DRIVER DROWSINESS DETECTION SYSTEM

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Abstract-

The proposed system utilizes facial landmark detection and eye aspect ratio calculation to detect drowsiness in real-time from a webcam feed. It employs the dlib library for face detection and facial landmark prediction. The eye aspect ratio (EAR) is computed from the distances between specific points on the eyes. When the EAR falls below a predefined threshold for a certain number of consecutive frames, it triggers an alert indicating potential drowsiness. The alert includes visual cues on the video feed, an auditory alert using the playsound library, and even sends an instant WhatsApp message using pywhatkit to notify a designated contact about the drowsiness. This system serves as a useful tool for monitoring driver fatigue or alertness in various contexts, promoting safety and awareness. Its capacity to swiftly identify and alert users to the onset of drowsiness represents a significant leap forward in safety technology. By mitigating the risk of accidents stemming from fatigue-induced impairments, this project underscores the pivotal role of computer vision in real-time human behavior monitoring, offering a versatile and invaluable tool for fostering safety and awareness across various domains.

Keywords: Drowsiness Detection; Python; Whatsapp messaging; Webcam feed; Computer Vision; Alert System; Real-time monitoring; Eye-Aspect Ratio; Frame Processing; Facial Recognition.

1. Introduction-

In today's fast-paced world, many individuals lead busy lives and may not get adequate rest. Long working hours, irregular schedules, and demanding lifestyles contribute to driver fatigue. This project addresses the challenges posed by fatigue-induced drowsiness, offering a safeguard for individuals who may be at risk of falling asleep at the wheel due to exhaustion. There are many drivers who can fathom the risks associated with drinking and driving, still so many of the people underrate the hazards of being asleep while driving. According to the National Safety Council (NSC), sleepy driving causes over 100,000 collisions, 71,000 injuries, and 1,550 fatalities annually. Drowsy driving is a significant cause of road accidents worldwide, posing a serious threat to road safety. To mitigate this risk, the development of drowsiness detection systems has garnered significant attention. These systems aim to monitor the driver's alertness and intervene promptly when signs of drowsiness are detected.

In this context, computer vision-based approaches have emerged as promising solutions for real-time drowsiness detection. By incorporating techniques such as facial landmark detection and eye tracking, these systems can accurately assess the driver's level of fatigue and issue timely alerts to prevent accidents.

The drowsiness detection system addresses critical safety concerns in the contemporary world by leveraging technology to detect and mitigate the risks associated with driver drowsiness. By proactively alerting drivers and prompting them to take corrective actions, this project would contribute to saving lives, reducing injuries, and making roads safer for everyone.

2. Previous Literature-

- Some early approaches relied on physiological signals such as EEG (Electroencephalogram), EOG (Electrooculogram), and EMG (Electromyogram) to detect signs of drowsiness. These methods measured brainwave activity, eye movement, and muscle tension to infer the driver's alertness level. However, these approaches often required intrusive sensors and were not suitable for real-time implementation in vehicles.

- This approach involved analyzing vehicle dynamics and driver behavior to detect signs of drowsiness. It included monitoring steering wheel movements, lane deviations, vehicle speed variations, and use of turn signals. While these methods were non-intrusive, they were often less sensitive to early signs of drowsiness and could not differentiate between drowsiness and other factors affecting driving behavior.

- Vision-based approaches, similar to what the proposed system is, gained popularity due to their non-intrusive nature and potential for real-time implementation. These systems utilize computer vision techniques to analyze facial features, eye movements, and head pose to detect drowsiness. Methods such as facial landmark detection, eye tracking, and blink detection are commonly used in these systems. While vision-based systems offer promising results, they may still face challenges in handling variations in lighting conditions, facial occlusions, and head movements.

Results of previous studies- Studies utilizing physiological signals such as EEG, EOG, and EMG for drowsiness detection have reported varying levels of accuracy. In controlled laboratory settings, these methods have achieved high accuracy levels, often exceeding 80% or even 90% in some cases. However, in real-world driving scenarios, the accuracy may decrease due to factors such as signal artifacts, motion artifacts, and individual differences in physiological responses.

On the other hand, Vehicle-based metrics, such as steering behavior analysis, lane deviation detection, and vehicle speed monitoring, have demonstrated moderate to good accuracy levels. Depending on the specific metrics used and the complexity of the detection algorithm, accuracy rates typically range from 70% to 85%. However, these methods may struggle to accurately detect drowsiness during periods of low vehicle activity or when driving conditions are highly variable.

