DRIVER DROWSINESS DETECTION

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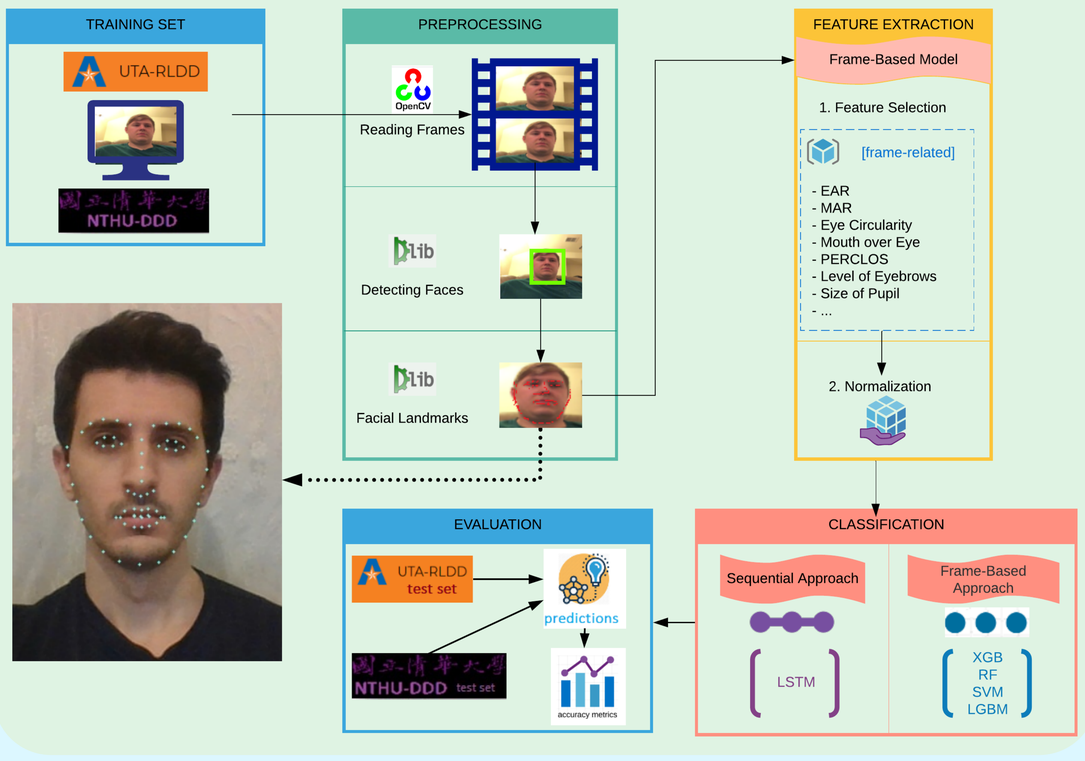
INTRODUCTION

Problem:
According to the KGM, last year 3704 people have died in road accidents in Turkey and 92.65% of accidents were caused by driver defects. Development of a robust and practical drowsiness detection system is a crucial.

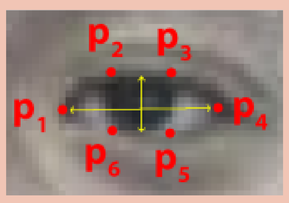
Solution:
A system that checks a driver's facial behaviour, mainly eyes and mouth, in real-time to be able to detect drowsiness status of the driver.

METHODOLOGY



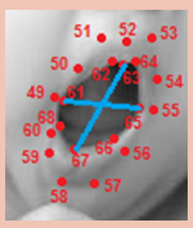
FACIAL FEATURES

Eye Aspect Ratio



$$EAR(i) = \frac{\|p_2 - p_6\| + \|p_3 - p_5\|}{2\|p_1 - p_4\|}$$

Mouth Aspect Ratio



$$MAR(i) = \frac{\|p_{63} - p_{67}\|}{\|p_{61} - p_{65}\|}$$

Eye Circularity

$$EC(i) = \frac{4 \times \pi \times Pupil\ Area}{(Eye\ Perimeter)^2}$$

$$Pupil\ Area = \left(\frac{\|p_{38} - p_{41}\|}{2}\right)^2 \times \pi$$

$$Eye\ Perimeter = \|p_{37} - p_{38}\| + \|p_{38} - p_{39}\| + \|p_{39} - p_{40}\| + \|p_{40} - p_{41}\| + \|p_{41} - p_{42}\| + \|p_{42} - p_{37}\|$$

