

DYNAMIC DRIVER FATIGUE MONITORING THROUGH VISUAL ANALYSIS

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Abstract –Road accidents are a common issue, with India recording the highest rate of fatalities, often due to driver drowsiness. Fatigue and sleepiness are significant factors contributing to these accidents. This paper outlines a system to detect driver drowsiness by analyzing eye aspect ratio (EAR) and mouth aspect ratio (MAR). If these values exceed set thresholds, an alert is triggered, notifying both the driver and passengers, thereby enhancing road safety and reducing accident risks. Based on EAR, drowsiness for the eye is detected and based on MAR, yawning is detected. Both yawning and sleepiness cause fatigue in drivers. So, to overcome this in this location of nearby hotels is displayed when a driver is under drowsiness.

Key Words: Drowsiness Detection, Hybrid Features, Transfer Learning, EAR, MAR, Hotel locations.

1.INTRODUCTION

Driver drowsiness detection systems are designed to monitor and analyze a driver's physical or behavioural signals to assess alertness levels and identify signs of fatigue. By detecting cues like slow blinking, yawning, or erratic head movements using cameras or sensors, the system can alert the driver to take action before an accident occurs. Some advanced systems also monitor physiological signals, such as heart rate, or use machine learning algorithms to improve detection accuracy.

In today's fast-paced world, people often overlook the importance of proper sleep due to their busy schedules, which can have a significant impact on road safety. Driving while drowsy is one of the leading causes of accidents, alongside drunk driving and general negligence. The consequences of these accidents are far-reaching, affecting not only the drivers but also others on the road.

The growing number of vehicles has heightened the need for effective measures to ensure safety, with driver fatigue being a major factor in traffic accidents.

To address this, driver drowsiness detection systems have emerged as crucial technologies that monitor the driver's behavior in real-time. These systems rely on visual analysis, focusing on cues such as eye closures, yawning, and head movements to detect signs of fatigue. By using advanced computer vision and machine learning

techniques, these systems can alert drivers promptly, helping to prevent accidents.

It monitors the driver's behavior for signs of drowsiness and provides timely alerts, encouraging them to take a break before losing focus or falling asleep. This system reduces the risk of accidents, especially on long drives or for commercial drivers, ensuring safer journeys and minimizing financial and legal impacts related to collisions. Road accidents frequently result from driver drowsiness, reduced focus, and fatigue, leading to slower reaction times and impaired control. Detecting drowsiness is critical for preventing these accidents by continuously monitoring the driver's alertness and issuing timely warnings. This system helps reduce crashes, protect lives, and ensure safer driving, particularly on long trips or during nighttime driving.

Haar Cascade Classifier is a popular machine learning-based approach for face detection. It uses Haar-like features, which are patterns of pixel intensities, to identify objects like faces in images. The classifier is trained on numerous positive images (faces) and negative images (non-faces) to distinguish between them. During detection, it scans the image at multiple scales and positions, looking for areas where the features match those of a face. The method is efficient and works well for real-time face detection, commonly used in applications like security systems and camera-based face recognition.

Eye Aspect Ratio (EAR) and Mouth Aspect Ratio (MAR) are key indicators used in driver drowsiness detection. EAR measures the ratio of distances between vertical eye landmarks and the horizontal distances between the eye corners. When a driver becomes drowsy, the eyes tend to blink more frequently or remain partially closed, causing a significant drop in EAR values. By continuously monitoring this ratio, the system can detect prolonged eye closures, signalling potential drowsiness.

Also, MAR tracks the ratio of mouth opening based on facial landmarks. As drivers get drowsy, they tend to yawn frequently, which increases the MAR value. By analysing these yawning patterns in combination with eye closure detection, the system can more accurately identify signs of fatigue, providing an early warning to help prevent accidents. Combining EAR and MAR enhances the overall accuracy of drowsiness detection systems.