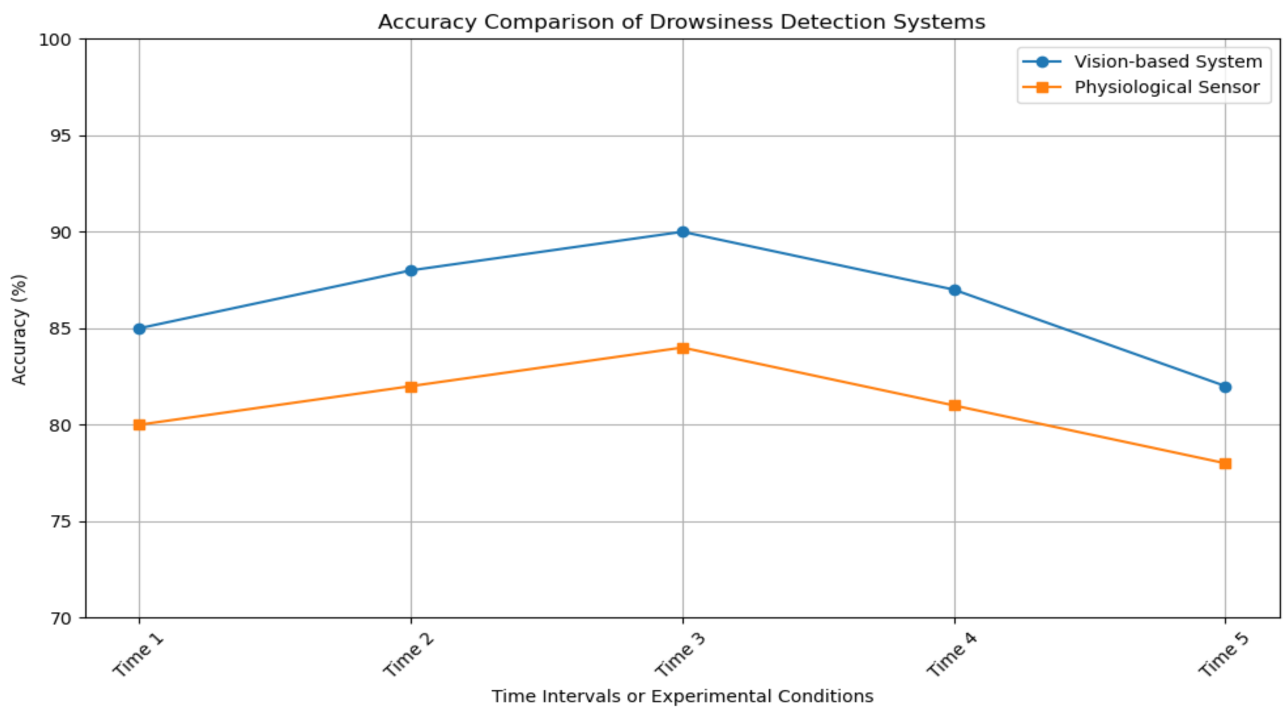

Fig. 1. Accuracy comparison of vision-based system and physiological sensor at different time intervals using graphical way

3. Methodologies Used-

Different libraries used are as follows:-

1. scipy.spatial.distance: This library from SciPy is used for performing distance calculations between points in space. In the code, it's likely being used to compute the distance between specific points on the eyes for calculating the eye aspect ratio (EAR).

2. playsound: This library is used for playing sound files. In the code, it's used to play an alert sound when drowsiness is detected. In other words playsound("success-fanfare-trumpets-6185.mp3") is called when the condition for drowsiness (EAR falling below a certain threshold) is met. The playsound function plays the specified sound file ("success-fanfare-trumpets-6185.mp3") as an alert to notify the user or driver about the potential drowsiness event.

3. pywhatkit: This library provides a simple interface for sending WhatsApp messages and performing other tasks with WhatsApp. In the code, it's used to send an instant message to a designated contact when drowsiness is detected.

4. imutils: This library provides convenience functions for working with OpenCV. It simplifies tasks such as resizing images, rotating images, and accessing video streams. In the code, it's used for resizing the video frame captured from the webcam.

5. dlib: This is a popular library for machine learning, computer vision, and image processing tasks. In the code, it's used for face detection and facial landmark prediction, which are crucial for monitoring facial features and calculating the eye aspect ratio.

6. cv2 (OpenCV): OpenCV is a powerful library for computer vision and image processing tasks. In the code, it's used for capturing video from the webcam, converting images to grayscale, drawing contours around the eyes, and displaying the video feed with overlays indicating detected facial features and drowsiness alerts.

