Drowsiness Detection using Computer Vision

[1]**Devansh Srivastava,** [2]**Gagan Tyagi**
Department of IT,Inderprastha Engineering College

Prof. (Dr.) Ragini Karwayun
Professor of Department of IT, Inderprastha Engineering College

Abstract: The proposed system aims to enhance transportation safety by reducing the number of accidents caused by driver fatigue and drowsiness, which have become increasingly common. The system analyzes facial and bodily gestures such as eye tiredness and yawning to identify signs of drowsiness and fatigue. Eye aspect ratio (EAR) is used to detect drowsiness by measuring the ratio of distances between horizontal and vertical eye landmarks. Yawn detection is performed by calculating a YAWN value based on the distance between the upper and lower lips and comparing it to a threshold value. The system incorporates an eSpeak module, a text-to-speech synthesizer, to provide appropriate voice alerts when drowsiness or yawning is detected. The ultimate goal of the proposed system is to reduce the number of fatalities resulting from road accidents and contribute to technology advancements.

Keywords: Drowsiness, eSpeak module, Eye aspect ratio, Yawn Detection.

INTRODUCTION

Sleep-deprived driving refers to driving a motor vehicle while experiencing psychological weakness due to lack of sleep. It is a significant cause of vehicular accidents, as it impairs a person's ability to function properly, leading to longer reaction times and weakened memory and judgment. Studies have shown that sleep deficiency can have an impact on driving abilities similar to that of alcohol intoxication. Shockingly, 20% of people have admitted to falling asleep while driving, with 40% of people confessing to experiencing this at least once in their driving careers. In India, research indicates that 40% of highway crashes or near-crashes occur due to drowsy driving, while more than 50% of deadly highway crashes involving multiple cars are related to alcohol. Furthermore, more than 65% of all fatal single-car crashes are due to inebriation. Therefore, it is crucial to develop a driver safety system that can estimate the driver's condition accurately. This paper reviews the relevant literature on this topic.

LITERATURE REVIEW

[1] In their article, Marco Javier Flores and JoséMaría Armingol address the challenge of detecting sleepiness in humans by analyzing their eyes and facial expressions. This task is complicated due to various factors, such as variations in lighting conditions and a wide range of possible facial postures. Regarding lighting conditions, the current state of the art can be divided into two categories: systems that utilize natural daylight and those that rely on near-infrared (NIR) illumination systems.

[2] In his research, Ameen Aliu Bamidele aims to create an affordable and non-intrusive solution for detecting driver drowsiness by utilizing a face and eye-tracking approach. To accomplish this, he

developed a model for tracking the face and eyes, as well as multiple machine-learning models. The face and eye tracking model was used to determine whether the driver's eyes were open or closed. A dataset of nearly 2 hours of driver drowsiness states occurring during both day and night was used for tracking. The nighttime data was particularly important for ensuring the accuracy of the machine learning models since drowsiness is more likely to occur at night[18][19]. Once the eye states were detected, they were analyzed by machine learning models for classification.

[3] This study explores the feasibility of creating a system for detecting drowsiness in car drivers using three methods: processing EEG and EOG signals and analyzing driver images. The authors have previously researched the first two methods, and in this paper, they focus on using images taken during driving to detect the driver's alertness or drowsiness by analyzing the state of their eyes (open, half-opened, or closed). To achieve this, the authors employed two types of artificial neural networks: a single hidden layer network and an autoencoder network.

[4]V B Navya Kiran has proposed three ideas for detecting drowsiness. The first involves creating a dataset of drowsy facial expressions. The second idea is to merge visual, non-visual, and vehicular features into a single system. Finally, Kiran suggests developing wearable hardware, such as smartwatches, to detect drowsiness.

[5] Mr. R. Somasundaram has proposed a three-stage approach for detecting drowsiness in drivers. The first stage involves detecting the ocular perceiver and monitoring lethargy, while the second stage involves monitoring the driver's heartbeat. The picture processing function identifies the driver's face and extracts an image of their ocular perceiver to detect drowsiness. A face detection algorithm is used to capture frames of pictures and output the detected face. The circle Hough Transform (CHT) is then applied to track the driver's eyes. If the eyes remain closed for a predetermined period of time, an alarm sounds to alert the driver and stop the vehicle using a relay. The driver's pulse rate is monitored using a pulse sensor. If drowsiness is not detected, the vehicle continues to run. The proposed system is implemented on a Raspberry Pi with a camera.

