International Journal of Combined Research & Development (IJCRD)
eISSN:2321-225X;pISSN:2321-2241Volume:14;Issue:8;August-2025

ALERTEYE: PREVENTING DROWSY DRIVING ACCIDENTS

Abuzaid Muneerahmad Pathan
PG, Student
Dept. of MCA
The Oxford College of Engineering,
Bommanahalli, Bengaluru- 560068
abuzaidpmca2025@gmail.com

Manivannan Jayachandran
Assistant Professor
Dept. of MCA
The Oxford College of Engineering,
Bommanahalli, Bengaluru- 560068
manivananmca@gmail.com

ABSTRACT

Sleepy driving has become a major and escalating cause of road crashes especially in long drives, commuting at night or when people have heavy work demands. As a solution to this problem, we introduce AlertEye, an offline-capable driver drowsiness alarm that operates in real time and is based on lightweight, threshold-based supervision-in this case, the use of Eye Aspect Ratio (EAR) -based on Euclidean distance between facial landmarks. Unlike deep learning methods, AlertEye is designed for simplicity, speed, and affordability with no training required, no heavy computing infrastructure or Internet required. With a common webcam and Mediapipe's facial landmark detector, the system continually retrieves eye landmarks, and deduces Ears EAR in real-time. When the EAR is kept at less than a stated level (e.g. 0.25) over a prolonged period of time (usually 4 seconds), then a sound or GUI alert is triggered to notify the driver that he is becoming drowsy. The method is centered on the eyelid closed duration as well as the blink rate—evidenced behavioral signs of fatigue. Architecture of AlertEye is smart and wise. It enables real time adjustment of the thresholds to be flexible in terms of different users and deployment settings. This selection can work on a basic device such as Raspberry Pi or in-car solutions that deliver high capacity (2030 FPS) and do not depend on the cloud services, hence, ensuring privacy and portability. On the validation tests, it was indicated that it performed well against all users of unequal facial features, eyewear, and clear, dim, and bright lighting with minimal false positives or detection omissions. It is mainly strong in being able to be interpreted, low latency, and small hardware footprint, which is how it can be used in real-world situations, such as in public transportation, monitoring of fleets, and in-car uses in the personal sphere. To conclude, AlertEye is an affordable, scalable, privacy-friendly, reliable system to alert driver fatigue. Its threshold based EAR model could be further enhanced with yawning, head pose analysis or steering behavior and hence resulted in a multi-modality drowsiness recognition system which

would hold special place in improving road security and accidents.

Keywords: *Driver Drowsiness Detection, Eye Aspect Ratio (EAR), Mouth Aspect Ratio (MAR), Facial Landmark Recognition, Real-Time Alert System, Computer Vision, Streamlit Interface, OpenCV, Dlib, Threshold-Based Monitoring, Multimodal Alerting, Driver Monitoring System.*

INTRODUCTION

Driver exhaustion is among the greatest contributors of accidents on the road which result into loss of thousands of lives and injuries yearly. Drowsiness is more threatening to the drivers since unlike alcohol or drugs, drivers do not notice it in time. There are classical options like steering sensors, lane departure monitors, or those based on EEG which, however, do not give a high enough accuracy or are too cumbersome and costly in order to be use. It is against these shortfalls that the AlertEye project was invented. Being light in weight, economical and software-based, the system employs facial landmark recognition to track the early indicators of drowsiness. The system detects fatigue in real time and warns the driver by monitoring the key behavioural indicators of fatigue that include long closure of the eye and excessive yawning. The AlertEye works on a normal hardware such as a laptop or a Raspberry Pi using a normal webcam rendering it affordable and it is also transportable.

LITERATURE SURVEY

Driver fatigue detection has been a research topic over the decades with various suggestions being put forward. In general, literature may be categorized into approaches based on vehicles, monitoring of Physiological signals, and vision.