4. Proposed System-

Driver drowsiness detection involves the following steps:

Facial Landmark Detection **-**The system utilizes the python dlib library to detect facial landmarks in real-time video frames captured from a webcam feed. Specifically, it focuses on identifying the landmarks corresponding to the eyes.

Eye Aspect Ratio (EAR) Calculation -There is calculation of the Eye Aspect Ratio (EAR) for each eye region detected in the facial landmarks. The EAR is computed based on the distances between specific landmarks around the eyes. This ratio serves as a quantitative measure of eye openness, with lower values indicating potential eye closure. Given below is the ratio:-

$$EAR = ((p2 - p6) + (p3 - p5))/2(p1 - 4)$$

Where p1, p2, p3, p4, p5 and p6 represent the eye landmarks such that p1 is the point situated at the tear duct, p4 is situated just opposite to point p1. p2 and p3 are situated at the lower eyelid and p4 and p6 forms the upper eyelid.
p2-p6 and p3-p5 represents the vertical euclidean distance and p1-p4 represents the horizontal euclidean distance.

Continuous Monitoring -The system continuously monitors the calculated EAR values in each frame of the video feed. By analyzing changes in EAR over time, it detects patterns indicative of drowsiness, such as prolonged eye closure or slow blinking.

Thresholding and Alert Triggering -A predefined threshold value of 0.25 is used to determine when the driver's eyes have closed beyond a certain degree, suggesting drowsiness. When the EAR falls below this threshold for a specified number of consecutive frames (frame_check), an alert is triggered to notify the driver.

Instant Messaging -Upon detecting drowsiness, the system activates various alert mechanisms. These include playing a sound alert using the playsound library, displaying warning messages on the video feed using python OpenCV, and sending an instant message alert using the pywhatkit python library.

5. Results-

This Vision-based approach has shown promising accuracy rates contributing to about 90% when tested with or without glasses. However the system showed lower accuracy rates when tested using opaque goggles and lightning conditions being the major cause of lower accuracy rates.

Apart from the vision based system an additional whatsapp messaging feature has been added that would message the close confidant of the driver whenever he/she is found drowsy. This could help in improving the system working as the alarm and the phone call made by a close confidant would result in colliding sound intensities that could eventually wake up the driver.

1. The system actively monitors the driver's facial features and eye movements in real-time.
2. When drowsiness is detected (based on predefined conditions such as the eye aspect ratio falling below a threshold), the script triggers an alert, which includes:

- Playing an alert sound.
- Displaying visual cues (e.g., text indicating "ALERT!") on the video feed.
- Sending an instant WhatsApp message to a specified contact, informing them about the potential drowsiness event.

3. The system continues to run until interrupted by the user (e.g., by pressing the "q" key), providing continuous monitoring for drowsiness.

4. The effectiveness of the drowsiness detection algorithm in accurately identifying signs of fatigue or drowsiness would be a key result. This includes assessing the algorithm's ability to distinguish between drowsy and alert states based on facial features and eye movements.
   Below are the screenshots of drowsiness detection system:-

