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Drowsy Driver Detection System

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Abstract: ***Drowsy driver detection system is a safety technology designed to identify the potential signs of fatigue or drowsiness of the driver to prevent accidents caused as a result of not being alert. It is a significant risk factor for traffic accidents which has led to thousands of accidents, injuries, and fatalities each year. In this system we have used some techniques to monitor the driver's behavior or state. This involves tracking facial features, eye movements or blink patterns and yawning. The system identifies signs of fatigue, such as slow eyelid closure, increased blink duration and yawn which often indicate drowsiness. As technology advances, these systems are becoming more accurate, efficient and integrated with other vehicle safety features. The continued development of drowsy driver detection technology holds significant promise for reducing traffic accidents and improving overall road safety.***
Keywords: Drowsiness, alert, fatigue, fatalities, traffic, accidents.

I. INTRODUCTION

Driver drowsiness detection is a safety technology which is aimed at preventing accidents caused by drowsy or fatigued drivers. There are many research and studies that suggest there is a significant number of road accidents caused as a result of driver fatigue or drowsiness. [4] This leads to gradual decline in alertness in drivers, posing a serious hazard to road safety. To meet this challenge, technologies are being developed to detect and counteract driver drowsiness. This technology continuously monitors the driver's behavior through a camera being placed in front of them. [13] The camera captures the real-time video, which is then analyses for detecting drowsiness of the driver and give timely alerts when needed. [9] When the system detects signs of drowsiness, it triggers an alarm to warn the driver, prompting him to take immediate action such as taking breaks. [11] Thus, preventing the potential accidents caused by drowsy driving. The main aim of this technology is to intervene before the driver's fatigue leads to increase risk of injuries and fatalities in accidents.

II. PROJECT OBJECTIVES

The objectives of the Drowsy Driver Detection System project include:

1) To develop a non-intrusive system that monitors the driver without any intervention while driving.
2) To monitor the driver's behaviour with real-time capturing video and then analyzing for drowsy detection.
3) To develop the system on behavioural measures based on two parameters Eye Aspect Ratio (EAR) and Mouth Opening Ratio (MOR) with the help of shape predictor facial landmarks.
4) To warn the driver timely to reduce the risk of accidents.

III. MOTIVATION

Driver Drowsiness poses a serious threat to road safety, contributing the increased number of road accidents all over the world. Researchers has verified the relation between the driver drowsiness and road accidents. This system aims to monitor the driver's behaviour by implementing an adaptive solution in combating the dangers of driver drowsiness, thereby enhancing safety. By using advanced technologies such as machine learning and computer vision, the system can analyses multiple parameters, including driver fatigue levels, facial expressions, head movements, etc. The ultimate objective of this project is to reduce the risks of fatigue related accidents and create a safer driving environment by addressing the root cause for such accidents.

IV. LITERATURE REVIEW

A brief description of the contributions is given below:

1) N. Parmar in "Drowsy Driver Detection System": This paper shows the development and design of a non-intrusive system for Drowsy Driver Detection System which uses machine vision with a monochrome security camera to monitor the eyes, which checks for 5 consecutive frames.

The system also detects when eyes cannot be found and operates effectively under varying lighting conditions, achieving its primary objective of unique eye detection for enhanced safety.

