SNOOZEGUARD: DRIVER FATIGUE DETECTION AND ALARM SYSTEM

M Varshith
Student, Computing Technologies SRM Institute of Science and Technology
CHENNAI, INDIA
mq7762@srmist.edu.in

Basim Ahamed
Student, Computing Technologies SRM Institute of Science and Technology
CHENNAI, INDIA
bk6579@srmist.edu.in

Dr. J . Ramaprabha
Assistant Professor, Computing Technologies SRM Institute of Science and Technology
CHENNAI, INDIA
ramapraj@srmist.edu.in

Abstract-

Nowadays, there are many traffic accidents caused by sleepy drivers. This is one of the main causes of car accidents . Therefore, to prevent these fatigue-related accidents, it is necessary to develop an intelligent system. The main idea of this project is to develop a robust system that can detect driver fatigue, warn them and save lives. In this project, we present a sleepiness detection scheme. In this model, driver is continuously monitored through webcam or camera. And we used OpenCV for extracting the driver face from continuous image frames of the camera. This model mainly focuses on the Region of interest (ROI) i.e., eyes as it is the important factor to detect drowsiness. We used an algorithm to track and analyze the blinking rate of the eyes. If the eyes are closed in more than two frames then model will detect as driver is drowsy and alerts the driver by playing alarm sound. This fatigue detection system represents a pivotal step in addressing the alarming rate of accidents attributed to drowsy drivers. By utilizing advanced technology, we aim to proactively prevent potential tragedies on the road. Our innovative approach involves real-time monitoring of drivers through readily available webcams or cameras, making it easily implementable across various vehicle types.

I. INTRODUCTION

For better living conditions, the development of technology allows the introduction of more advanced solutions. Sleep is a state near sleep, where the person has a strong desire to sleep. Sleeping is dangerous in some situations where there is a constant need for concentration while performing tasks such as driving. When a driver is tired enough, it causes him to fall asleep causing traffic accidents. According to new statistics, about 21 percent of fatal accidents are caused by a drowsy driver. According to estimates from the National Highway Traffic Safety Administration (NHTSA), every year, drivers cause 100,000 traffic accidents combined fatigue. The latest statistics show that accidents related to fatigue are increasing every day. Fatigue-related accidents are occurring due to driver fatigue, lack of concentration and other weather conditions. The development of technology for detecting sleep and preventing accidents is a big challenge.

This project aims to create a simulation of a driver drowsiness detection system. Developed models focus on openness and closed eye position. This model will constantly monitor the driver's eyes and detect drowsiness early and prevent traffic accidents. Sleep detection involves scanning multiple facial images and looking at them using an algorithm. If the distance is closed, the signal will increase when the threshold value is reached, then the model warns the driver by playing the sound of an alarm.

II. LITERATURE SURVEY

[1] This approach combines deep learning and IoT technologies to identify drowsiness, utilizing multiple factors such as facial expression recognition, blink patterns, and yawn occurrences. The authors are expected to delve into methods for effectively detecting driver drowsiness, potentially utilizing advanced deep learning techniques, such as convolutional neural networks and recurrent neural networks, to process and analyze data from various sources, including physiological and behavioral indicators. The primary focus of the research may involve the development of a smart alerting system that responds to detected drowsiness, and this system is likely to be connected to IoT devices integrated within the vehicle. These IoT sensors would collect real-time data about the driver's condition and their surroundings, ultimately playing a pivotal role in preventing accidents and enhancing road safety. The document may also include empirical findings from experiments or studies demonstrating the system's efficacy in mitigating the risks associated with drowsy driving

[2] This project developed a face detection system based on Histogram of Oriented Gradients (HOG). To monitor driver drowsiness, we employed the Eye Aspect Ratio (EAR) as a quantitative metric in our proposed algorithm. The real-time testing of our system using Dlib yielded an average accuracy of 80.17% for eye detection and 78.50% for drowsiness detection. It's important to note that these real-time detection results are somewhat lower due to the system's current reliance on optimal lighting conditions for optimal performance.

