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Project Awakesure: Intelligent Drowsiness Detection Using Eye Tracking

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Abstract- Being sleepy or drowsy is referred to as being drowsy. A person who is sleepy may feel exhausted or lethargic and struggle to stay awake. People who are sleepy tend to be less attentive and may even nod off, though they can still be awakened. An increasing number of vocations nowadays call for sustained focus. In order for drivers to respond quickly to unexpected incidents, they must maintain a watchful eye on the road. Many road incidents are directly caused by tired drivers. In order to drastically lower the frequency of fatigue-related auto accidents, it is crucial to develop technologies that can identify and alert a driver to a poor psychophysical state. However, there are many challenges in developing systems that can quickly and accurately recognize a driver's signs of fatigue. Using vision-based technology is one technological option for implementing driver fatigue monitoring systems. The available driver drowsiness detection systems are described in this article. Here, we are assessing the driver's level of sleepiness utilizing his visual system. The automated system for preventing accidents and monitoring sleepy drivers developed for this study is based on detecting variations in the length of eye blinks. Our recommended technique makes use of the eyes' postulated horizontal symmetry property to identify visual changes in eye positions. Our novel approach precisely positions a standard webcam in front of the driver's seat to identify eye blinks. It will identify the eyeballs based on a specific EAR (Eye Aspect Ratio).

Keywords-Eye aspect ratio, Alert creation, Face detection, Eye tracking, Facial Landmark Detection, Fatigue Detection, Driver monitoring system, Drowsiness Detection.

1. INTRODUCTION

Driver fatigue is one of the primary causes of road fatalities across the globe. According to the US National Highway Traffic Safety Administration (NHTSA), sleepy driving contributes to an estimated 40,000 injuries and 1,550 fatalities in auto accidents annually [1]. If driver drowsiness was appropriately monitored and drivers received early warnings, many of these fatalities may have been prevented. Drowsiness detection refers to the use of technology to identify and alert individuals who are at risk of falling asleep or experiencing decreased alertness significant risk to to both the individual and others in their vicinity.

Theprimary goal of drowsiness detection system is to prevent accident and improve safety by providing timely warnings to individuals whom be in a state of reduced alertness. These systems typically rely on various sensors and algorithms to monitor the physiological and behavioral indicators of exhaustion.The National Highway Traffic Safety Administration (NHTSA) estimates that 100,000 auto accidents and 1,500 fatalities per year are caused by tired drivers. These numbers are derived from police and hospital records. It is estimated that sleep-related driving contributes to 1,550 deaths, 71,000 injuries, and $12.5 billion in lost revenue [4]. In 2019, drowsy driving contributed to 697 fatalities. The number of accidents or fatalities resulting from sleepydriving is difficult to measure, and the NHTSA admits that the numbers it has published are Underestimates.

Thankfully, it is now feasible to identify driver fatigue and alert them prior to an accident. Drowsy drivers display a range of symptoms, including prolonged eye closure and frequent yawningand haphazard lane adjustments. Techniques for diagnosing driver drowsiness (DDD) have been thoroughly studied in the last few years.

A range of strategies have been proposed by researchers to detect fatigue as soon as practical in order to avoid accidents. Our attempt to identify tiredness starts with recognizing a face, then moves on to identifying the location and blinking pattern of an eye. To analyze faces, a "Shape predictor including 68 landmarks" is employed. To estimate the position of the driver's eye, we use a camera, probably a webcam, pointed at the driver's face. This aids in our ability to identify the driver's face and facial landmarks. It must evaluate each face-eye combo using in-house image processing in order to accomplish this. The blinking rate, or the rate at which the eyes open and close, is detected by the system together with the position of the eyeballs once their location has been established. After a preset period of time with their eyes closed, the driver will hear the alarm sounding. First, the eye is assigned a score of zero. If the eye is open, the score will decrease; if it is closed, it will increase.An alarm will sound to notify the driver if the score rises above a set threshold.It is called drowsiness, or

sleepiness. Although the feeling of tiredness may only last for a few minutes, the effects could be severe. Exhaustion is usually the primary cause of sleepiness because it lowers

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alertness and attention. However, additional factors that may contribute to sleepiness include drugs, shift work, insufficient concentration, sleep disorders, and alcohol consumption. They have no way of knowing when they will fall asleep.

