REAL-TIME DRIVER DROWSINESS MONITORING SYSTEM

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Abstract— **On average, microsleep has contributed to around 100,000 accidents, 71,000 injuries and 1,550 deaths per year[1]. Slow facial palpation and frequent yawning are common symptoms of a drowsy driver, generally lighting conditions worsen in the middle of the night and early morning This proposed project aims to develop a driver drowsiness recognition system a based on eye-facial actions working with light sources at a distance Any system inputs. As an output device, the built-in webcam is paired with the speaker. Sleep positions can be determined using Eye Aspect Ratio (EAR) and Mouth Aspect Ratio (MAR) algorithms that generate 68 OpenCV and dlib points for facial markings in real time The flow of activity for this system is facial analysis, with eye blinks and yawn is followed by detection simultaneously live streaming the driver's face from a webcam is driven The alarm sound is sounded after the driver is detected asleep. This system is capable of detecting driver sleep in positive and negative lighting conditions with or without mirrors. The experiments conducted throughout the study showed that the exactness of the presented system ranged from 85% to 95%.**
Keywords—Facial Expressions, Yawning, Fatigue, Drowsiness, Eye Blinks.

I. INTRODUCTION

Drowsy driving has become one of the main problem for road and vehicle safety. Small sleep has been recognized as a major cause of accidents in many countries. According to the National Sleep Foundation website, the most dangerous time for drowsy driving is in the middle of the night and early morning, when light is low Common actions of a drowsy driver are blinking and yawning her eyes a lot . As a result, the driver will leave the roadway, including driving on curves and missing traffic signals. Thus, this work proposes to test the effectiveness of a designed sleep recognition system based on eye and facial behaviors in real time and to investigate its performance with different typesof lighting.

Based on a study from the Ministry of Road Transport and Highways Transport Research Wing, traffic collisions resulted in the loss of 1,53,972 lives and injured 3,84,448 individuals across India in 2021[1]. A study by the Central Road Research Institute (CRRI) found that **40%** of highway accidents occur due to drivers dozing off . India has the highest road accidents deaths in the world with an average of **426 per day** or **18 deaths per hour**.

This proposed work focuses on 68-point facial markers, specifically eyelid ratio (EAR) and eyelid ratio (MAR) as key features of sleep recognition. The program operates on a personal computer attached to a window camera as input to the driver and a loudspeaker triggered alarm sound as output Three basic methods of measuring sleep and vehicle-based, behavioral, and physiological. All of these behavioral dependencies were used in this project and were suitable to achieve the objectives where a driver sleep recognition system based on eye-facial behaviors was developed that worked in real time with lights so The advantage of this method is that It is not so intrusive that the monitored camera or device will not be placed on any part of the driver's body. Furthermore, the operation is very simple compared to other methods, as only the camera acted as the attached device. So it is easy to use even if the driver has no experience with it. Even so, the technique is limited by lighting conditions and the distance of the driver from the camera. So the proposed work used facial marking algorithm as its accuracy is good and it can run in real time despite the complexity of implementation Later as Python satisfied the need of real time processing and library processing multiple open packages, this work was done in Python to build a sleep detection system to execute programs Simplified by taking common requirements from previous projects, which trigger an alarm once sleep is detected on.

II. METHODOLOGY

The methodology followed for the development of proposed Real-Time Driver Drowsiness Monitoring System is given in detail in this section. The section consists of three main parts (i)System Design (ii) preprocessing (iii) Feature Extraction And (iv) Classification takes place.
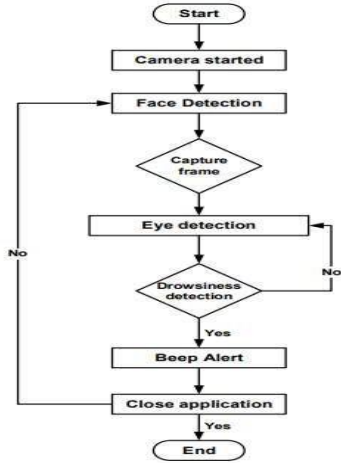
A. System Design

Fig. 1. Working Procedure of Real-Time Driver Drowsiness Monitoring System

The above DFD simplifies that how system is going to work in the real environment with the users. The very first step of the procedure is face detection through web camera which is installed in front of the face of the driver. After face detection various frames for eyes and face will be captured and drowsiness will be identified using various techniques that is given further in the paper. If the drowsiness is found then an alert signal will start beeping to aware the driver till his response and if no drowsiness is found then process will take place in a loop.[8]