[6] Dwipjoy Sarkar has developed a system using open-source technology, which includes a 5-megapixel digital camera, an embedded system board called Raspberry Pi loaded with Raspbian-OS, and Python-IDLE with Open-CV installed. The Raspberry Pi board is connected to another open-source embedded system board called Arduino Uno using the I2C protocol. The Arduino Uno performs tasks such as issuing an alarm notification and cutting off the car power source to stop the vehicle upon receiving a positive drowsiness detection message from the Raspberry Pi.

[7]Wei has developed a nonintrusive method for recognizing drowsiness using eye-tracking and image processing. To address issues caused by changes in illumination and driver posture, a robust eye detection algorithm was introduced. Six measures were calculated, including the percentage of eyelid closure, maximum closure duration, blink frequency, the average opening level of the eyes, the opening velocity of the eyes, and the closing velocity of the eyes. These measures were combined using Fisher's linear discriminant functions with a stepwise method to reduce correlations and extract an independent index. The results of driving simulator experiments with six participants showed the feasibility of this video-based drowsiness recognition method, which achieved an 86% accuracy rate.

III. OBJECTIVES The primary goal of this project is to create a highly accurate and reliable system that can detect a driver's drowsiness in real-time[6] by monitoring eyelid movement and yawning and providing appropriate voice alerts. Other objectives include developing a system that can regularly monitor the driver's eyes, particularly the retina, to detect drowsiness. The system should also generate an alert if the driver yawns frequently or if their eyes remain closed for several seconds. Importantly, the system should function effectively even if the driver is wearing glasses and is not affected by poor lighting conditions.

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METHODOLOGY

DIFFERENT APPROACHES FOR DETECTING DROWSINESS: There exist numerous methods for detecting driver drowsiness, which can be broadly categorized into three main types:

Physiological Parameters-based Techniques*:* This category encompasses techniques that involve measuring the driver's physical conditions to determine their level of drowsiness.

Vehicular Parameters-based Techniques*:* This category includes methods that measure the level of driver fatigue by analyzing the patterns of vehicle operation.

Behavioral Parameters-based Techniques*:* This category encompasses techniques that do not require the use of invasive instruments to measure driver fatigue. Instead, these methods analyze the driver's behavior, including their eye closure ratio, blink frequency, yawning, head position, and facial expressions, to determine their level of fatigue. The eye closure ratio is the primary parameter utilized by the system in question.

IMPLEMENTATION/CORE MODULE

6.1 Algorithms/Approaches used for the project

For the drowsy drivey system, we trained our dataset using the images depicted below. Initially, we trained the model on static images before proceeding to train it on real-time videos of the user. We captured the images frame by frame and employed an open CV for this purpose.

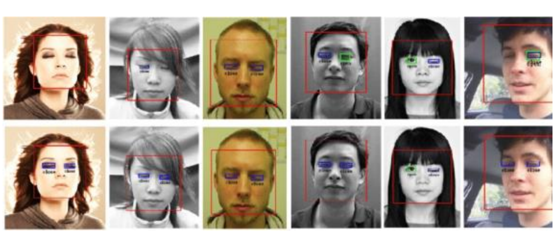

Fig 1: Detection of eye using HAAR

Computer Vision

Computer Vision is a field of study concerned with the reconstruction, interpretation, and comprehension of a 3D scene using 2D images, taking into account the structural properties of the scene. It involves the use of computer software and hardware to simulate and replicate human vision.

Computer Vision overlaps significantly with the following fields:−

- **Image Processing** − It focuses on image manipulation.
- **Pattern Recognition** − It explains various techniques to classify patterns.
- **Photogrammetry** − It is concerned with obtaining accurate measurements from images.

Haar cascade The algorithm we are using is capable of detecting objects in images, regardless of their location or scale within the image. It is also capable of detecting human faces. Once a face is detected, we crop the image to isolate the face and then pass it through an eye-detection process.

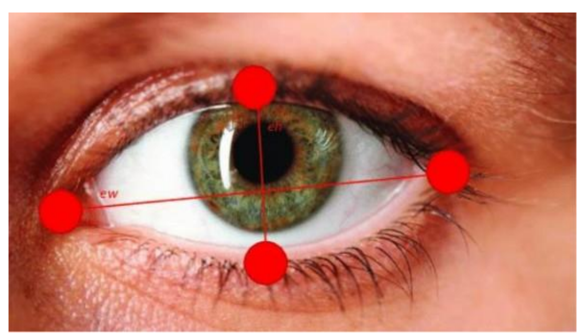

Fig 2: Detection of the state of eye using Perclos

After getting the coordinates of the eyes (ex, ey, ew, eh) draw bounding boxes for the eyes on the original picture

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draw bounding box for faces using coordinates(x,y,w,h) on the original picture