2) V. Saini and R. Saini in "Driver Drowsiness Detection System and Techniques: A Review": In this review paper they discussion on how the drivers neglect taking regular breaks during long journeys and have fatigue which leads to drowsiness and how they fail to recognize it; drowsy driving surpasses the dangers of drinking and driving; it further discusses the how a driver is warned and directed to nearby service areas through COMMAND navigation system, aiming to mitigate the risks associated with driver fatigue and enhance road safety.
3) A. K. Biswal, D. Singh, B. K. Pattanayak, D. Samanta, and Ming-Hour Yang in "IoT-Based Smart Alert System for Drowsy Driver Detection": This paper shows the development of a robust alert system to avoid accidents with certain techniques such as Video Stream Processing (VSP) which is analyzed by eye blink concept through an Eye Aspect Ratio (EAR) and Euclidean distance of the eye and face landmark algorithm is also used. Upon detecting driver fatigue, this module issues a warning message, including collision impact and location details, communicated through a voice interface via the Raspberry Pi monitoring system.
4) A. Sahayadhas, K. Sundaraj and Murugappan Murugappan in "Detecting Driver Drowsiness Based on Sensors: A Review": In their review paper they discuss how in recent years driver drowsiness has become a significant factor of road accidents leading to several injuries, fatalities and economic losses; they have discussed about the various measures to determine driver drowsiness: (1) vehicle-based measures; (2) behavioural measures and (3) physiological measures. They provided a detailed study on these measures, issues associated with them and the enhancements to make a robust system.
5) C. Murukesh and P. Padmanabhan in "Drowsiness Detection for Drivers Using Computer Vision": This project proposes a non-intrusive drowsiness detection system using Computer Vision and OpenCV, implemented on Linux environment. It uses a camera with night vision capabilities also. It considers the parameters such as face and eye detection, blinking, eye closure, and gaze. The system aims to efficiently reduce road accidents with a cost-effective approach.
6) M. Jain, B. Bhagirathi, Sowmyarani C N in their paper" Real Time Driver Drowsiness Detection using Computer Vision": The proposed system aims to reduce accidents M caused by drowsy driving by analysing facial features and gestures. It uses Eye Aspect Ratio for detecting drowsiness in eyes and a YAWN value for yawning detection and triggering voice alerts through an eSpeak module to enhance road safety and prevent fatalities.
7) Md. Y. Hossain and F. P. George in "IOT based Real-time Drowsy Driving Detection System for the Prevention of Road Accidents": This paper proposes a non-intrusive, real-time system for detecting drowsiness. It uses the eye closure ratio as a parameter for drowsiness detection and alerting the driver with a buzzer. Implemented with a Pi camera, the system is incorporated using Raspberry Pi technology.
8) Wei Zhang, Bo Cheng, Yingzi Lin in "Driver Drowsiness Recognition Based on Computer Vision Technology": This paper proposes a non-intrusive drowsiness recognition method for drivers using eye-tracking and image processing techniques. Six measures, including eyelid closure and blink frequency, are combined using Fisher's linear discriminant functions, achieving 86 percent accuracy in driving simulator experiments with six participants.

V. METHODOLOGY

The methodology for the Driver Drowsiness Detection System involves a step-by-step process leveraging computer vision techniques and facial gesture analysis.

1) *Face Landmark Detection:* In the initial step the camera captures the real- time video of the driver. The system uses OpenCV and Dlib libraries for facial detection and localization. [10] Facial landmarks, including eyes, eyebrows, lips, nose, and jawline, are identified for subsequent analysis through shape predictor facial landmark detection. [3]

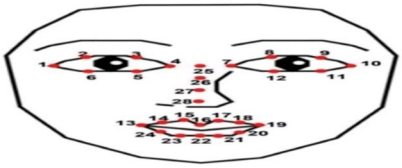


Fig: Face Landmarks

2) *Eye Detection:* To detect drowsiness, the system focuses on eye-blinking patterns. Eye Aspect Ratio (EAR) is used to calculated the Euclidean distances between specific facial eye landmarks. [12] A decreasing EAR (Eye Aspect Ratio) is indicative of drowsiness, capturing changes in eye openness that occur when a person is active, getting drowsy or falling asleep.