B. Preprocessing

To preprocess, the coloured figure is transformed to grayscale. Then, for acquiring the eyes and mouth functions, the face turned into extracted by means of making use of Dlib's Histogram of Oriented Gradients(HOG) face detector, wherein the detector function back a rectangle's coordinates, which enclose the face area. Following that, the Dlib facial landmarks answer became utilized. This answer estimates the place of sixty eight points at the face, forming a map that represents the important thing facial structures on the face, as proven in Figure 2[2]. Thus, it turned into used to discover and extract the eye and mouth areas.
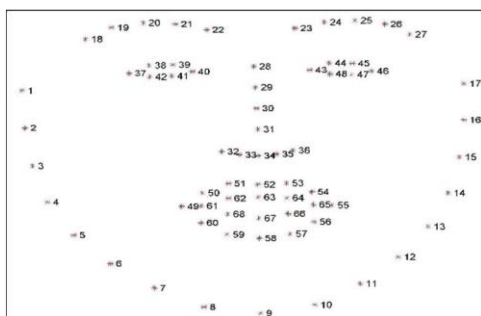

Fig. 2 Dlib facial landmarks solution map

C. Feature Extraction

In drowsiness detection systems, various human and vehicle features have been used to model different systems. However, in this work, the modeling is based on the EAR and MAR metrics along with drowsy head pose estimation [123]. The EAR (Eye Aspect Ratio) and MAR (Mouth Aspect Ratio) are two of the most commonly used metrics for detecting drowsiness in drivers.

EAR(Eye Aspect Ratio) Metrics

Rosebrook says the EAR has many features advantages over conventional imaging techniques If you want to check blink. The first of the conventional methods steps and positioning of the eye. Then, thresholding is applied to see the white eyes in the image. finally, A blink of an eye tells us that loss of the white part of the eye. In contrast, the EAR metric requires no images The characteristics of the. So it requires less memory space and timing of operations. rather it depends on the EAR type In calculating the difference between the angles Symptoms in the eye, with simple solutions. The Calculate the share excluded from the EAR metric six miles up and down to the eyemark coordinates, as shown in Figure 3 . These are the theories numbered from the left eyelid starting with p1 and rotates clockwise to p6. Rosebrook explains that all six coefficients from p1 to p6 are ambiguous. The EAR value remains the same Almost every day with his eyes open. However, if the eyes are closed, it makes a difference coordinates p3 and p5 and p2 and p6 disappear, .Since the EAR value drops to zero, as shown Figure 3 .
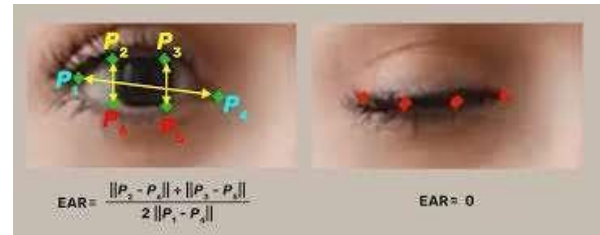

Fig. 3 EAR Change

Eye Aspect Ratio (EAR)[2] is a measure of the eye opening state. It is calculated using the distance between the vertical landmarks of the eye and the distance between the horizontal landmarks of the eye. The more the EAR, the more widely the eye is open.

$$EAR = \frac{\|p_2 - p_6\| + \|p_3 - p_5\|}{2\|p_1 - p_4\|}$$

MAR(Mouth Aspect Ratio) Metrics

The MAR is employed in identifying if an individual is yawning. Based on the facial points mentioned, the coordinates pertaining to the mouth range from 49 to 68. However, for our purposes, we'll specifically utilize eight points, denoted as points 61 to 68.

The computation relies on the MAR formula, where the top number signifies the gap between vertical points, while the bottom number represents the gap between horizontal points within the mouth. A rise in the MAR value illustrates the widening of the mouth, as depicted in figure 4[1].
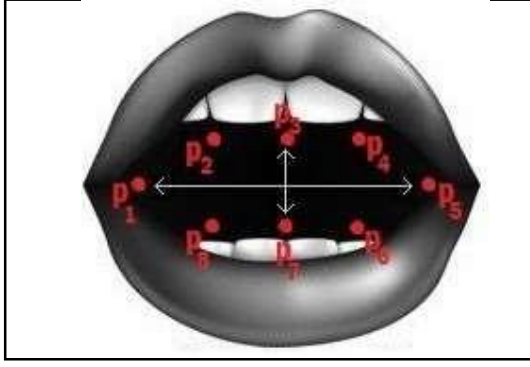
Fig.4 MAR change