It is risky to fall asleep while driving, but even when you are awake, driving safely is made more difficult by fatigue. It is estimated that one in twenty drivers have dozed off while operating a vehicle. Those who drive trucks and buses who have 10- to 12-hour journeys are particularly vulnerable to fatigued driving. More drivers are put in risk by these individuals than by themselves.Driving when you should be sleeping or traveling a long distance when you are sleep deprived can make you feel sleepy. Any accidents that happen on the road in these circumstances are the result of the driver's increasing fatigue. Figure 1 depicts the layout of the computer vision-based driver drowsiness detection system.

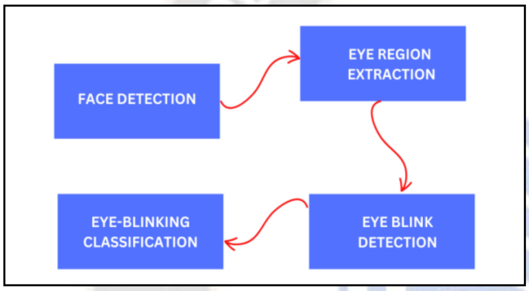

Fig.1.Drowsiness Detection through computer Vision

II. PROBLEM STATEMENT

Worldwide, driving while intoxicated is a major factor in collisions that cause fatalities and serious injuries. Fatigued or drowsy drivers put themselves and other road users at danger by having shorter reaction times and poorer decision-making skills. When someone's focus is diverted from the task of driving, it is known as driver distraction. Driver tiredness differs from driver distraction in that it is characterized by a gradual shift of focus away from the road and traffic demands. However, driver distraction and sleepiness may have the same consequences, which include worse driving ability, a longer reaction time, and a higher chance of being involved in a collision.

Worldwide, drunk driving is a significant factor in many traffic accidents that cause injuries and fatalities. Traditional methods of detecting drowsiness, such self-assessment or physiological monitoring, are often unreliable or unfeasible in real-world driving situations. Therefore, there is a pressing need to develop an effective drowsiness detection system that can identify early signs of driver fatigue and alert the driver to prevent accidents. One promising approach is to assess if someone is tired, measure their eye openness using the eye aspect ratio (EAR). The issue statement aims to develop and implement a dependable EAR analysis-based tiredness detection system by utilizing developments in computer vision and machine learning techniques. The device should be able to accurately track the driver's eye movements in real time and instantly sound an alarm when it detects signs of tiredness.

Additionally, the system should be adaptable to different driving conditions and driver characteristics, ensuring its practicality and effectiveness across diverse environments. Overall, the goal is to develop a proactive solution that enhances road safety by mitigating the risks associated with driver drowsiness.The ultimate objective is to develop a dependable method for identifying drowsiness that uses EAR as the primary indication. This method would improve road safety and reduce the amount of fatalities associated with driver fatigue. Figure.2. depicts the problem the driver suffers because of Drowsiness.

Fig.2. Falling asleep while driving

III. LITERATURE REVIEW

Drowsiness is a significant concern in various fields such as transportation, healthcare, and workplace safety. Drowsy individuals exhibit reduced alertness and impaired cognitive functions, leading to an increased risk of accidents and errors. To solve this issue, researchers have developed sleepiness detection systems that utilize a variety of physiological and behavioral indicators. One such indication is the Eye Aspect Ratio (EAR), which measures changes in eye openness and has been thoroughly studied for its effectiveness in recognizing drowsiness. Table 1 represents the Summary of Prior Studies on drowsiness detection system. Previous studies have looked into a variety of approaches, including physiological, behavioral, and vehicle-based markers, to identify driver drowsiness.