2.LITERATURE SURVEY

This paper proposes a hybrid drowsiness detection system combining visual features (PERCLOS) with non-visual ECG sensors, achieving a 94.5% detection rate and addressing night-time driving challenges. [1]

This paper uses deep learning techniques to detect driver drowsiness by analyzing facial features like yawning, eye blinking, and head movements. [2]

This paper proposes a drowsiness detection system using Haar classifiers to detect eye and mouth regions, focusing on eyelid movements and yawning. By processing only one eye to improve speed and reduce false detections, the system achieves an 80% performance rate, proving effective under varying lighting conditions. [3]

This paper presents a driver drowsiness detection system that uses an IR camera to track pupil movement and determine if the eyes are open or closed. If the eyes remain closed for several frames, the system detects fatigue and triggers an alarm, helping to prevent accidents caused by drowsiness. [4]

This paper investigates a driver drowsiness detection system using three methods: EEG, EOG signal processing, and image-based eye state analysis. By focusing on eye states (open, half-open, closed), the study utilizes two neural networks—single hidden layer and autoencoder—to assess the feasibility of accurately detecting drowsiness through image-based analysis. [5]

This paper introduces a module within the Advanced Driver Assistance System (ADAS) that enhances road safety by detecting driver fatigue using AI and visual information key indicator of drowsiness, allowing the system to alert the driver in real-time and prevent accidents. [6]

The paper introduces DriCare, a system designed to detect driver fatigue through facial expressions like blinking, yawning, and eye closure duration using video images. Unlike earlier approaches that required physical sensors on the driver, DriCare uses a non-invasive method by analyzing facial features captured in real-time. It employs a new face-tracking algorithm for higher accuracy and uses 68 key facial points to evaluate the driver's condition. [7]

3.SURVEY STUDY REPORT

A) Primary Reason for Road Accidents: Driver fatigue is one of the leading causes of road accidents, contributing to a significant percentage of crashes worldwide. Fatigue impairs a driver's reaction time, concentration, and decision-making abilities, often leading to delayed responses or falling asleep at the wheel. Visual analysis of eye closure, yawning, and head movements helps monitor fatigue in real-time, aiming

to reduce the risks associated with long driving hours and monotonous conditions.

B) High Death Rate: The Fatigue is a common cause of high road accident death rates, particularly on highways and at night when driving, which impairs vehicle control and causes a delayed reaction to dangers.

4.PROPOSED METHOD

The Steps involved in implementing Drowsiness Detection are:

- Start webcam
- Haar cascade Face Detection
- landmarking
- Calculate EAR and MAR
- Based on threshold show drowsiness
- If driver drowsy , show nearest hotels for rest
- Stop the webcam

Web camera monitor driver facial details continuously to take an action. When driver is in normal condition means eyes are fully opened and mouth is closed, there is no warning shown to driver. When driver is closing eyes then drowsy warning will be displayed and nearby hotels to take rest for driver will be shown by taking location details of driver. Even same case happens with yawning. When yawning is detected driver should take rest so we are displaying the nearby hotels.

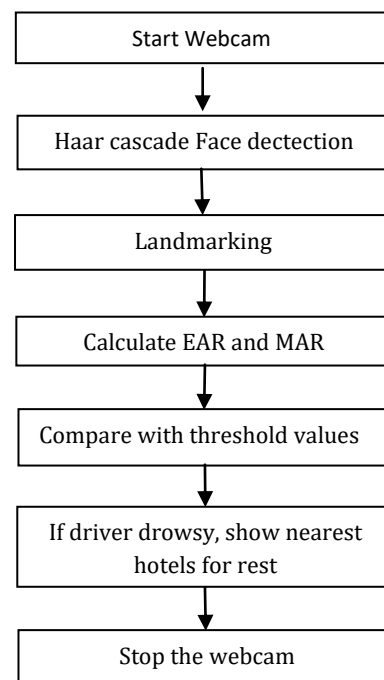


Fig -4.1: Flow Diagram for Proposed Method

Flow chart is explained in detail below,

The webcam is first turned on to continually record the driver's face in real time as part of the sleepiness detection system. The basis for finding fatigue signs that can notify the driver before drowsiness hampers driving is provided by this real-time data. The system first employs Haar Cascade, a machine learning-based method for face detection that rapidly recognizes the driver's face in every frame. By concentrating on important facial regions, Haar Cascade isolates pertinent facial features for additional examination, facilitating effective processing.

Following face detection, the algorithm marks important facial features using facial landmarking. The dlib library, which uses the iBUG 300-W dataset—a dataset intended to identify 68 different facial landmarks—is used to accomplish this. Important regions surrounding the mouth, nose, jawline, and eyes are included in these landmarks. The areas surrounding the mouth and eyes are especially crucial for detecting drowsiness because they aid in tracking certain signs of exhaustion, like yawns and eye blinks. Calculating certain metrics like the Eye Aspect Ratio (EAR) and Mouth Aspect Ratio (MAR) requires accurate coordinates, which are provided by the 68-point facial landmark model in dlib.