$$MAR = \frac{|p2 - p8| + |p3 - p7| + |p4 - p6|}{2|p1 - p5|}$$

Classification of the output

EAR and MAR after taking face mark points The value calculated by the server is now available on android The driver was machined and compared to the threshold value with the former being 0.25(T. Soukupova and J). Sech, 2016). If the value is less than the threshold. the counter value increases, otherwise the counter value is reset It's going to zero. When the counter value reaches three, an alarm occurs Inspired on an Android device. Apart from that, another change (Sleep Counter) is maintained which counts the number generally the EAR and MAR values are less than the threshold values. Variable (Total Counter) Stores the total number of responses from server side and ECR (Eye Closure Ratio)[4] which is obtained by taking ratio of Sleep Counter with Total Counter value.

III. THEMATIC OVERVIEW

Driver Drowsiness Monitoring System is for identifying driver fatigue is a vehicle safety innovation that aids in averting accidents resulting from the driver becoming sleepy. which helps in monitoring the visual cues of the driver, such as eye movements, facial expressions, and head movements, as well as the driver's input behavior, such as steering, braking, and lane deviations. It can also take into account other factors, such as the high speed and the weather forecast conditions, to calculate the driver's tiredness index. If the system detects that the driver is too sleepy to drive safely, it can alert the driver and suggest taking a break or stopping the car.

There are different types of proposed systems, on the basis information they use. Some systems use biological-based measures, such as heart beat, skin conductance, and brain functionalities, to assess the driver's physiological state. Some systems use image-based measures, such as sensors and eye tracking cameras, to analyze the driver's visual cues. Some systems use vehicle-based measures, such as speed, steering angle, and lane position, to evaluate the driver's driving behavior. Some systems use hybrid-based measures, which combine two or more types of information, to enhance the correctness and reliableness of the detection.

Driver drowsiness monitoring systems are segments of the advanced driver assistance systems (ADAS), encompassing diverse initiatives and technologies crafted to enhance driving safety and minimize human error. Driver drowsiness monitoring systems have been installed in some cars and trucks, and have shown promising results in reducing fatigue- related accidents. However, there are still some challenges and limitations in the field, such as the variability of individual drivers, the lack of standardized datasets and evaluation methods, the privacy and ethical issues, and the practicality and usability of the system.

IV. CRITICAL ANALYSIS

Driver drowsiness monitoring systems are car safety technologies that help in escaping accidents due to fatigue or drowsiness of the driver. They are able to monitor the driver's visual signs, such as eye movements, facial expressions, and head movements, as well as the driver's input behavior, such as steering, braking, and lane deviations. They can also take into account other factors.[6] I will critically analyze the strengths and weaknesses of driver drowsiness detection systems, and discuss their implications and future prospects.

A. *Strengths*

- **Reducing fatigue-related accidents**: Driver drowsiness detection systems can help in minimizing the number and seriousness of fatigue-related misfortunes, which are a major cause of road fatalities and injuries. According to the World Health Organization, driver fatigue is the reason for up to 20% of road crashes in some countries. Driver drowsiness detection systems can alert the driver before they fall asleep or lose control of the vehicle, and prevent potential collisions anddamages.

- **Improving driver performance and comfort**: Driver drowsiness detection systems can also help improve the driver's performance and comfort, by providing feedback and suggestions on how to maintain optimal alertness and driving behavior. For example, some systems can adjust the car's settings, such as the temperature, lighting, and music, to suit the driver's preferences and needs.

- **Enhancing car safety and intelligence**: Systems that detect driver drowsiness are a component of the advanced driver assistance systems (ADAS), a collection of diverse programs and technologies intended to enhance safety while driving. Driver drowsiness detection systems can work together with other ADAS, such as lane keeping assist, adaptive cruise control, and collision avoidance, to provide a more comprehensive and integrated car safety and intelligence of the system.

B. *Weaknesses*

- Variability and complexity of driver drowsiness: Driver drowsiness is a complex and dynamic phenomenon, that can vary from person to person, and from situation to situation. There is no universal definition or measure of driver drowsiness, and different drivers may have

different levels of tolerance and sensitivity to fatigue. Moreover, driver drowsiness can be affected by several reasons, such as physical and mental health of the driver, the driving environment, the car's condition, and the task's demand.

- Lack of standardization and evaluation: There is also a lack of standardization and evaluation of driver drowsiness detection systems, both in terms of the methods and metrics used to develop and test the systems, and in terms of the regulations and guidelines that govern the systems' deployment and use. There is no consensus on what constitutes a valid and reliable driver drowsiness detection system, or what are the best practices and criteria to evaluate the system's performance and effectiveness.