[3] This system was documented in their research published in the Journal of Information and Communication Convergence Engineering in 2018, specifically in Volume 16, Issue 3, spanning pages

[4] This system is responsible for discerning whether the eye is in a drowsy or alert state, triggering an alarm when drowsiness is detected. Initially, the Viola-Jones detection algorithm is employed to identify the face and eye regions. Subsequently, a stacked deep convolutional neural network is devised to extract relevant features and facilitate the learning process. A SoftMax layer within the CNN classifier categorizes the driver as either awake or asleep. The proposed system demonstrates a remarkable accuracy rate of 96.42%.

[5] Electroencephalography (EEG) is a method for measuring electrical brain activity, which can assess various parameters like pulse, eye blinking, and even basic physical movements like head motion. It can be applied to both human and animal subjects to monitor brain activity by utilizing specialized equipment with sensors placed on the top of the head to capture electrical signals. The authors highlight the suitability of the EEG technique for detecting signs of sleepiness and fatigue, stating that it offers an ideal approach. EEG analysis involves four types of frequency components, including alpha, beta, and delta. Increased power in the alpha and delta frequency bands indicates the presence of fatigue and drowsiness in a driver. Nevertheless, this method has its limitations, notably its sensitivity to environmental noise in the vicinity of the sensors. Conducting EEG research necessitates a completely quiet surrounding, as any noise interference can disrupt the sensor's ability to accurately capture brain activity. Additionally, a drawback is the impracticality of using EEG for real-time driving applications. It 23 involves the inconvenience of wearing a device with wires on the head, which can potentially dislodge if the driver moves their head. While EEG may not be suitable for immediate driving applications, it remains one of the most effective methods for research purposes and data collection.

[6] The detection system comprises various processes, including the extraction of facial images, identification of yawning tendencies, detection of eye blinks, and extraction of the eye area. This paper conducts a comparative analysis of literature concerning driver drowsiness detection and alert systems. The system is engineered to function without the continuous recording or retention of data.

III. PROPOSED METHODOLOGY

Our methodology commences with The driver fatigue detection system utilizing machine learning and Python libraries like OpenCV, dlib, and imutils, with the Eye Aspect Ratio (EAR) as a key metric, offers several advantages over other existing methods for drowsiness detection.

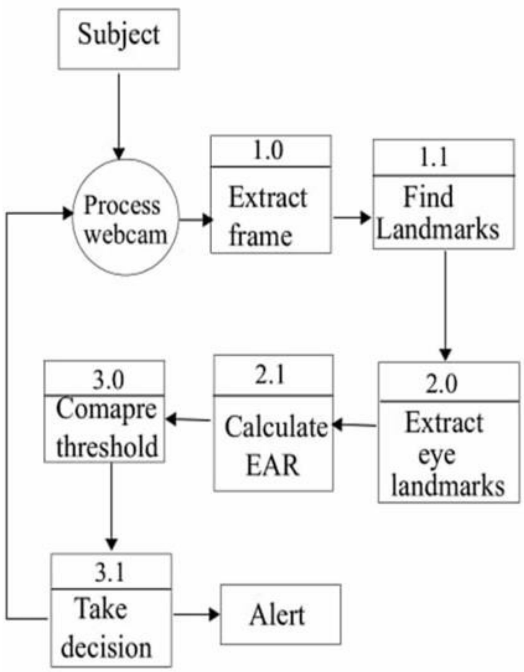

Fig. 1: Architecture Diagram

3.1 Libraries Used

Driver fatigue detection using machine learning, with Python libraries like OpenCV, dlib, imutils, and the calculation of the Eye Aspect Ratio (EAR), is a robust method for monitoring a driver's alertness based on their eye movements and facial features. OpenCV and dlib provide powerful tools for face and eye detection, while imutils aids in simplifying image processing tasks.

3.2 Data Collection

Gather a dataset of images or video frames that includes examples of both alert and drowsy drivers. You can capture these images or frames using a webcam or dedicated camera placed in the vehicle. Ensure that the images or frames are of sufficient quality and resolution, allowing for accurate facial landmark detection. Adequate lighting conditions and minimal noise are essential. Annotate the images or video frames by labeling them as "alert" or "drowsy." This annotation is essential for supervised machine learning.