Fig -4.2: Face landmark Detection

Using the 68 facial landmark coordinates, the system computes the Eye Aspect Ratio (EAR) and Mouth Aspect Ratio (MAR) to track sleepiness indicators, including eye blinks and yawns. Six distinct eye landmarks—P1, P2, P3, P4, P5, and P6—are used to determine EAR.

$$EAR = \frac{\|P_2 - P_6\| + \|P_3 - P_5\|}{2 \times \|P_1 - P_4\|}$$

This formula calculates eye openness by dividing the horizontal distance across the eye by the vertical distance between the eyelids, which is averaged over two locations. The EAR is a good measure of eye blinks or extended closure brought on by weariness because it drops as the eyes close.

However, in order to identify yawning, another indication of tiredness, MAR evaluates mouth openness. The MAR formula divides the average vertical distance between three pairs of points by the horizontal distance across the mouth using the mouth landmarks P1, P3, P4, P5, P6, P7, and P8. A rise in MAR, a measure of tiredness, is brought on by yawning. A measure of eye blinks or extended closure brought on by weariness because it drops as the eyes close.

$$MAR = \frac{\|P_2 - P_8\| + \|P_3 - P_7\| + \|P_4 - P_6\|}{2 \times \|P_1 - P_5\|}$$

The system computes EAR and MAR, then compares these ratios to predetermined cutoff points. The system will display a warning if either ratio is higher than its threshold, which indicates that the driver might be sleepy. The system may use Google Maps to suggest hotels or rest areas in the area when tiredness is detected, which encourages the motorist to take a break and promotes safe driving.

When no more indications of exhaustion are found or the driver takes the required step to rest, the system ends the webcam's drowsiness detection procedure. Improved road safety for the driver and others is ensured by this cycle of ongoing observation and prompt action.

5. RESULT ANALYSIS

Here results are analysed for total three different person and observed that our proposed system is working more efficient.

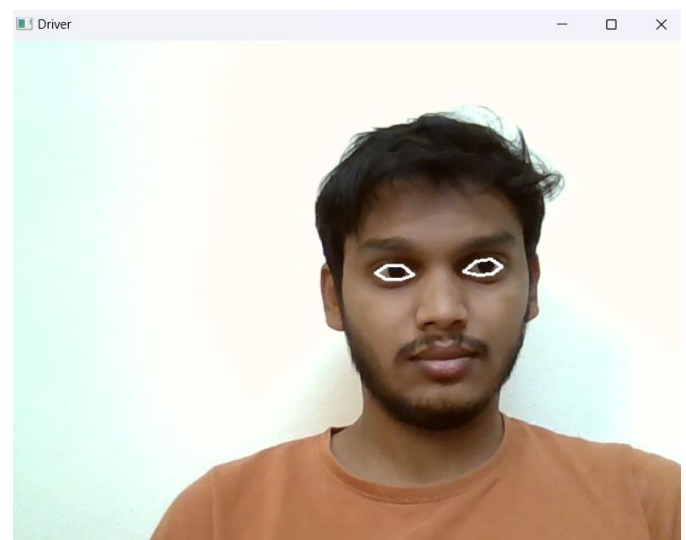


Fig -5.1: Normal condition (No instruction to driver)

Figure 5.1 illustrates that no warnings are given when the driver is in a normal, alert condition since the EAR and MAR values remain within safe bounds. In order to prevent

needless distractions, the system passively observes the driver's face data without getting involved. This guarantees constant, discrete monitoring that only triggers notifications when signs of drowsiness appear. As a result, the technology offers a driving experience that is encouraging but unobtrusive.