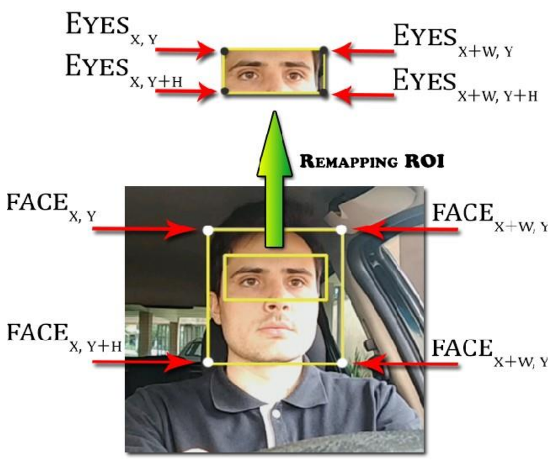

Fig 3: Structure of the proposed System

PERCLOS is a percentage of the total frame that eye is closed during a certain time interval.

The eye is defined as closed based on predetermined PERCLOS values.

The PERCLOS measure is calculated based on the area estimation of the iris.

We used the left iris area, the right iris area, and the total of both. Three threshold values (60%, 70%, and 80%) were tested in this study and they are referred to as P60, P70, and P80. P60 means the percentage of the total time that the eye is closed at least 60%.

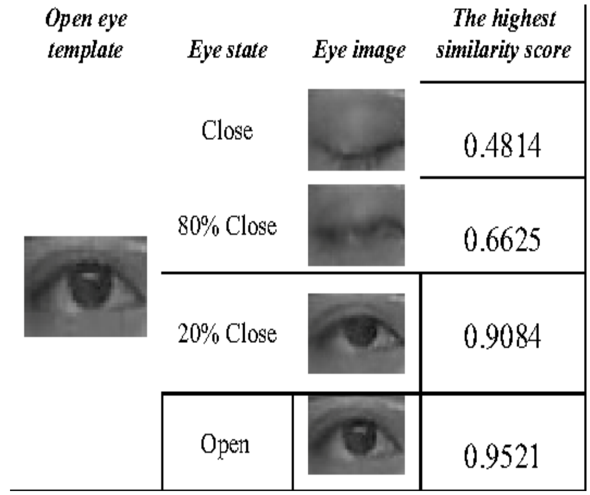

Fig 4 : Prediction of the state of the eye

6.2 Implementation of Modules/Algorithms

In this study, PERCLOS measurement was used to determine the percentage of time that the eyes were closed during a specific time interval. The closure of the eye was determined based on predetermined PERCLOS values, which were calculated by estimating the area of the iris. The left and right iris areas were used, as well as the total of both. Three different threshold values (60%, 70%, and 80%) were tested and referred to as P60, P70, and P80, respectively. For instance, P60 indicates the percentage of time that the eye was closed for at least 60% of the total time interval. The same interpretation applies to P70 and P80.

The PERCLOS is calculated as follows:

$$PERCLOS\ (\%) = \frac{the\ sum\ of\ frames\ when\ eye\ is\ closed}{interval\ of\ frames}\ x\ 100\ \%$$

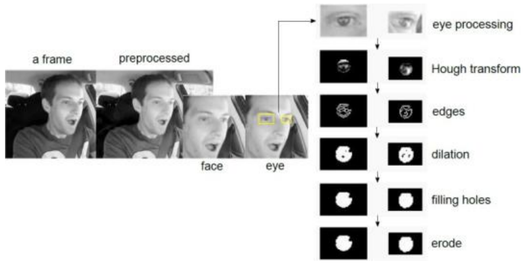

Fig 5: Processing of the model

7. RESULTS / OUTPUTS & TESTING

7.1 Output Screenshot

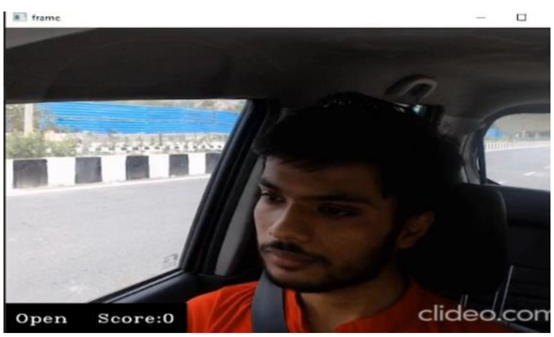

Fig 6: Actual Implementation of the model

7.2 Testing

Test Id	Test Condition	System Behavior	Expected Result
T01	Straight Face, Good light, No glasses	Alarm Beeping	Alarm Beeping
T02	Straight Face, Good light, No glasses	Alarm Beeping	Alarm Beeping
T03	Straight Face, Good light, No glasses	Alarm Beeping	Alarm Beeping
T04	Straight Face, Good light, No glasses	Alarm Beeping	Alarm Beeping

CONCLUSIONS

The system fully satisfies the set objectives and requirements. It has reached a stable state where all the errors have been eliminated. The system caters to knowledgeable users who understand its benefits and how it addresses the problem of alerting drivers who are at risk of drowsiness while driving.