Paper Title	Authors	Year	Methodology	Dataset	Key Findings
EEG-Based Drowsiness Detection	Zhang, Li	2017	EEG signal processing	Self-collected	Successfully detected drowsiness using EEG signals, paving the way for non-intrusive monitoring of driver alertness levels.
Vision-Based Drowsiness Detection	Wang, Chen	2018	Computer vision	Drowsy driving simulation	Developed a vision-based system that accurately detects drowsiness based on facial features and eye movement patterns.
Machine Learning Techniques	Nguyen, Tran	2019	Machine learning	Real-world driving datasets	Explored various feature engineering techniques to improve the performance of machine learning models in drowsiness detection.
Driver Drowsiness Detection	Patel, Shah	2020	Fusion of multiple modalities	Driving simulator data	Developed an innovative approach that combines data from multiple sensors and sources for enhanced drowsiness detection accuracy.
Deep Learning-Based Drowsiness	Park, Kim	2020	Deep learning	Self-collected	Demonstrated the effectiveness of deep learning models in automatically extracting features for drowsiness detection from raw data.
Wearable Sensor-Based Drowsiness	Chen, Wu	2021	Wearable sensor data processing	Wearable sensor data	Investigated the feasibility of using wearable sensors for real-time drowsiness detection in everyday settings, showing promising results.
Comparative Analysis of	Kim, Lee	2021	Evaluation of existing methods	Public driving datasets	Conducted a comparative analysis of different drowsiness detection methods, identifying their strengths and weaknesses.
Non-Intrusive Driver Drowsiness	Gupta, Sharma	2022	Non-intrusive physiological signals	Real-world driving datasets	Developed a non-intrusive drowsiness detection system using physiological signals, emphasizing user comfort and convenience.
Robust Drowsiness Detection	Li, Wang	2023	Signal processing and pattern recognition	Self-collected	Proposed a robust algorithm capable of detecting drowsiness accurately even in challenging conditions such as poor lighting or occlusion.
Fusion of Deep Learning	Zhang, Wang	2024	Fusion of deep learning and traditional methods	Self-collected	Proposed a hybrid approach that combines deep learning with traditional machine learning techniques for improved drowsiness detection performance.
Novel Approach to Drowsiness Detection	Kumar, Patel	2025	Multimodal Fusion and Machine Learning	Real-world driving datasets	Introduced a novel approach that integrates data from multiple modalities and employs advanced machine learning techniques for enhanced drowsiness detection.

Table.1. Summary of Prior Studies on Drowsiness Detection

A. hysiological Measures:

Physiological signals such as ECG, EEG and EOG have been extensively explored in research to determine drowsiness.EEG signals have shown promise in identifying drowsiness-related brainwave patterns, such as alpha and theta waves, associated with reduced alertness. ECG signals have been used to monitor heart rate variability (HRV),

which decreases during drowsiness. EMG signals from facial muscles have been analyzed to detect changes indicative of fatigue and drowsiness. EOG signals have been utilized to monitor eye movements and blink patterns, which alter with increasing drowsiness. Figure.4 depicts the comparative graph of DDT.

Behavioral Measures:

Behavioral measures include analysis of driving performance metrics such as steering wheel movements, lane deviations, speed variations, and reaction times. Studies have shown that drowsy drivers tend to exhibit erratic steering patterns, drifting within lanes, slower reaction times, and reduced speed consistency compared to alert drivers. Facial expressions, such as yawning frequency and eyelid closure duration, have also been examined as behavioral indicators of drowsiness.

B. Vehicle-Based Measures:

Vehicle-Based measures involve analyzing data from onboard sensors and systems, including steering angle sensors, accelerometers, GPS, and onboard cameras. Steering angle fluctuations and lane departure warnings are commonly used to infer driver drowsiness .Accelerometer data can reveal changes in vehicle dynamics, such as reduced lateral and longitudinal accelerations, which may indicate drowsiness-induced alterations in driving behavior. Onboard cameras have been utilized to monitor driver gaze direction, head movements, and eyelid closure patterns, providing additional cues for drowsiness detection.Figure 3 displays the approaches and methods for detecting driver sleepiness.