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

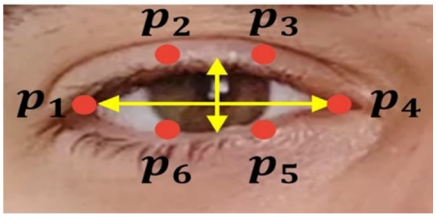


Fig 2 : Eye Landmark

3) *Yawn Detection:* Yawning is considered another sign of driver fatigue. MOR (Mouth Opening Ratio) or Lip Distance is calculated using the distance between specific lip landmark points. [1]

The Mouth Opening Ratio (MOR) is defined as the ratio of lip distance, indicating whether the driver is yawning. A maximum MOR signifies an open mouth, and a decreasing ratio over time suggests normal conditions. [6]

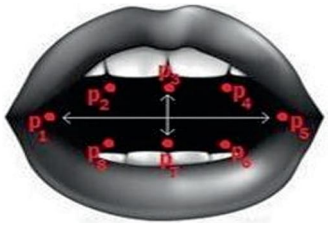


Fig 3: Mouth Landmark

VI. IMPLEMENTATIONS

The proposed system uses shape predictor to detect objects in real time, in this case, the face and eyes of the driver. The model uses libraries such as OpenCV, Dlib, NumPy, Imutils to facilitate the working of the software and the input\output used. The initially defines four constants- EYE-AR-THRESH for the eye aspect ratio and MOUTH-AR-THRESH for the mouth aspect ratio to indicate a blink and yawn and for the number of consecutive frames the system will monitor to detect drowsiness. [8] Now, we initialize the Dlib's based face detector and then create the facial landmark predictor using the facial features data provided in the shape-predictor- 68-face-landmarks.dat file.

Now we starts with real-time capturing video of the driver where the face of the driver is detected along with the landmarks; if the face detection is not done it goes back to capture the real-time video of the driver and if the face detection is a success then it moves forward to eye detection and yawn detection and then EAR (Eye Aspect Ratio) and MOR (Mouth Opening Ratio) is calculated respectively which is basically the Euclidian distance between the landmarks on each eye and the mouth. [14] When both the calculations are done the next step is to check whether the EAR and MOR calculated is above or below the threshold value (already considered) which results in either yes or no in both the cases. [2] The following points shows the various possible outcomes by combining the results to get an accurate result.

For EAR:

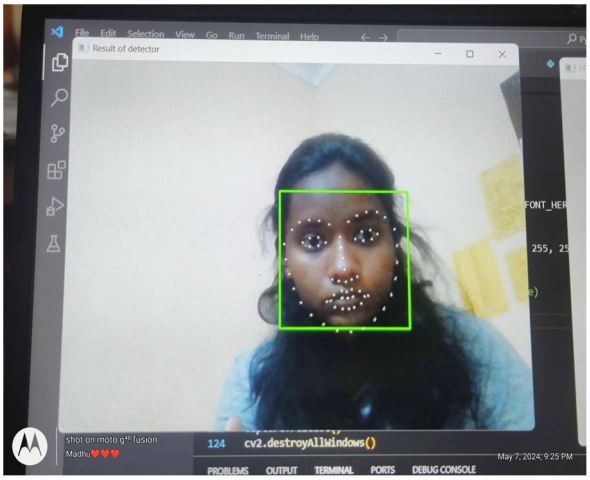
1)"Yes": EAR is below the Threshold Value.

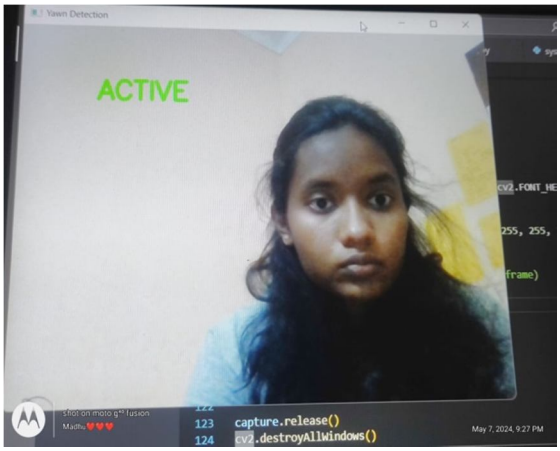
2)"No": EAR is above the Threshold Value.