The software system for detecting fatigue utilizes computer vision, specifically the conv2D classifier, as its foundation. Its primary objective is to develop a timely and accurate method for detecting fatigue. The input is captured via a camera, and when drowsiness is detected, the output takes the form of a buzzer that alerts the user. The shape predictor algorithm serves as the basis for this system, providing a non-intrusive approach to drowsiness detection. To detect drowsiness, specific facial features are identified, and the system employs the concept of video processing.

REFERENCES

[1] Flores, M., Armingol, J. & de la Escalera, A. Driver Drowsiness Warning System Using Visual Information for Both Diurnal and Nocturnal Illumination Conditions. EURASIP J. Adv. Signal Process. 2010, 438205 (2010).

[2] Ameen Aliu Bamidele, Kamilia Kamardin, Nur Syazarin Natasha Abd Aziz, Suriani Mohd Sam Irfanuddin Shafi Ahmed, Azizul Azizan, Nurul Aini Bani, Hazilah Mad Kaidi Non-intrusive Driver

Drowsiness Detection based on Face and Eye Tracking (IJACSA) International Journal of Advanced Computer Science and Applications, Vol. 10, No. 7, 2019

[3] T. Vesselenyi1, S. Moca1, A. Rus1, T. Mitran1 and B. Tătaru1 Driver drowsiness detection using ANN image processing Citation T. Vesselenyi et al 2017 IOP Conf. Ser.: Mater. Sci. Eng. 252 012097 DOI 10.1088/1757-899X/252/1/012097

[4]V B Navya Kiran Raksha R, Varsha K N, Dr. Nagamani N P JSS Academy of Technical Education Bengaluru, India Driver Drowsiness Detection, NCAIT - 2020 Conference Proceedings

[5] IMPLEMENTATION OF DRIVER DROWSINESS DETECTOR WITH VOICE ALERT AND HEALTH MONITORING SYSTEM by Mr. R. Somasundaram, S. Manoj, H. Mohammed Asraf Ali, M. Mohanakarthikeyan, M. Ranjithkumar

[6] Dwipjoy Sarkar, Atanu Chowdhury International Journal of Engineering Trends and Technology (IJETT) – Volume 10 Number 9 - Apr 2014 ISSN: 2231-5381 Page 461 A Real-Time Embedded System Application for Driver Drowsiness and Alcoholic Intoxication Detection

[7] Wei Zhang, Bo Cheng, Yingzi Lin," Driver Drowsiness Recognition Based on Computer Vision Technology," Tsinghua Science And Technology, pp354-362, Volume 17, Number 3, June 2012.

[8] EEG-based System Using Deep Learning and Attention Mechanism for Driver Drowsiness Detection M Zhu, H Li, J Chen, M Kamezaki

[9] "Drowsiness Detection Using Physiological Signals: A Review" by Vural et al.

[10] "Driver Drowsiness Detection System Using Machine Learning Techniques: A Review" by Kumar et al.

[11]"A Review of Driver Drowsiness Detection Systems and Technologies" by Kim et al.

[12]"Driver Drowsiness Detection System Based on Hybrid Features of Eye and Mouth States" by Sharma et al.

[13]"Driver Drowsiness Detection Using Convolutional Neural Networks" by Hu et al.

[14] "Real-Time Drowsiness Detection Using Wearable Sensors: A Review" by Suryadevara et al.

[15]"Drowsiness Detection in Transportation Operators: A Systematic Review" by Dingus et al.

[16]"Driver Fatigue Detection Using Machine Learning Techniques: A Review" by Patil et al.

[17]"Drowsiness Detection for Intelligent Driver assistance Systems: A Review" by Li et al.

[18]"Driver Drowsiness Detection Based on EEG Signals and Machine Learning Techniques" by Wei et al.

[19]Drowsy and fatigued driving problem significance and detection based on driver control functions by A Eskandarian, A Mortazavi, RA Sayed - Handbook of intelligent vehicles, 2012

[20]Camera measurement of physiological vital signs D McDuff - ACM Computing Surveys, 2023