V.   SYNTHESIS AND IMPLICATIONS

There are different methods and techniques for developing a system for detecting drowsiness and fatigue, depending on the type of data and features added to measure the different driver's states. Synthesis and implication are given below:

1. **Synthesis:**

- **Biological-based measures**: These methods use physiological signals from the driver, such as Electroencephalogram (EEG), Electrocardiogram (ECG), or Electromyogram (EMG), to detect changes in brain activity, heart rate, or muscle tension that indicate drowsiness. These methods are usually invasive and expensive, and may not be reliable in noisy or dynamic environments.

- **Hybrid-based measures**: These methods combine biological-based measures with other types of data, such as eye movements, facial expressions, head position, or voice quality, to enhance the accuracy and robustness of drowsiness Monitoring. These methods can use cameras, sensors, or microphones to capture various aspects of thedriver's behavior and appearance.

- **Image-based measures**: These methods use computer vision techniques to analyze the visual features of the driver's face or eyes, such as Eye Aspect Ratio (EAR), Mouth Opening ratio (MOR), Nose Length Ratio (NLR), yawning frequency (YF), blink rate (BR), gaze direction (GD), or pupil size (PS). These features can reflect the level of alertness and attention of the driver.

- **Vehicle-based measures**: These methods use information from the vehicle itself, such as speedometer readings, accelerometer values, steering angle changes, brake pressure changes, or lane departure events. These measures can indicate how much control the driver has over the vehicle and how much attention they are paying to their driving task.

2. **Implication:**

- **Safety Enhancement:** A reliable drowsiness monitoring system can significantly enhance road safety by preventing accidents caused by sleepy or fatigued drivers.

- **Driver Health Awareness:** Continuous monitoring can help drivers become more aware of their own fatigue patterns and encourage better sleep hygiene and breaks during long drives.

- **Insurance and Liability:** Insurance companies might incentivize or offer reduced rates for vehicles equipped with such safety systems, potentially impacting the automotive industry.

- **Ethical Considerations:** Balancing privacy concerns with safety measures, ensuring the system doesn't intrude excessively into the driver's privacy while effectively performing its safety function, is an ongoing ethical consideration.

VI.   RECOMMENDATION FOR FUTURE REASEARCH

1. **Real-time Monitoring and Feedback:**

a. Develop real-time monitoring systems that can provide instant feedback to the driver, encouraging them to take breaks or adopt countermeasures when drowsiness is detected.
b .Investigate the effectiveness of different feedback mechanisms, such as auditory alerts, haptic feedback, or adaptive lighting within the vehicle**.**

2. **Advanced AI algorithms and Use of Reinforcement Learning:**

a. Explore advanced machine learning algorithms, including deep learning, for more accurate and adaptive drowsiness detection.
b. Investigate the use of reinforcement learning to enable the system to adapt to individual drivers' patterns and preferences over time.

3. **Personalized Drowsiness Detection:**

a. Research methods to personalize drowsiness detection systems based on individual differences, such as sleep patterns, driving habits, and other personal factors.
b. Investigate the impact of individualized feedback and alerts on user acceptance and effectiveness.

4. **Naturalistic Driving Studies:**

a. Conduct extensive naturalistic driving studies to better understand the real-world scenarios and factors contributing to driver drowsiness.
b. Analyze the interaction between drowsiness and other variables, such as time of day, road conditions, and driver workload.

5. **Validation and Standardization:**

a. Work on standardizing evaluation metrics and testing protocols for drowsiness detection systems to facilitate fair comparisons between different systems.
b. Validate the effectiveness of the systems in diverse driving conditions and with a wide range of driver demographics.

VII. CONCLUSION

In end, the proposed driving force drowsiness detection with an alarm gadget the use of a webcam efficiently detected drowsiness counting on eye blinking and yawning with numerous lights conditions based on the outcomes obtained in the included program. The accuracy percentage presented is proper, at 95% throughout the day and 85% at night. However, there are elements that contribute to the system's inability to stumble on drowsiness, inclusive of the microprocessor used, eyeglass involvement, and camera placement. Therefore, the microprocessor used need to be like minded to keep away from the lagging problems that affect the whole system and upgrade the net digicam to a night time imaginative and prescient digicam to increase light intensity for better detection in low-mild situations.

The guidelines for future work for this proposed mission are to enhance the output audio by using producing up to 80 dB of vibrations for deaf human beings to be brought on with the aid of the alarm while drowsiness is detected and to use the Raspberry Pi to build a machine prototype that is appropriate for real-world applications. All in all, it could be concluded that this mission has successfully achieved its goals.

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