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DRIVER MONITORING SYSTEM

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ABSTRACT

A new technology called driver monitoring systems aims to reduce the number of accidents on the road that are caused by inattentive drivers. The driver's behavior and condition are tracked by the system through the use of computer vision and image processing algorithms. Our results show that the system is reliable and effective for use in real-world scenarios. providing a practical solution for a driving accident caused by a distracted motorist.

1. INTRODUCTION

Roughly 1.3 million people die from road accidents each year, making them one of the major causes of mortality globally. The majority of these collisions are the result of inattentive or distracted driving. Many things might cause a motorist to get distracted, including being sleepy or failing to pay attention to the road. A motorist who is preoccupied makes slower and occasionally unable decisions because he is less aware of his surroundings and less focused on the road. In the end, all of this increases the likelihood that the motorist will be involved in an accident.

whenever a system that continually monitors the driver and sounds a warning whenever it detects driver distraction or tiredness, this may be avoided. The goal of the Driver Monitoring System is to offer a user-friendly, affordable solution to lessen the number of accidents brought on by distracted drivers. The suggested system seeks to continually monitor the driver using computer vision techniques and to inform the driver via audio output in the event that distracted driving is discovered. There is hope that the technology would significantly lower the amount of traffic accidents. Documenting the creation and assessment of the Driver Monitoring System is the goal of the research study.

Documenting the creation and assessment of the Driver Monitoring System is the goal of the research study. The purpose of this study is to investigate current technologies and solutions for driver monitoring systems, as well as computer vision methods utilized in the development of the suggested system and its effectiveness and usability in real-world scenarios. Additionally, user reviews and contrasts with current systems will be displayed. The possibility for more study in this area will also be presented in the report.

2. LITERATURE SURVEY

A. Overview of current technologies and solutions for driver monitoring system:

Cameras are a popular piece of DMS equipment that can take pictures and assess a driver's behavior, including head posture, tiredness, and yawning.

Biometric sensors, which may identify indicators of driver stress and weariness, such as heart rate monitors and electroencephalography devices, are another type of technology utilized in driver monitoring systems.

Additionally, some businesses have created customized solutions for driver monitoring systems that can follow an individual's eyes, identify the direction in which they are gazing, and count the number of times they blink their eyes—a sign of sleepiness. All things considered, there are many different technologies and solutions for driver monitoring systems; each has advantages and disadvantages of its own. The DMS application's use case and unique requirements determine the technology to be used.

B. Limitations of existing systems:

1. **Cameras**: Inadequate illumination, reflections, and other environmental elements can have an influence on cameras, reducing their accuracy. Because they take pictures of drivers' faces, they may potentially cause privacy issues.
2. **Biometric Sensors:** Biometric sensors can be expensive, and installing extra hardware in the car is necessary. External variables like the driver's attire and skin condition may also have an impact on them.
3. **Machine Learning Algorithms**: For machine learning algorithms to be taught efficiently, a substantial amount of data is needed. Bias in training data may also have an effect on them, which might reduce their accuracy.
4. **Eye-Tracking technology:** Contact lenses or spectacles worn by drivers can impede the accuracy of measurements made with eye tracking equipment. External elements like strong sunshine or reflections on the windshield may also have an effect.

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C. Review of relevant computer vision techniques for driver monitoring system:

Because computer vision techniques are utilized to evaluate driver behavior and status, they are essential to the Driver Monitoring System. The following computer vision methods are pertinent to the driver monitoring system.

1. **Face Detection and Recognition:** The driver's identity is established and facial traits including head posture and eye movements are monitored by face detection and recognition. This can be used to identify distracted or sleepy behaviors.
2. **Eye Tracking**: Eye tracking measures the direction and motions of a driver's gaze, which might reveal information about their degree of attention and attentiveness. Additionally, it may be used to identify symptoms of weariness, including excessive blinking.
3. **Head Pose Estimation**: Drivers' head motions are tracked using a technique called Head Pose estimation, which can provide information about how engaged they are with the road. It can also be used to identify indicators of fatigue or distraction, such drifting off.
4. **Facial Expression Analysis:** Changes in the driver's facial expression, such as yawning and frowning, can be identified by facial expression analysis. This can be used to identify symptoms of stress or exhaustion.

3. PROPOSED METHODOLOGY

A. PROPOSED SYSTEM

The primary goal of the system is to identify driver distraction by continually analyzing the driver's facial expression using the facial landmark detection technique. The following are the project's goals:

1. Face recognition from the incoming video feed
2. Eye closure detection using the eye aspect ratio (EAR) estimate method.
3. Estimating the mouth aspect ratio (MAR) to detect yawning.
4. To notify the motorist if they are found to be distracted.