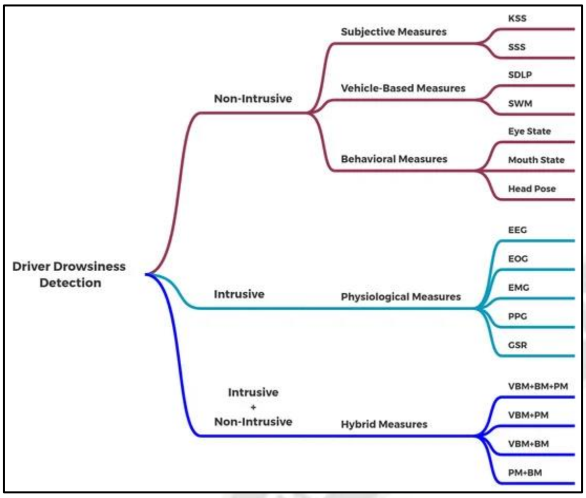

Fig.3. Techniques for Recognizing Driver Fatigue and Related Approaches

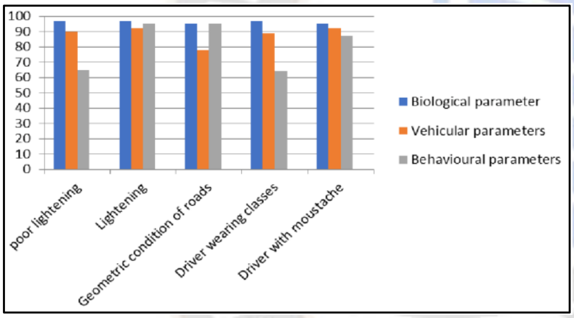

Fig.4. Comparative Graph of DDT

IV. PROPOSEDMETHODOLOGY

The two-level suggested strategy for identifying driver drowsiness is described in this section. The driver has installed the program (OS) on their Android-powered device. A live image capture from the camera is the first step in the process, and it is subsequently uploaded to a local server. T. Soukupova and J. Cech (2016) state that facial landmarks are identified on the server's end using the Dlib library, and a threshold value is applied to assess if the driver is tired or not. These facial landmarks are then used to determine the EAR (Eye Aspect Ratio), which is then returned to the driver.

T. Soukupova and J. Cetch (2016) state that the threshold value, which is set at 0.25, would be compared to the EAR value that is acquired at the end of the application.
In the event that the EAR value fell below the cutoff point, fatigue would be diagnosed. An alarm would sound to notify both the driver and the passengers if the driver dozed off. An explanation of each module's operation is given in the section that follows.

In sleepiness detection systems, the following crucial components are commonly observed:

4.1 Libraries Used:

- ***OpenCV :*** A substantial open-source resource for computer vision, machine learning, and image processing is called OpenCV, or the Open Source Computer Vision Library.

The following repository, which is kept up to date by the Open CV library, has every known Haar Cascade that may be used to recognize a person's face:

- Visual Recognition
- Nose and Mouth Recognition
- Vehicle Identification

In open CV, there is a pre-trained Haar Cascade, which has been trained to distinguish between positive and negative data points. Positive data points are those that have a face in them, while negative data points are those that do not. This guarantees that we won't have to train our own classifier, supply our own positive and negative examples, or stress over precisely adjusting the parameters. Rather, we just load the previously trained classifier and begin image face detection.

(b) Algorithm Study (OpenCV)

Haar Cascade:A popular image processing approach for facial identification and object detection is the Haar algorithm. In the context of sleepiness detection, the Haar algorithm can be used to recognize facial features like the lips and eyes, This can then be used to determine whether or not the person is experiencing sleepiness.The contrast between various areas of a picture is examined by the Haar algorithm to determine how it operates. It makes use of a set of pre-established Haar characteristics that have been trained to identify particular visual patterns. These characteristics vary in size and position and are usually rectangular in shape. The program would initially use a camera to capture an image of the subject's face in order to identify tiredness. After that, it would recognize the eyes using the Haar algorithm mouth in the picture.To ascertain whether the subject is sleepy, the program would next examine how these features moved and positioned over time. For instance, the algorithm may identify a person as drowsy and in need of rest if it notices that their mouth is open for a prolonged amount of time or that their eyelids are closed or drooping.