Vehicle-Based Approaches:

They were primitive types of systems of fatigue detection which were based on indirect vehicle indicators. Drowsiness was inferred by monitoring the steering wheel angle, lane deviation, and abrupt corrections, i.e., metrics. Research indicated that drivers suffering fatigue are likely to have a poor control of the steering behaviour and lane discipline. Although they can be useful under some circumstances, they have serious drawbacks: an experienced driver, exhausted however, may maintain the vehicle on the road in the short term and hence may cover the indicators of fatigue. More so, false alarms could be the result of the road type, conditions of vehicle, and disturbances in the environment (such as crosswinds). Such methods also do not have

Physiological Signal Monitoring:

The other area of research is in the field of monitoring inner body conditions i.e. brain activity (EEG), eye movement (EOG), or heart rate variability (ECG/PPG). These signs bear solid indications of alertness and have been efficiently applied in the lab. EEG headbands, e.g., are able to effectively identify instances of micro-sleep. Nevertheless, they are obnoxious, not comfortable to use in the long-term perspective, and are not applicable in the case of day-to-day driving. Custom-made and individually calibrated equipment therefore limit in vivo applications.

Vision-Based Techniques:

Drowsiness detection using vision has become the most useful and non-intrusive one. It does not require any special camera, but only an ordinary one; which means that it is only cost-effective and easy to carry around. One of the most frequently reported procedures is the Eye Aspect Ratio (EAR) developed by Soukupova and Cech (2016) that can be used to estimate whether the eyes are closed or laser-scanned. EAR is calculated with distances between particular eye landmarks. Methods of EAR are proved to be quick and straightforward, need no training data. Besides this, the detection of yawning using the Mouth Aspect Ratio (MAR) has also been tried, since high instances of yawning are another common sign of fatigue.

EXISTING SYSTEM

The most prominent widely used approaches of drowsiness detection systems can be classified into two categories, commercial car systems and non-commercial research prototype. Commercial systems, usually installed in luxury vehicles include steering patterns, lane or depression sensors or inbuilt cameras that can be used to keep track of the driver. Although they offer a level of such assurance, they cannot be depended on since they are costly, dependent on the vehicle and usually create simple warning signals like on-dash lamp or warning beep that could be ignored by the motorist. Conversely, research done by academicians has introduced the use of physiological sensor using EEG and ECG, iris used in infra red imaging, and deep learning in classifying images. Despite their potential good accuracy in constrained settings, these methods themselves are subject to practical limitations: EEG/ECG feedback is uncomfortable and invasive in automotive applications and significant amounts of data and computation are required to train deep learning solutions, in addition to their reliance on internet / cloud resources which is less optimal in offline use on resource-scarce hardware. Moreover, currently available systems are inflexible, almost impossible to work in different settings, and do not allow multi-modal alerts or reporting. The synthesis of these disadvantages demonstrates the niche in the market to have a lightweight, cheap, offline, privacy-preserving product such as AlertEye.

PROPOSED SYSTEM

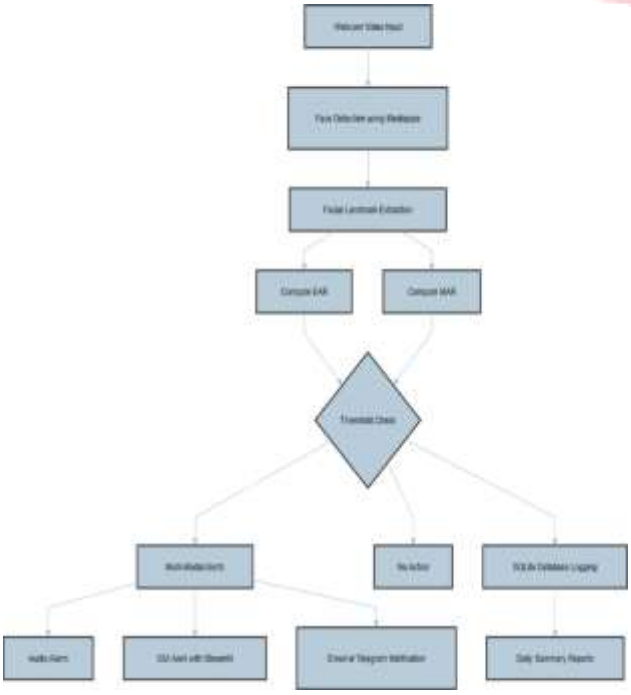
When compared to current solutions, it has the potential to solve the drawbacks of current methods since the proposed AlertEye system is lightweight, offline, and budget-friendly, capable of running in real time even under a normal webcam. Primarily, the system is based on the computer vision methods, where the facial landmarks are examined, and as a result, two significant behavioral parameters are calculated, i.e., the Eye Aspect Ratio (EAR) used to estimate eyelid closure, and the Mouth Aspect Ratio (MAR) used to indicate yawning. Using threshold based rules, the system can detect when a driver should most probably be feeling fatigued including when there is a sustained reduction in the EAR to less than 0.25 over some few seconds or when the driver yawns frequently. As soon as drowsiness is identified, the system will emit multi-modal alert, such as a loud audio alert that will re-engage the driver and warning messages showing on the screen using Streamlit interface, and remote alert via email and Telegram to the administration. On the contrary, deep learning models demand powerful computing resources and internet connectivity and hence their use is restricted to the internet, whereas AlertEye is portable and designed to run on locally accessible hardware including laptops and Raspberry Pi, securing their privacy and portability and making them easy to implement. Besides providing real-time alerts, the system also provides SQLite database to record the occurrence of an event and also each morning we create daily report logs on the drowsiness pattern regularly and can be tracked to the administrators. The simplicity of execution, its scalability, and reliability demonstrate that the proposed system offers an effective solution to decrease the number of fatigue-related accidents in personal vehicle use, in urban and extended public transportation, as well as in fleet management.

