In-Vehicle Monitoring for Passengers' Safety

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20TH ANNIVERSARY
German University in Cairo
الجامعة الألمانية بالقاهرة

Driving drowsiness detection through videos/images is one of the most important issues for driver safety in today's world. Because of the great advancement in technology in the last several decades, deep learning techniques applied to computer vision applications such as sleep detection have shown promising results. Drowsiness is characterised by closed eyes, yawning, and microsleeps. Moreover, one of the biggest tragedies in the news lately, is toddlers or pets dying in hot cars. In this work, a realtime deep learning algorithm is designed to monitor driver drowsiness, driver distraction, forgetting children and pets alerts system and seat belt adjustment monitoring system. Results showed that our proposed system had 95% drowsiness detection, 90% distraction detection, 87.5% children and pets monitoring and 70% seat belt adjustment monitoring.

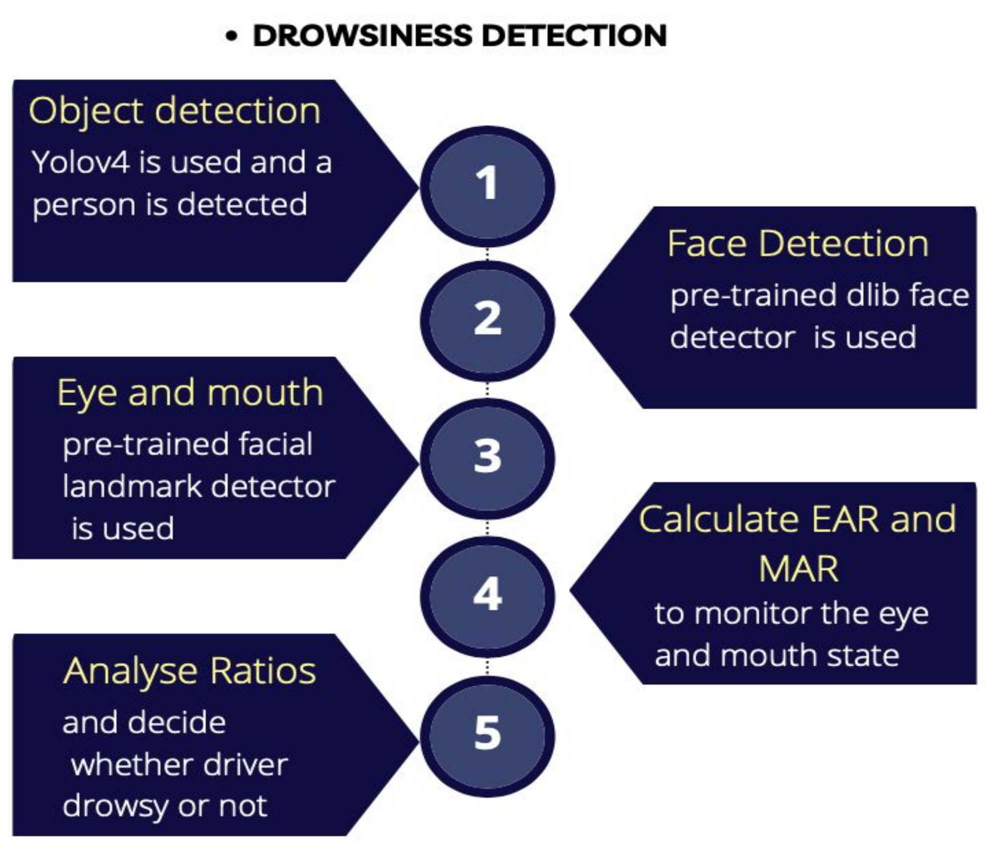
Literature Review

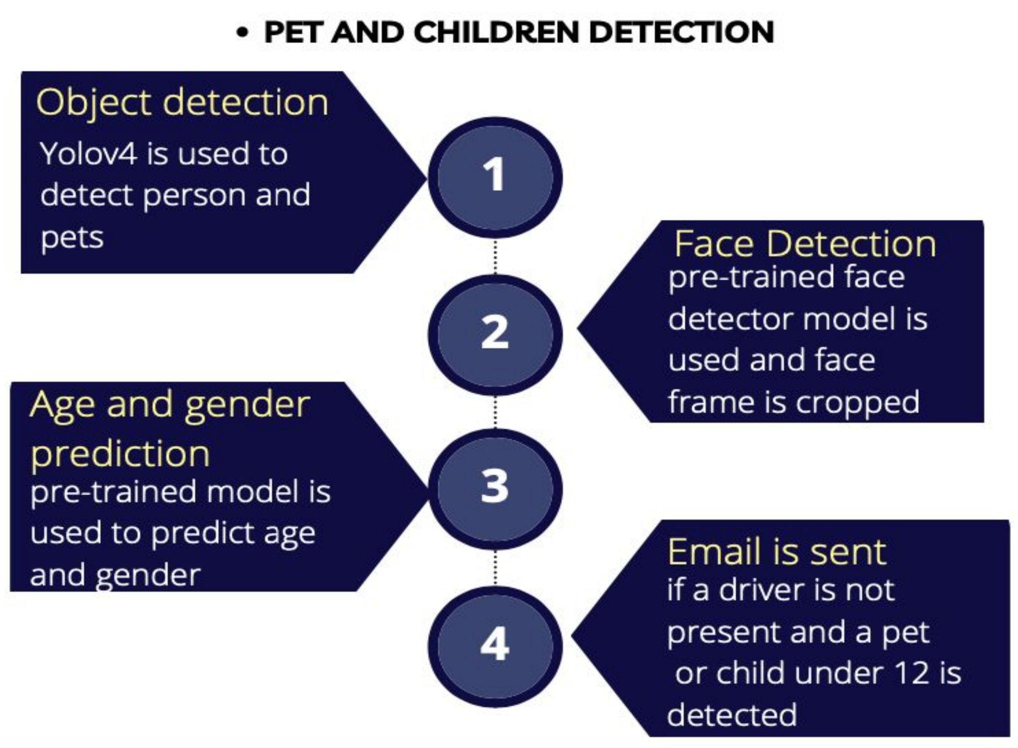
In 2021, Salman et al. presented a paper[1] in which they used four different Convolutional Neural Network (CNN) approaches to detect and investigate the level of driver drowsiness based on yawning frequency and position and occlusion changes, CNN1, CNN2, CNN3, and Ensemble Convolutional Neural Network (ECNN). The method adopted in this paper goes as follows,