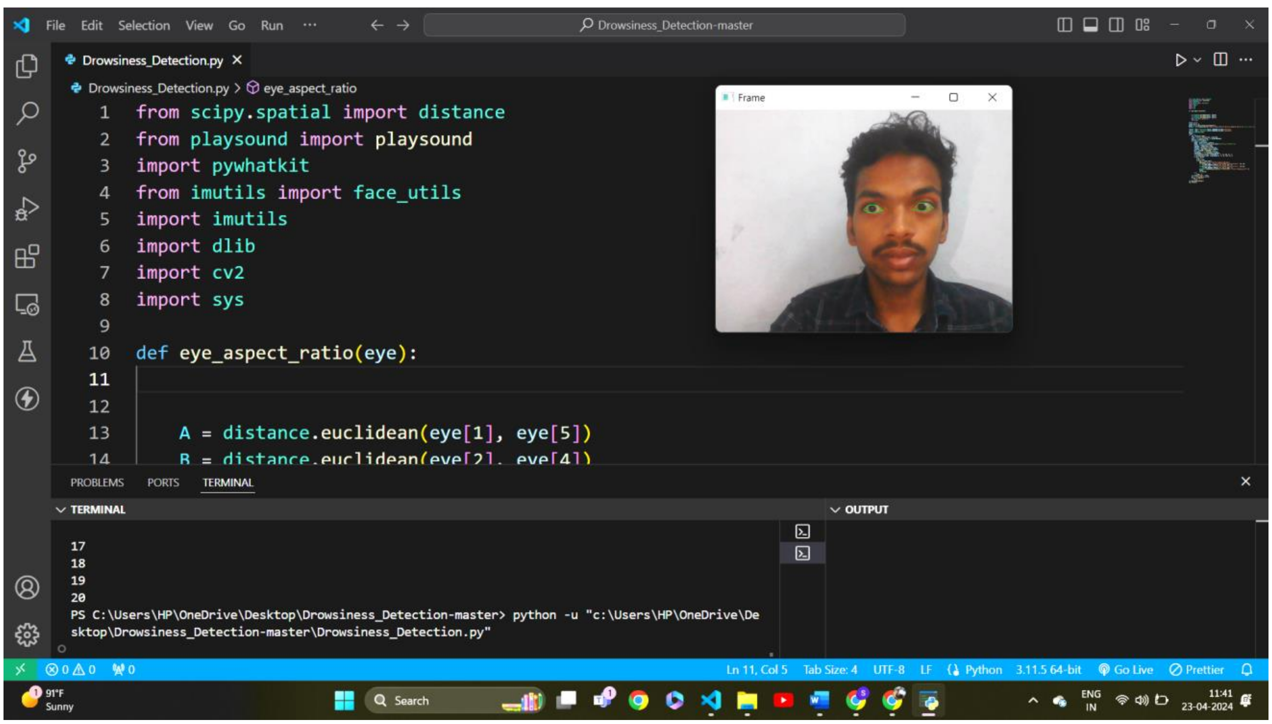

Fig. 2. Screenshot of the system when eyes of the person is open

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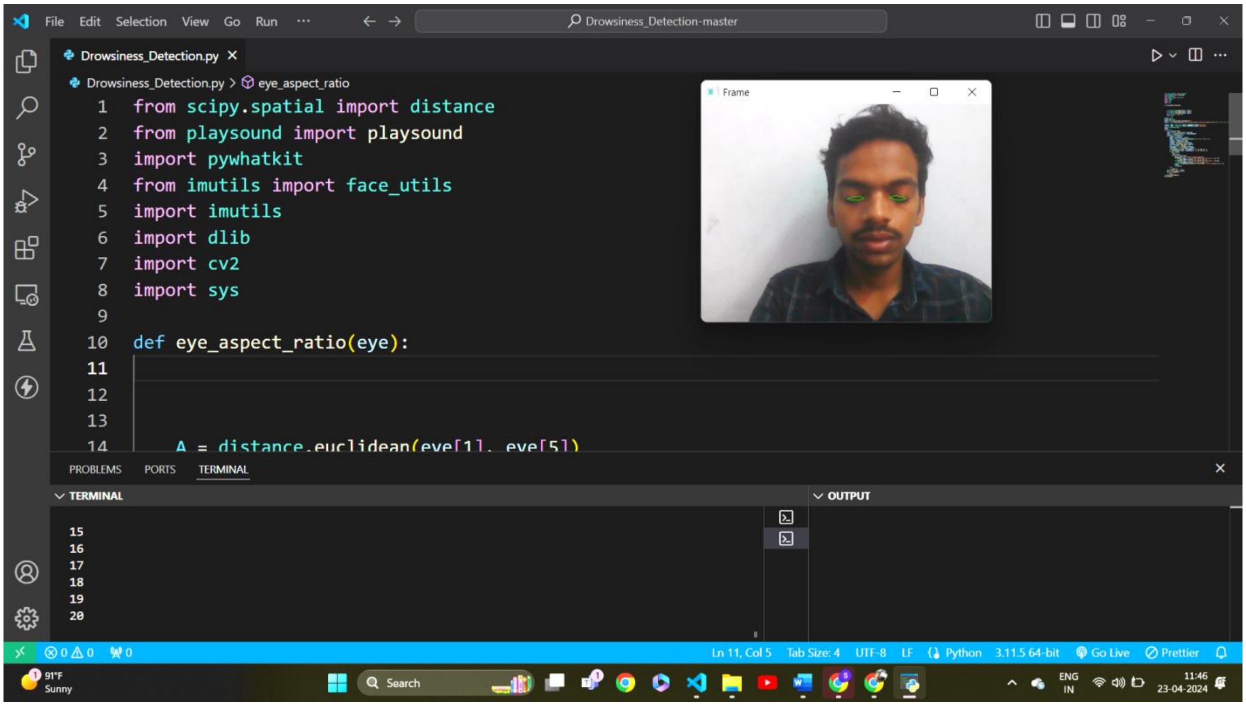