METHODOLOGY

The AlertEye methodology consists of the sequential approach to computer vision, resulting in reliable and continuously-detected identification of driver drowsiness with the assistance of only the webcam. Originally, the system constantly captures video frames of the driver face which were then enqueued to a facial landmark detector ran by Medapipe to identify major features of the face like eyes and the mouth. Based on these landmarks two key behavioral indicators are calculated, the Eye Aspect Ratio, or how open the eyelids are (EAR) and the Mouth Aspect Ratio or how wide the mouth is in connection with the behavior of yawning (MAR). A decision rule based on threshold is then employed when, in case EAR stays at less than 0.25 over a time of 2-3 seconds, the system will perceive it to be persistent eye closure whereas repeated high values on MAR will connote a yawn. To make the alert mechanism responsive, it is multi-threaded, thus it allows triggering audio alarms, visual alarming, and notifications by remote via email or Telegram as soon as possible without pausing the video processing. Each detection is captured in an SQLite database along with a timestamp so that an administrator can view activity in retrospect. Also, there is a scheduler that produces daily reports that summarise the events of drowsiness with each user. Such a simple yet effective method ensures that the system is not heavy and can be used without the Internet connection and can be ported to different devices with diverse hardware, to both laptops and cylindrified or modified Raspberry Pi devices.

RESULTS

To determine its stability, accuracy and usability in real life conditions, a wide range of situations were tested in order to check the functionality of the AlertEye system. The participants used in the tests were of different facial characteristics both with and without glasses, in various lanterns such as daylight, moderate, and bright artifacial light. The system recorded stable real-time applications at around 25 30 frames per second (FPS) on low-resource devices like a Raspberry Pi and this showed that portable deployment is possible. The drowsiness detection using long durations of eye closure along with yawning was determined to have a very high accuracy and the false positives were very negligible after appropriate tuning of the thresholds. AlertEye was stable and provided reliable results regardless of which user was wearing the device in a wide variety of conditions where many vision-based solutions will fail due to poor lighting or eyewear. According to the participants, the sound signals reported to be loud and get attention well, and the GUI notifications and remote signals through the email and Telegram added the second and third level of security. The campus administrators also found the day-to-day summary reports that the system generated to be useful in reviewing detector trends and user activity. In general, the outcomes proved that AlertEye is a light, quick, and durable drowsiness detection system that can provide prompt warnings and dependable recording on both individual drivers and fleet observance purposes.