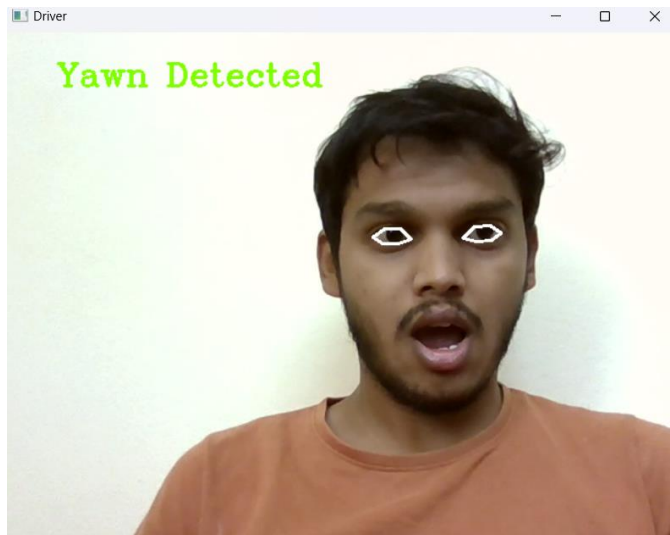


Fig -5.2: Yawn detected as mouth is open

Figure 5.2 illustrates how the system indicates a yawn and recommends motels in the area for the driver to stay at when their MAR surpasses the predetermined level. By addressing early indicators of fatigue, this alert seeks to persuade the driver to take a rest. The detection guarantees prompt action to promote safe driving.

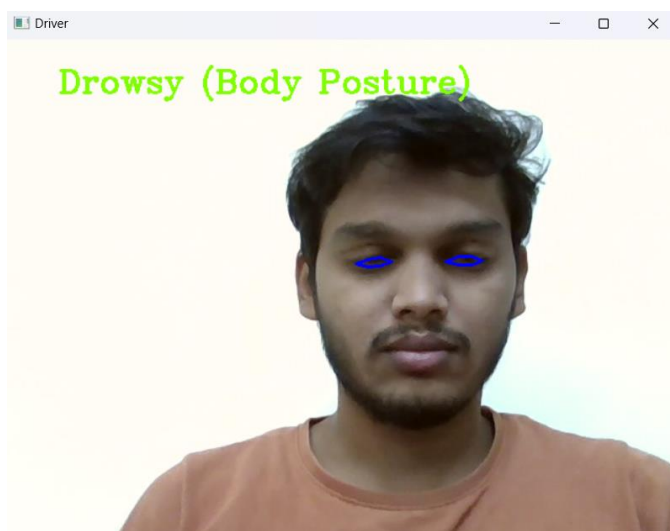


Fig -5.3: Eyes are near to close, so drowsiness is detected

The system detects tiredness when the driver's EAR drops below the threshold, which indicates close eye closing, as shown in Figure 5.3. It immediately shows a sleepiness

warning and recommends motels in the area for rest. By encouraging the motorist to stop and take a break, this alarm system improves road safety.

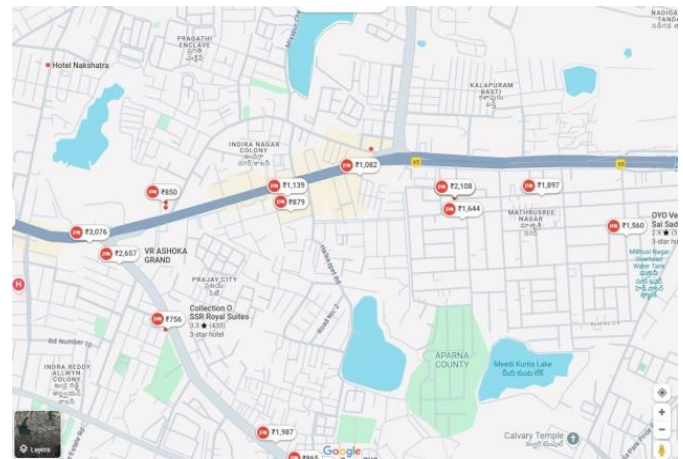


Fig -5.4: Hotels near driver

The system uses real-time location data to recommend rest stops and shows the driver hotels in the area (Figure 5.4). When sleepiness symptoms are identified, this feature kicks in, giving the driver easy ways to take a break and guaranteeing safer driving by encouraging rest when necessary.

6.CONCLUSION

Driver drowsiness is a major cause of road accidents, particularly in countries like India, where the fatality rate is alarmingly high. By utilizing eye aspect ratio (EAR) and mouth aspect ratio (MAR) to monitor driver fatigue, this system offers a reliable method to detect early signs of drowsiness. When these indicators exceed the threshold values, timely alerts are sent to both the driver and passengers, significantly reducing the likelihood of accidents. This approach can play a crucial role in improving road safety and preventing fatalities caused by drowsy driving. When driver drowsiness so our application suggests driver to take rest in nearby hotels and even hotel details are diaplyed on the screen of driver so he can choose hotel based on price, location and other details.

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