B. METHODOLOGY

The following actions are part of the driver monitoring system project's suggested methodology:

1. **Facial landmark Detection:** Many computer vision applications have used facial landmarks, including head posture estimation and blink recognition. The procedure of identifying a facial landmark involves two steps: first, the collected image's face region is identified, and then the face's important characteristics are determined.

Fig 1. 68 Facial Landmark Visualization.

2. Detection of Closed Eye: The face is continually gathered via a web camera, and the opencv environment is used to evaluate the obtained frames. Applying the facial landmark detector from Dlib. Key aspects of the face are removed once it has been identified. both ocular areas In the frame, landmark indices are marked. The eye aspect ratio is displayed in the frame and is continually computed. When the eyes are opened, the EAR value will be elevated. When they are closed, the EAR value will decrease. Eye closure is identified when the EAR value drops below a certain level. When the alarm senses that the driver's eye is closing, it sounds to warn the driver.

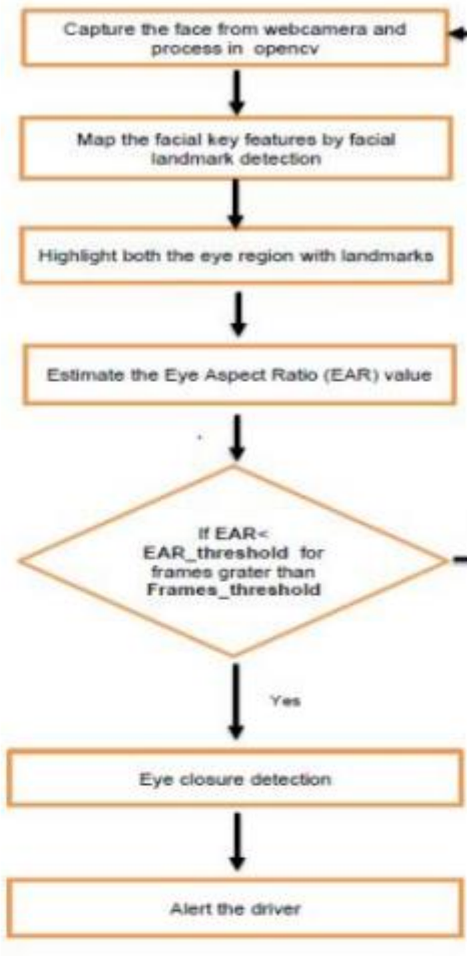

Fig 2: Process Flow of Eye Closure Detection

3. Eye Aspect Ratio: Eye aspect ratio, or "EAR," is a word that is commonly used to measure fatigue as well as the timing and rate of blinks in the left and right eyes.

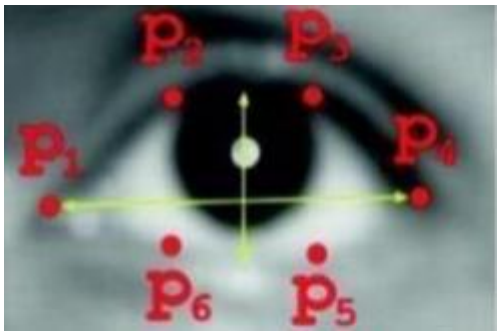

Fig 3: Landmarks when eyes open

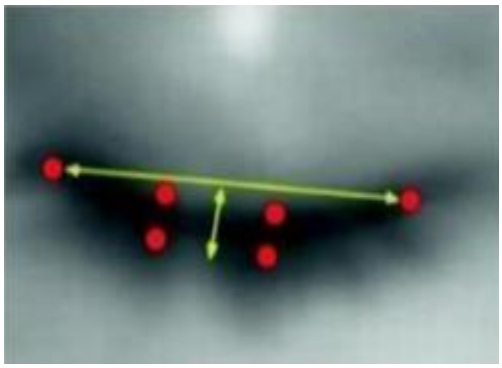

Fig 4: Landmark when eyes closed.

The Eye Aspect Ratio (EAR) formula is given by:

The numerator of this equation calculates the distance between vertical eye landmarks. Correctly weighting the denominator as there is only one, but the denominator determines the separation between the horizontal and vertical eye landmarks by taking into account two sets of vertical points and one set of horizontal points.

$$EAR = \frac{|p2-p6|+|p3-p5|}{|p1-p4|}$$

4. Yawn Detection: The face is captured via a webcam and analyzed in an OpenCV environment. The mouth landmark indices are located and indicated. The Mouth Aspect Ratio (MAR) is estimated; when the mouth is closed, the MAR value will be lower. It will identify the yawn. When yawning is detected, the warning mechanism will be activated.