CONCLUSION

The creation of AlertEye shows that driver fatigue can also be efficiently captured with a low-weight and low-cost, privacy-preserving system with no need to utilize expensive sensors or deep learning algorithm-based models. Through easy-to-use, but powerful measurements, the system detects long-term eye closure and yawning in real time to provide real-time alerts via sound, GUI messages, and remote messaging. It can serve completely offline thus ensuring the privacy of the users, as well as allow deployment in platform with little resources available like Raspberry Pi thus making the service more accessible to individual drivers and potentially to larger of fleet operations. Test in different conditions reaffirmed that the system is strong, flexible, but has fewer false positives that make it practically useful in road safety. Even though AlertEye in its present stage is already a reliable solution, some improvements are possible to be implemented in the future by adding features like infrared support enabling night driving and adaptive thresholds as well as a head-pose estimating option, the effectiveness of those systems could be tested in the future also. On the whole, AlertEye can be a valuable contribution to safer transportation with a scalable and realistic approach to the accident reduction on the highways due to fatigue.

REFERENCES

[1] Harshit Verma, Amit Kumar, Gouri Shankar Mishra, Ujjwal Deep, Pradeep Kumar Mishra, Parma Nand (2023). "Driver Drowsiness Detection."

[2] Ruben Florez, Facundo Palomino-Quispe, Roger Jesus Coaquira-Castillo, Julio Cesar Herrera Levano, Thuanne Paixão, Ana Beatriz Alvarez (2023). "A CNN-Based Approach for Driver Drowsiness Detection by Real-Time Eye State Identification."

[3] Jagbeer Singh, Ritika Kanojia, Rishika Singh,

Rishita Bansal, Sakshi Bansal (2022). "Driver Drowsiness Detection System – An Approach by Machine Learning Application."

[4] Robert Chen-Hao Chang, Chia-Yu Wang, Wei-Ting Chen, Cheng-Di Chiu (2022). "Drowsiness Detection System Based on PERCLOS and Facial Physiological Signal."

[5] Vasundhara Iyer, Atharv Vanjari, Varun Patil, V Ingale, V Gujarathi, Y Rathod (2021). "Driver Drowsiness Detection System."

[6] Elena Magán, M. Paz Sesmero, Juan Manuel Alonso Weber, Araceli Sanchis (2022). "Driver Drowsiness Detection by Applying Deep Learning Techniques to Sequences of Images."

[7] Srinidhi Bajaj, Leena Panchal, Saloni Patil, Krutika Sanas, Harshita Bhatt, Swapnali Dhakane (2023). "A Real-Time Driver Drowsiness Detection Using OpenCV, DLib."

[8] Md. Ebrahim Shaik (2023). "A Systematic Review on Detection and Prediction of Driver Drowsiness."

[9] Hrithik Haritash, Sushma Yadav, Rajat Rathi, Harshit Bansal (2022). "Driver Drowsiness Detection System."

[10] Furkat Safarov, Farkhod Akhmedov, Akmalbek Bobomirzaevich Abdusalomov, Rashid Nasimov, Young Im Cho (2023). "Real-Time Deep Learning-Based Drowsiness Detection: Leveraging Computer-Vision and Eye-Blink Analyses for Enhanced Road Safety."

[11] Emma Perkins, Chiranjibi Sitaula, Michael Burke, Jessica Manousakis, Clare Anderson, Faezeh Marzbanrad (2023). "Investigating Physiological and Behavioral Sensing Modalities Toward Drowsiness Detection."

[12] Subbaih Desanamukula Venkata, Pushkal Padala Rao, K. Venkata (2022). "Driver Drowsiness Detection System Based on Infinite Feature Selection Algorithm and Support Vector Machine."

[13] Shiplu Das, Sanjoy Pratihar, Buddhadeb Pradhan, Rutvij H. Jhaveri (2023). "IoT-Assisted Automatic Driver Drowsiness Detection Through Facial Movement Analysis Using Deep Learning and a UNet-Based Architecture."

[14] Dr. Jayshree Pansare, Ranjeet Deshpande, Shubham Shingare, Harshal Deokar, Piyush Manwar (2022). "Real-Time Driver Drowsiness Detection with Android – An Effective Approach for Early Detection in Drowsiness."

[15] Abhishek Gadde, Abhinandan Gorde, Aditya Bopte, Nidhi Kapgate, Aashay Nevatia, Swapna Choudhari (2022). "Employee Alerting System Using Real-Time Drowsiness Detection."