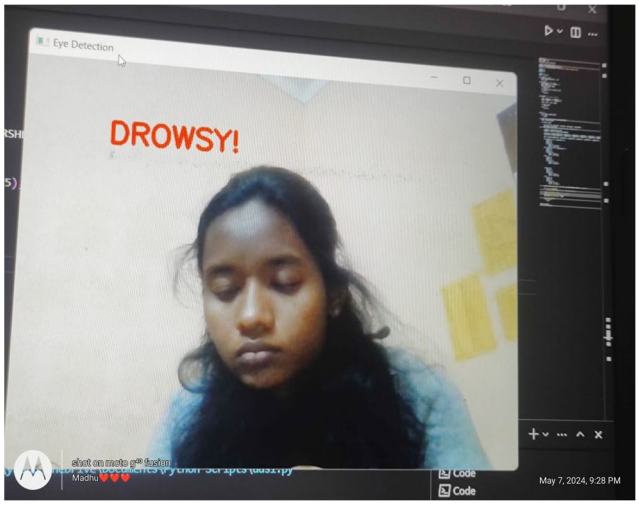
For MOR:
1)"Yes": MOR is above the Threshold Value.
2)"No": MOR is below the Threshold Value.
On combining these outcomes, we get 3 cases as follows:
Case 1. When both the outcome is "no" then the driver is fully active and the system goes back to real-time video capturing of the driver. [7]
Case 2. When one outcome is "yes" and the other outcome is "no" then we are not sure about the driver being fully awake. [5]
Case 3. When both the cases are "yes" then the driver is considered drowsy. [15]

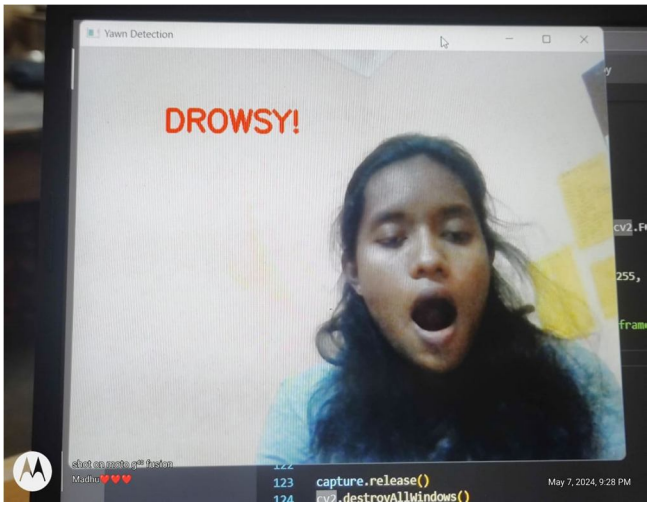
VII. RESULT AND DISCUSSION

A thorough literature review showed that various methods implement drowsiness detection and terminate possible hazards while driving. Moreover, the technological development and continuous advancement in the computer vision domain solved many challenges faced by such systems and enhanced their performance. We will use Python, OpenCV, NumPy, and dlib to build a system that can detect the closed eyes of drivers and alert them if ever they fall asleep while driving. If the driver's eyes are closed, this system will immediately inform the driver. OpenCV that we are going to use now will monitor and collect the driver's images via a webcam that was attached and feed them into the machine learning and then the model will classify the driver's eyes as 'open' or 'closed.' If it is an open eye then it will say Active and if it is a closed eye then it will check for a few seconds and then it will say the driver is drowsy and will beep an alarm.









VIII. CONCLUSION

In this paper, we have reviewed the various methods available to determine the drowsiness state of a driver. The implementation of a drowsy driver detection system represents a significant stride towards enhancing road safety and preventing accidents caused by driver fatigue. Through the integration of advanced technologies such as machine learning algorithms, computer vision and its classified eyes as open or closed. Drowsiness was determined based on Ratio of closed eyes. Using OpenCV and Dlib in Python, Ratio of yawning was examined. This system offers a proactive approach to identifying and alerting drivers when they exhibit signs of drowsiness.