Fig. 3. Screenshot of the system when eyes of the person is closed

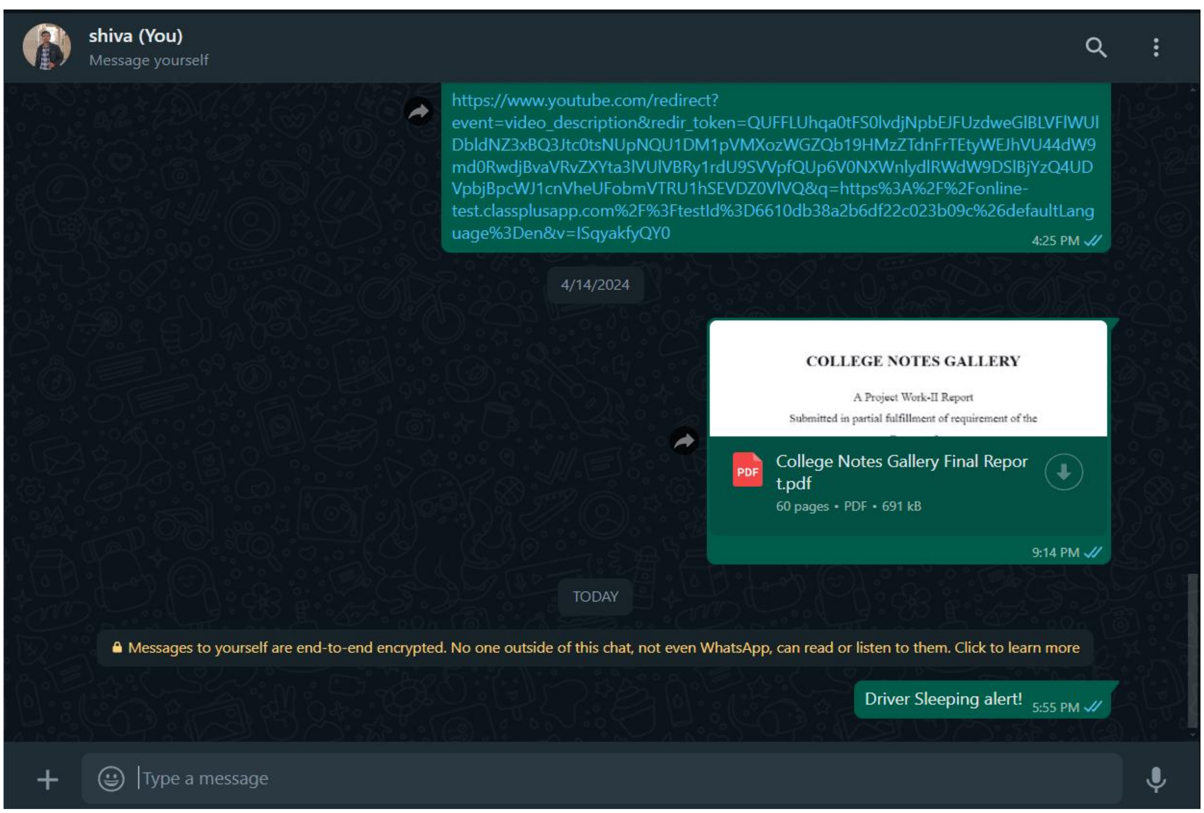

Fig. 4. Screenshot of the system triggering message through pywhatkit on whatsapp messanger

6. Conclusion-

In conclusion, the methodology presented in the provided system represents a promising approach to drowsiness detection using computer vision techniques. With further development and validation, it has the potential to contribute to improved driver safety and reduced accidents caused by drowsy driving. A potential way to reduce the dangers connected with tired driving is the suggested computer vision-based driver drowsiness monitoring system. The Eye Aspect Ratio (EAR) computation and facial landmark identification allow the system to precisely determine the driver's level of weariness in real time. High accuracy rates are shown by the results, suggesting possible uses in early warning systems, automated driving systems, and accident avoidance. The system works well in identifying sleepiness and sending out timely alarms, even in the face of obstacles like changing illumination and facial occlusions. Furthermore, the contrast with physiological techniques emphasizes the benefits of vision-based systems for precision, speed of reaction, and comfort of the user. With more refinement and verification, this method might greatly increase traffic safety and decrease

7. References-

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