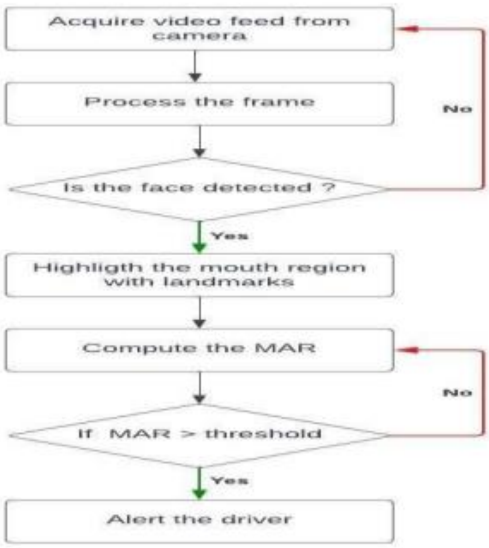

Fig 5. Process of Yawn Detection

5. Mouth Aspect Ratio: Mouth distance, or MAR, is the mouth's distance divided by its vertical to horizontal ratio. One horizontal distance and three vertical distances are considered in the MAR estimate. When the driver yawns, the horizontal distance decreases and the vertical distance increases. When someone yawns, their MAR value is assumed to be higher than 0.43 for faithful detection; MAR values below this level are disregarded.

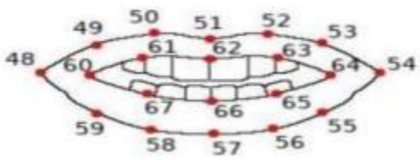

Fig 6. Landmark indices for mouth region

As the mouth opens, the horizontal length will decrease while the vertical lengths grow. Consequently, the MAR value will increase upon yawning.

4. RESULTS AND DISCUSSION:

A. RESULTS

1. Facial Landmark Detection Output: The suggested work's first step is to identify the face's landmarks. In order to do this, the primary characteristics of the face are identified using the Dlib facial landmark detector. Figure 7, which displays 68 facial markers surrounding the mouth and eyes, is the resultant output.

2. Eye Closure Detection Output: When eyes are opened, the EAR value increases, as seen in figure 7. On the other hand, the EAR levels start to drop when the eyes are closed. The ear value threshold of 0.2 is used to measure tiredness; if the ear value is below this level, it suggests that the driver is either blinking or sleeping lightly. An alarm is set off to notify the driver if the eyes remain closed for longer than 20 consecutive frames. As seen in figure 8

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3. EAR Response: Using the matplotlib package, a graph is created to show the relationship between the frames and the corresponding EAR value. In Figure 10, the graph is shown. The EAR value of each frame is appended to an empty list that has been established in order to form the graph. Consequently, the list includes the EAR values for each frame. The graph illustrates how a blink differs from a light slumber. For a minimum of 20 consecutive frames, the EAR must stay low in order to detect tiredness.

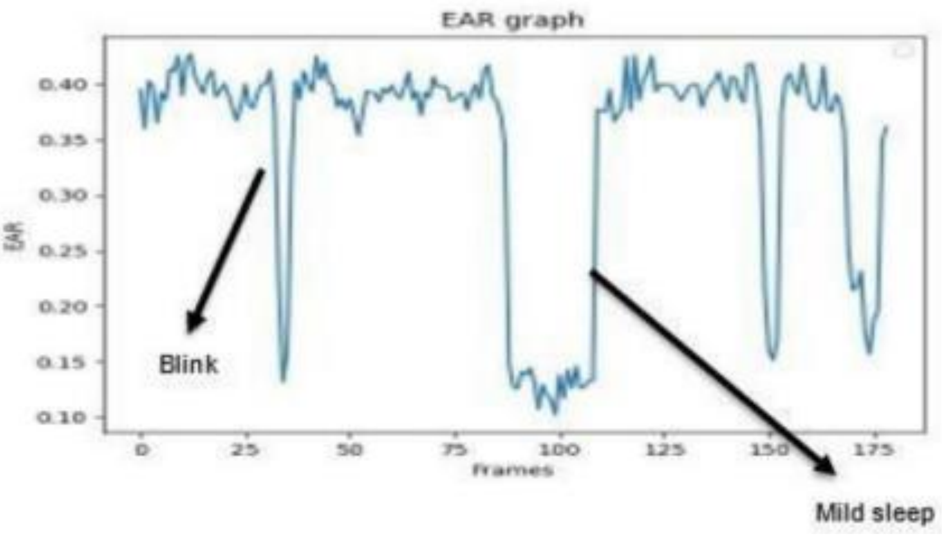

Figure 9: EAR Plot

4. Yawn Detection: The MAR value increases when the mouth is opened, whereas the comparable value decreases when the mouth is closed. There is a threshold value of specified to identify yawning. The motorist is alerted when the MAR value exceeds this level, indicating that they are yawning. The output of the apparatus when the mouth is opened is shown below.