IX. FUTURE SCOPE

This technology is still in the early research stage of development. Based on the work completed thus far, following modifications can be implemented:

An alarm was set to ring after the detecting a driver is sleepy or Drowsy to alert them.

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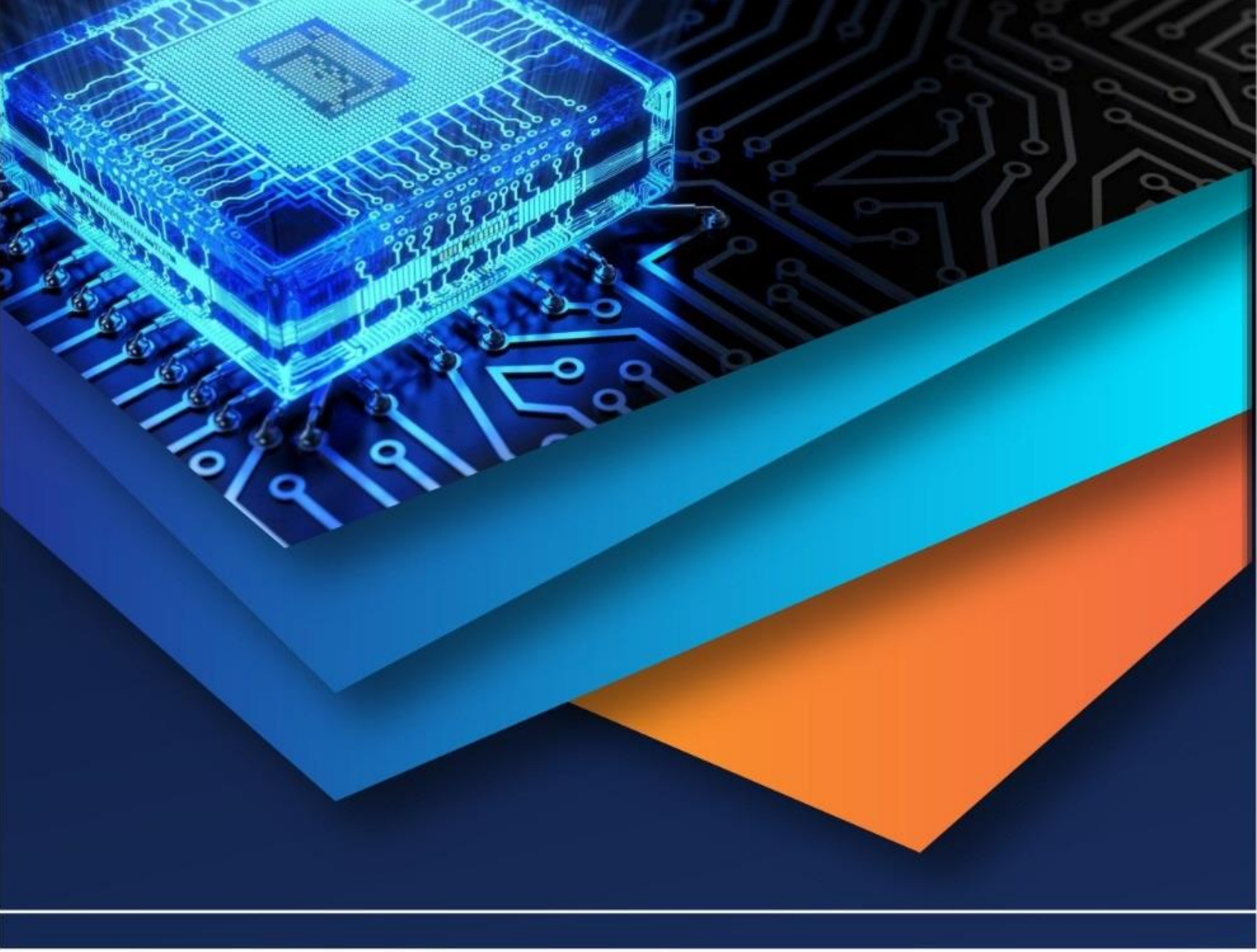

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