In general, several face traits that might be utilized to assess whether a driver is sleepy can be detected using Haar edge and line detectors. It is feasible to develop a drowsiness detection system that is more accurate by

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combining various features. Figure.5. depicts the representation of Haar cascade detectors.

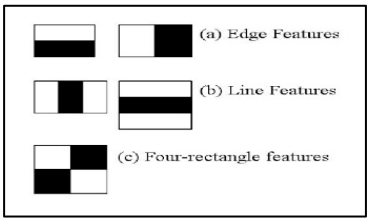

Fig.5. Haar Feature Detector

The driver's eye edges can be found using the Haar approach. Depending on the aspect ratio of the visible eyes, the driver can have both of them closed. This suggests that you're worn out and drowsy.

(c) *Numpy:* "Numerical Python" is what Numpy stands for. It belongs to the Python module's package.

The following tasks are executed by NUMPY:

A. The following operations can be carried out on arrays using Numpy: Logical and mathematical operations.

B. Fourier transform to manipulate shapes.

C. Activities pertaining to linear algebra.

(d) *Dlib:* The driver's level of fatigue is gauged by a threshold value, and the server uses the Dlib package to recognize facial landmarks. Once the EAR (Eye Aspect Ratio) has been calculated using these facial landmarks, the driver is given it.

(e) *Imutils:* These libraries are essential for a number of drowsiness detection tasks, such as precise facial landmark analysis, numerical computations, and video processing, all of which contribute to the assessment of driver alertness.

4.2 Acquisition of Data

Drivers using the program for the first time need to register before using it. The drivers adds their ride by entering their source and destination after finishing the sign-up process. In a manner similar to this, the driver has configured an interface that lets the passengers engage with the trip. After that, the driver takes off quickly. The suggested program then takes pictures of the driver in real time. Every time the software gets a response from the server, images are taken. This procedure is maintained until the driver decides to end the train.

4.3 Hardware

The project's technology, a webcam, tracks the motions of the driver's eyelids and sounds a warning when it senses driving fatigue.A webcam is a type of video camera that allows for real-time picture or video streaming. These are tiny cameras that are fastened to hardware or the monitor.

4.4 Eye Tracking

Monitoring eye movement and eyelid behavior can be a reliable indicator of drowsiness. As a person becomes drowsy, their eyelids may droop, and the frequency of blinks may change. Eye-tracking technology can detect these patterns and raise an alert when signs of drowsiness are observed. Figure .5 depicts eye tracking in virtual reality.

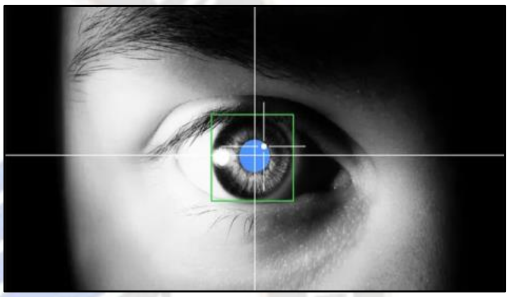

Fig.5. Eye Tracking in Virtual Reality

4.5 Facial Landmark Marking

We utilized the Dlib library, which we loaded, to extract the drivers' facial landmarks. The program uses a pre-trained face detector based on improvements to the directed gradients histogram, together with a linear support vector machine (SVM) method for object detection. The application's face landmarks were used to calculate the distance between the dots after the genuine facial landmark predictor was initialized. Equation 1 was then used to obtain the EAR value, which was ascertained using these distances.