For sleepiness detection, the driver's behavior is commonly classified as alert, or drowsy. Therefore, images/frames from input video samples are retrieved based on these classes [25]). After pre-processing, the frames collected from the video database are used for Face detection, which is the following stage. It is one of the most frequent methods for detecting tiredness using facial cues such as yawning and eye blinking. The retrieved features would then be used to search for more photos with comparable matching features. The calculation of acknowledging face detection was done using CNN. The PERCLOS (percentage of Eye Closure), the ratio of mouth opening, head movement, and pose variety are some of the assimilated traits. During face detection, cropping is done to delete portions of undesired areas from the image to eliminate incidental useless features and enhance the image's surroundings. The image is then resized and evaluated. The results showed that the Ensemble-based approach outperformed classic CNN models when used alone. In comparison to the other CNN models, the Ensemble approach fared better, with recall scores of.903 and.995 in the drowsy and alert periods, respectively. However, there were some limitations to the study, such as conducting the experiment on only 1 dataset, rather than comparing the proposed model's performance to the literature, only four different CNN-based strategies were proposed and the compatibility of our proposed models with real-world situations wasn't investigated.

Methodology

Object detection: Because speed is critical in our pipeline, we must be able to deliver results in real time with minimal delay. For object detection, the You Only Look Once (YOLO) model will be used. Yolov4 is used.