3.3 Data Preparation

Uses dlib's facial landmark predictor to detect facial landmarks in each image or video frame. The facial landmark predictor is a pre-trained model that can locate key facial points, including the eyes.Calculate the Eye Aspect Ratio (EAR) for each frame. The EAR is computed using the coordinates of the eye landmarks and serves as a measure of eye openness. You can calculate it as follows: $EAR = (||P2 - P6|| + ||P3 - P5||) / (2 * ||P1 - P4||)$ Where P1 to P6 are specific eye landmarks corresponding to the corners and edges of the eyes. Organize the data into training and testing subsets. Split your dataset into two parts, typically in a 70-30 or 80-20 ratio, for training and testing the machine learning model. Save the EAR values along with their corresponding labels (alert or drowsy) for each image or frame in a structured format, such as a CSV file or a database. This data will be used to train and evaluate the model.

3. Detection Process

The Eye Aspect Ratio (EAR) is a key metric in this process. It quantifies the degree of eye closure, which is a crucial indicator of drowsiness. EAR is calculated by measuring the ratio of the horizontal eye landmarks' distance to the vertical eye landmarks' distance. The EAR value decreases as the eyes close, signaling potential fatigue. A threshold EAR value can be set to trigger an alert when drowsiness is detected.

3.3 Process Implementation

By using these libraries and EAR calculation, a Python-based system can continuously analyze a driver's facial expressions and eye movements in real-time. When the EAR falls below the specified threshold, it can trigger alarms or alerts, such as audio warnings or seat vibrations, to prompt the driver to stay alert and prevent accidents caused by drowsy driving.

This approach is effective, non-intrusive, and can be integrated into existing vehicle safety systems to enhance road safety by proactively detecting and addressing driver fatigue. However, it is crucial to fine-tune the EAR threshold and conduct rigorous testing to minimize false alarms and ensure accurate drowsiness detection.

3.4 Function Specification

In addition to real-time drowsiness detection, the combination of machine learning and Python libraries like OpenCV, dlib, and imutils offers the potential for continuous data collection and analysis. This data can be valuable not only for immediate alerting but also for generating insights into a driver's fatigue patterns over time. By recording and analyzing EAR values and other facial features, it becomes possible to identify trends and variations in a driver's alertness during different times of the day or under varying driving conditions.

Furthermore, the scalability and adaptability of this system make it a suitable candidate for integration into various types of vehicles, from personal cars to commercial fleets. Such integration can significantly contribute to road safety by providing drivers with early warnings and facilitating more informed decisions, thereby reducing the risk of accidents due to driver fatigue. Nonetheless, continuous research and development are essential to fine-tune the system's accuracy and robustness, ensuring that it remains a reliable tool for combating the dangers of drowsy driving in the real world.

3.5 Model Validation and Future Predictions

The model's evaluation takes place using the testing dataset, where standard metrics such as accuracy, precision, recall, F1-score, and the confusion matrix are used to gauge the model's performance. These metrics provide insights into how well the CNN can correctly classify alert and drowsy states.

This model is validated with EAR values along with their corresponding labels (alert or drowsy) for each image or frame in a structured format, such as a CSV file or a database. This data will be used to train and evaluate the model.

IV. CONCLUSION

In conclusion, the development and implementation of the driver fatigue detection system presented in this project represent a significant leap forward in enhancing road safety and mitigating the risks associated with drowsy driving. The project, which integrates advanced technologies such as real-time video analysis, Machine Learning, facial feature recognition, and alert mechanisms, has yielded promising results and has the potential to make a profound impact on the lives of drivers and those sharing the roadways.

One of the primary objectives of the project was to continuously monitor a driver's alertness through real-time video frame analysis. By utilizing Machine Learning techniques and features like the Eye Aspect Ratio (EAR), the system was capable of accurately assessing the driver's condition and alertness level. This ability to detect early signs of drowsiness is crucial for preventing accidents caused by impaired alertness, a significant contributor to road accidents.

The effectiveness of the alerting mechanism, which includes the use of sound alarms through speakers, proved to be an essential component of the system. The carefully selected alarm tones and user-friendly design ensured that the driver was promptly notified when drowsiness was detected. Safety was a paramount consideration, and the project was implemented to comply with regulatory guidelines, with a focus on non-distracting and effective alerts

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