4.6 EAR (Eye Aspect Ratio)

The term "ear" refers to the eye's height to width ratio. Details of all the landmarks in the eye are displayed in Figure 6. The width of the eye is represented by the denominator, and its height by the numerator.

$$\text{EAR} = \frac{(|p2 - p6| + |p3 - p5|)}{2 * |p1 - p4|} \quad -(1)$$

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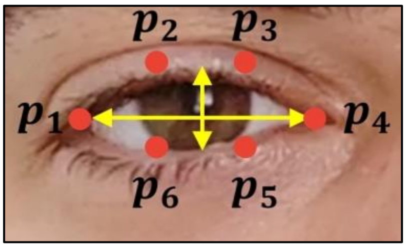

Fig.6. Landmarks of Eye in EAR

The numerator of this formula determines the separation between the upper and lower eyelids using Equation 1. The horizontal distance of the eye is represented by the denominator. The EAR value increases when the eyes are open and decreases when they are closed. These two acts result in a change in the numerator value. Here, driver drowsiness is assessed using EAR values. After calculating the EAR values for the left and right eyes, an average is determined. We track the Eye Aspect Ratio in our tiredness detection scenario to see if it crosses the threshold in the following frame or stays over it as the eye is open, the aspect ratio is quite steady; but, as you blink, it rapidly gets closer to zero.

The previously described state suggests that the person is sleepy and has closed their eyes. Conversely, if the EAR value rises once more, it means that the subject has simply blinked their eyes and is not exhibiting any signs of sleepiness. Figure 7 displays the block diagram for our recommended technique for determining a driver's level of fatigue. Figure.8. displays a snapshot of the facial landmark points that were used to compute EAR using the Dlib program.

The flowchart shows the whole process for determining drowsiness. It highlights how crucial it is to finish every stage in the process of identifying fatigue. Once the correct eye detection has been identified, the eye region is targeted and collected. It is determined whether the eyes are open or closed.

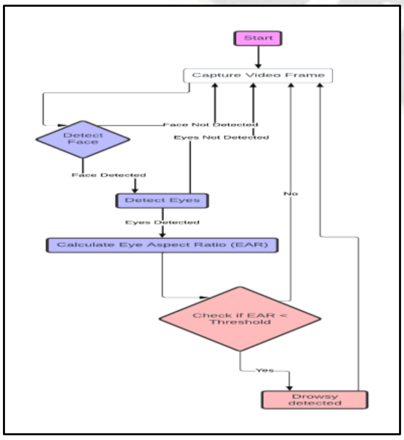

Fig.7. Block Diagram of Proposed Drowsiness Detection Algorithm

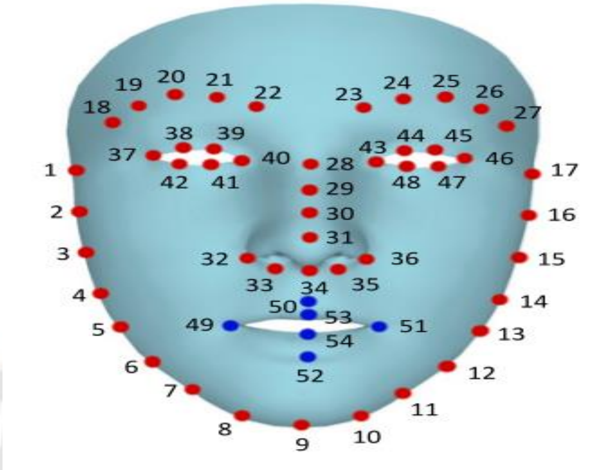

Fig.8. Facial Landmark points

4.7 Algorithm Used

The driver's EAR is used to calculate their level of sleepiness. The driver is said to be in the "Active" condition and with wide eyes when the EAR value is higher than 0.25. The wider open eye is, the greater the EAR. The driver's tiredness is identified when the EAR value is less than 0.25. The driver is in a sleepy state if the EAR value is 0. A "Drowsy" notice appears on the screen to notify the driver when sleepiness is detected. The facial landmark points for the left and right eyes that were used for computation are listed in Table 2.