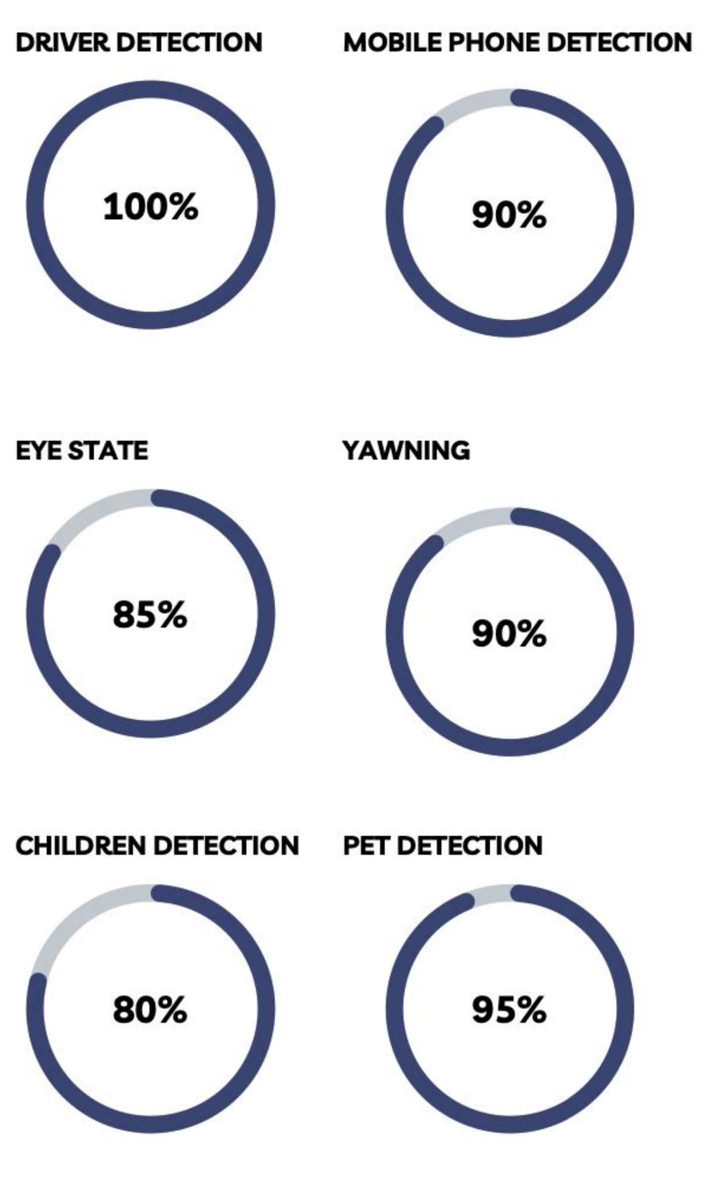




Seat belt detection: is done using Opencv and based on line detection.

After the frame of a person is detected using Yolov4, this frame is resized and converted to gray-scale. Blurring is applied to the frame for smoothness then converted to edges using the canny edge detection algorithm and lines are extracted. Moreover, we loop over the lines and calculate the slope of each line. If the current line's slope is greater than 0.7 and less than 2 and the previous line's slope is Within the same and both lines are not too far from each other.

Results



Situation	Accuracy
Micro-sleep detection	85%
Yawning detection	90%
Distraction detection	98%
children and pets monitoring	84%
Seat belt adjustment	70%

Conclusion

In this work, we presented a real-time deep learning algorithm to monitor driver drowsiness, driver distraction, forgetting children and pets alerts system and seat belt adjustment monitoring system. Results showed that our proposed system had 95% drowsiness detection, 90% distraction detection, 87.5% children and pets monitoring and 70% seat belt adjustment monitoring. Thus, based on the findings of our investigation, we can conclude that, our proposed is capable of being used to monitor driver and their children or pets to avoid accidents or children and pets dying in hot cars.

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Prepared for Thesis Poster Display Conference

11th -12th June 2022

Faculty of Management Technology
THESIS Poster Display Conference 2022