Accuracy of eye and yawn detection: To determine the accuracy of the eye closure and yawn detection module, the system is opened and a sample of four persons is collected. To determine the accuracy of the system, each participant is requested to yawn and simulate being sleepy. The related output from the system is then recorded.

Sample Number	**No. of Times Drowsiness imitated**	**No.** distracte**of times drowsiness**The stu **detected**	l driver. **Accuracy** dy lso highlights
1	30	29 to the dri	ver 96.66%
2	30	28 Overall,	the study demonstrates 93.33%
3	30	29	96.66%
4	30	Future w 28	ork could 93.33%

.

Fig 11: Accuracy of drowsiness detection

The accuracy of sleepiness detection is determined by:

$$\text{Accuracy [Eye Closure]} = \frac{\textit{no.of blinks detected}}{\textit{no.of times blinked}} \text{ X } 100\ \%$$

Sample Number	No. of times yawned	No. of times yawn detected	Accuracy
1	30	29	96.66%
2	30	27	90.00%
3	30	29	96.66%
4	30	28	93.33%

Fig 12: Accuracy of yawn detection

The accuracy of the Yawn Detection is determined by:

$$\text{Accuracy [Yawn detection]} = \frac{\text{no.of yawns detected}}{\text{no.of times yawned}})$$

The accuracy of Yawn Detection is: 94.16%

B. DISCUSSION

The study's findings demonstrate the efficacy of the suggested technique in identifying distracted drivers and providing them with real-time feedback. The device uses a machine learning model that has been trained on thousands of face photos to analyze the driver's facial landmarks in real-time. In order to provide the best performance and safety, it is crucial to take into account a methodology and algorithm that can continuously monitor the driver at a high frame rate. This methodology is a promising approach for developing driving monitoring systems, and it can help prevent accidents. entail adding more modules, such as those for gaze and head attitude detection, in order to collect more information needed to identify distracted drivers.

5. CONCLUSION

In summary, the real-time driver monitoring system that was previously presented has potential in terms of both speed and functionality. The system has been tested in a variety of conditions, and it has performed consistently in each case. But rather than employing a threshold for distraction. It is suggested that a continuous scale driver distraction detection system be created in order to continually monitor the driver's level of attention. The technology may monitor the amount of distraction continually and, when it reaches a certain threshold, create a trigger signal to operate the vehicle's hydraulic braking system. This would enhance road safety by reducing the number of accidents brought on by distracted drivers. To improve precision and dependability, further study may be conducted.

The method for detecting driver attention using eye blinks and yawns that has been described has demonstrated promising results in terms of reliably identifying individual distraction. Its ability to perform effectively in low light conditions and its excellent accuracy rates of 94% and 95% for eye blink and yawn recognition respectively make it a dependable choice for a driver monitoring system. Its usefulness for usage in a variety of situations is further enhanced by its continuous face identification and real-time functioning. Overall, by offering a dependable method of identifying driver attention and averting accidents, the technology has the potential to greatly improve road safety.

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We would like to thank everyone who helped this project come to fruition and for their contributions.

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6. FUTURE SCOPE

Future development and extension of the driver monitoring system might focus on the following areas:

1. Multi-Person Detection: The existing approach is intended to identify a single person's distraction. It can be expanded in the future to simultaneously identify numerous people.

2. Integration with other sensors: To increase the accuracy of the driver distraction system, the system may be improved by connecting it with other sensors such an EEG sensor and a heart rate monitor.

3. Machine Learning: To increase the system's accuracy, machine learning techniques can be applied. via feeding the algorithm new data to train on. It is capable of picking up on more subtle indicators of distraction. resulting in improved distraction detection and avoidance.

4. Integration with driverless vehicles: To provide an extra degree of security, the system may eventually be integrated with autonomous vehicles. The technology can determine a passenger's level of distraction and take over if needed.

5. Facial expression recognition: Additional facial expressions, such rage, despair, and happiness, may be detected by the system. This can also assist us in gaining further insightful knowledge on the driver's mental state while operating the car.

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