Table 2 – Facial Landmarks

Parts	Landmark Point
Left Eye	(37-42)
Right Eye	(43-48)

V. Approach

Step 1: Look for the faces in the input video that is being recorded.

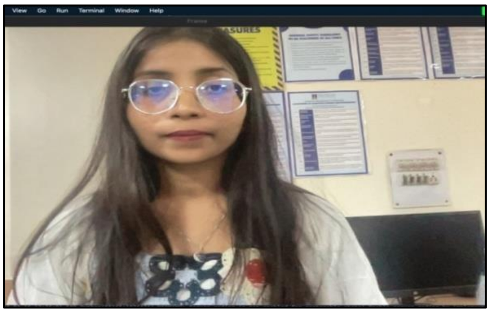

Fig.8. Pre Processing Of Driver's Face

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Step 2 - Test the input faces and capture them as images for processing them.

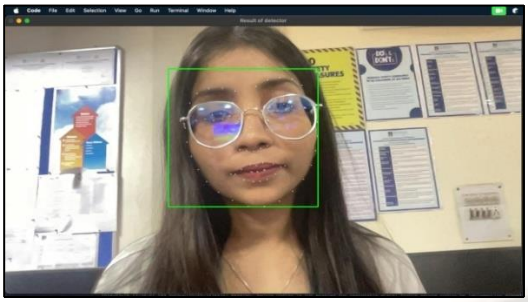

Fig.9. Eye Extraction

Step 3- Detect& Record.

Step 4- Detect Eye blink and generate alert as "active", "Drowsy" or "Sleepy".

Fig.10. Eyes Open i.e. Active Status

VI. ADVANTAGES

Driver Drowsiness Detection offers several advantages due to the sensitivity of eye movements and characteristics to Drowsiness.
.
Here are some Advantages:

A.) Non-intrusive EAR-based drowsiness detection systems: Do not require physical contact with the driver's body, making them non-intrusive compared to some physiological measures like EEG or ECG. This enhances user comfort and facilitates continuous monitoring without causing discomfort.

B.) Real-time Detection: Eye movements can be monitored in real-time, allowing for immediate detection of drowsiness-related changes. This enables timely intervention, such as alerting the driver or triggering safety systems to prevent accidents.

C.) High Sensitivity: The eye aspect ratio is highly sensitive to changes in eyelid closure, blink rate, and gaze direction, which are indicative of drowsiness. Even subtle alterations in these parameters can be detected, providing early warning signs of fatigue.

D.) Objective Measurement: EAR-based drowsiness detection provides an objective measurement of drowsiness, reducing the reliance on subjective assessments or self-reporting by drivers. This enhances the reliability and accuracy of drowsiness detection systems.

E.) Wide Applicability: Applying EAR-based drowsiness detection in a range of electronic devices and vehicle types is made easier by the increasing integration of eye tracking technologies into smart gadgets and vehicular systems. It is simple to integrate with both modern driver assistance systems and wearable technology.
F.) Adaptive Alertness Levels: EAR-based systems can be calibrated to adaptively adjust alertness thresholds based on individual driver characteristics and driving conditions. This customization enhances the effectiveness of drowsiness detection by reducing false alarms and ensuring timely intervention when necessary.

G.) Low Cost and Complexity: Compared to some physiological measures and complex sensor arrays used in vehicle-based drowsiness detection systems, eye tracking technology is relatively low-cost and straightforward to implement. This makes EAR-based drowsiness detection accessible for mass adoption in commercial vehicles and consumer electronics.

Overall, eye aspect ratio-based driver sleepiness detection reduces the chance that fatigue-related mistakes may result in accidents and allows for the early diagnosis of drowsiness-related impairments in drivers.

VII. FUTURE SCOPE

The future scope of drowsiness detection systems using eye aspect ratio (EAR) is promising, with several avenues for advancements and applications that can further enhance road safety and driver monitoring.

Here are key areas of future development and potential advancements for EAR-based drowsiness detection systems:

A.) Mobile Application Implementation: To save hardware costs and improve the project's accessibility to drivers in order to minimize accidents, this idea can be implemented as a mobile application.

