep belief network," pp. 117–133, 03 2017.

RESULTS

Frame Rate

- **23.6fps**

Training Data

- **9 minutes**

Mean Accuracy (%)	Standard Deviation
81.40	12.22

Table 1 : FAU Classifier Test Metrics

Mean Accuracy (%)	Standard Deviation
99.43	0.36

Table 2 : Drowsiness Classifier Test Metrics

Fig. 3 : Timing diagram for pipeline

CONCLUSION

- Two Stage Representation Learning Pipeline for Driver Drowsiness Detection based on Facial Action Units and Facial Landmarks
- Demonstrated high prediction accuracy from subject specific calibration
- Minimised data requirements for subject specific training
- Robust to varying illumination conditions
- Robust to occlusions of the eye

Thank You