Percentage of Eye Closure

$$PC = \frac{count\ of\ frames\ when\ the\ eyes\ are\ closed}{total\ count\ of\ frames\ up\ until\ that\ moment} \times 100\%$$

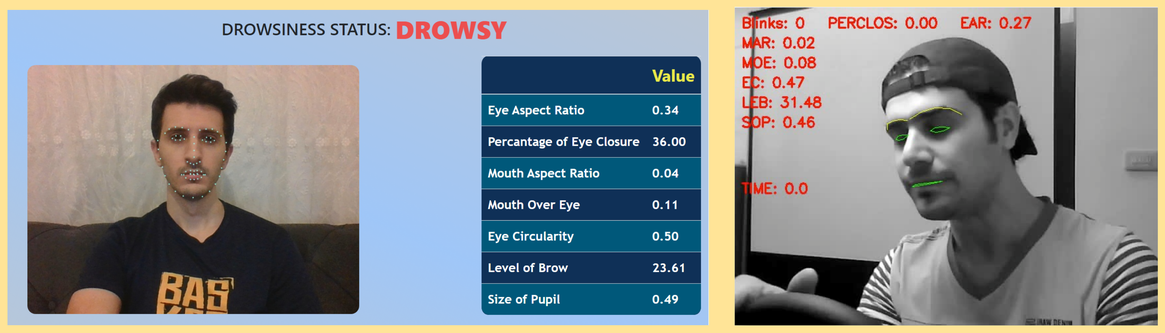
Level of Eyebrows

$$LEB(i) = \frac{\|p_{21} - p_{40}\| + \|p_{22} - p_{40}\|}{2}$$

Size of Pupil

$$SOP(i) = \frac{\|p_{38} - p_{41}\|}{\|p_{37} - p_{40}\|}$$

APPLICATION



EXPERIMENTAL RESULTS

Evaluation Metric: **F1 Score**

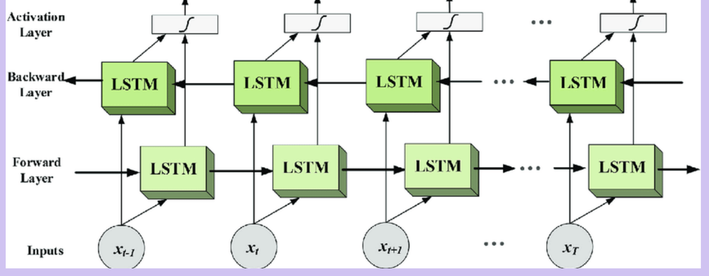
$$F1 = 2 \times \frac{Precision * Recall}{Precision + Recall}$$

	NTHU DROWSY	RLDD HALF AWAKE	RLDD DROWSY	MERGED HALF AWAKE	MERGED DROWSY
DECISION TREE	0.77	0.82	0.84	0.80	0.80
EXTRA TREES	0.84	0.82	0.85	0.81	0.81
BAGGING CLASSIFIER	0.83	0.86	0.88	0.84	0.84
XGBOOST	0.80	0.87	**0.89**	0.86	0.86

Evaluation Metric: **MSE & F1**

$$MSE = \frac{1}{n}\sum_{i=1}^{n}(y_i - \tilde{y}_i)^2$$

	MEAN SQUARED ERROR	F1 SCORES
LSTM-vanilla	0.93	0.63
LSTM-stacked	0.96	0.71
LSTM-Bi	0.95	0.71
CNN-LSTM	0.98	0.61
CONV-LSTM	0.99	0.62



CONCLUSION

Achieved Aims

High Accuracy (89%)

Early Detection (2 secs)

Real-Time Performance

Adaptivity to the Subject

In conclusion, our trained model has reached 89% accuracy in drowsiness detection. We did several experiments to determine the best classifer for us. Also we try to minimize the effect of variant faces on the decision-making mechanism in the classfiers by normalizing the feature values.

REFERENCES & USED TECHNOLOGIES

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[4] Zhong, G., Ying, R., Wang, H., Siddiqui, A., & Choudhary, G., Drowsiness Detection with Machine Learning. [Online]. Available: https://towardsdatascience.com/drowsiness-detection-with-machine-learning-765a16ca208a (Date of Access 20 / 04 /2020)