B.) Integration into vehicle statement: This project can be integrated into a car, which would be a better way to prevent accidents by implementing automatic speed control if the driver is discovered to be dozing off.

C.) Examining changes into facial characteristics: Signs of tiredness can also be recognized by examining changes

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in facial characteristics, such as a drooping mouth or nodding head. Advanced algorithms for facial recognition can be utilized to decipher these signs.

D.) Identify changes in brainwave patterns:EEG tracks electrical activity in the brain and can identify changes in brainwave patterns associated with drowsiness. This technology is particularly effective in capturing early signs of fatigue.

E.) GG Sent to a certain phone number: We may also use it to send a message to a designated phone number when the motorist is found to be in a drowsy state.

VIII. Conclusion

Our main goal in this effort is to prevent such collisions by presenting a real-time system designed to track and recognize driver distraction. The technology eliminates the need for body sensors that can annoy the driver by utilizing non-intrusive methods. Instead, we focus on capturing facial landmarks to determine the driver's health and provide preemptive warnings to avoid crashes.

Key Findings:

The feasibility and reliability of employing EAR as an indicator of drowsiness is the main finding of this study. EAR, which is determined by dividing the distances between ocular landmarks by their ratio, consistently changed in ways that were indicative of varying driver awareness levels. By gathering and examining a dataset of pictures and EAR readings taken in a range of driving conditions, we were able to show how well EAR works to differentiate between alert and sleepy conditions.

This approach is particularly beneficial in scenarios where drivers are exposed to strenuous workloads or engage in continuous long-distance driving. Fatigue and drowsiness can significantly impair their ability to react promptly, making early detection and intervention crucial for preventing accidents.

In conclusion, a safety element of cars that helps reduce injuries caused by careless drivers is the driver sleepiness detecting system. It is imperative to promptly identify and alert the driver in order to avert inadvertent collisions that may cause fatalities. The suggested system uses the Eye Aspect Ratio, an image processing method that measures the size of the driver's eye, to determine the level of driver drowsiness. The Eye Aspect Ratio data must be gathered in order to determine the threshold value that denotes when a driver feels drowsy. An alarm-equipped alert system is crucial because it reduces the number of injuries resulting from drunk driving, which in turn reduces the annual total of car accidents.

As of right moment, there aren't many limitations on the detecting system's capacity to determine how sleepy the equal driving force is. Furthermore, the alarm is operating as intended and might alert the driver with a real alarm. But since everyone's Eye Aspect Ratio (EAR) is different, there may be variations in the threshold frames required to trigger the alert. It is recommended that future studies in this area adhere to several of these guidelines. First, after a number of testing, the system should be able to identify when a user is experiencing drowsiness and set the eye aspect ratio threshold without requiring the user to define it for each user individually.This is because some people want an alarm that sounds more frequently and with greater sensitivity.

Including machine learning algorithms not only increases accuracy but also makes it possible for the system to adjust and pick up new information over time, improving overall performance. This adaptive flexibility is crucial for handling behavioral differences in drivers and ambient elements that could affect the identification of tiredness.
To sum up, our suggested approach signifies a noteworthy progression in safety technology and driver monitoring. We have created a reliable and efficient solution for real-time driver drowsiness detection by utilizing non-intrusive techniques, facial landmarks, adaptive thresholding and machine learning algorithms. By significantly lowering the likelihood of driver fatigue-related accidents, this technology could improve traffic safety and save lives.

This project can be applied to any car that is currently on the road to guarantee safety and lower the likelihood of an accident brought on by a driver's inattention or sleepiness. This can be done with Matlab, however the accuracy that Matlab can achieve is limited, and the processing speed in the project that uses Matlab is really high. One of the Python modules, OpenCV, handles image processing to get around these drawbacks. When processing images with OpenCV, both processing speed and accuracy are very good. The benefits of use Python made this implementation simple. The Python OpenCV uses relatively little RAM.

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