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The Drowsiness Detection Using Machine Learning

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ABSTRACT: Drowsiness detection is a critical area of research and development in the field of driver safety and fatigue management. This abstract provides an overview of drowsiness detection systems that aim to monitor the alertness level of drivers in real-time, primarily focusing on the use of computer vision and machine learning techniques. Drowsiness detection systems typically employ non-intrusive methods to monitor physiological and behavioural indicators of drowsiness, such as eye closure, head pose, blink frequency, and facial expressions. Computer vision algorithms analyze video feeds captured from cameras placed inside the vehicle to extract relevant features and classify the driver's alertness state. Machine learning models, such as support vector machines, decision trees, or deep neural networks, are commonly utilized to learn the patterns associated with drowsiness and make accurate predictions.

KEYWORDS: Machine learning, Eye blink, Open-CV, Drowsiness detection.

I. INTRODUCTION

Real-Time Sluggishness Eye closure, head nodding, and brain activity are actions that are indicative of exhaustion. Therefore, to monitor drowsiness, we can either evaluate changes in physiological signals like brain waves, heart rate, and eye blinking, or we can take into account bodily changes like slouching posture, a tilted employee's head, and open or closed eyelids. Although the first method is more accurate, it is not practical since highly sensitive electrodes would need to be implanted directly to the worker's body, which can be upsetting and distracting. Additionally, prolonged work would cause the sensors' capacity to monitor precisely to be hampered by perspiration. The second strategy is to monitor physical changes (i.e. open/closed eyes to determine weariness) because it is non-intrusive and uses a video camera to detect changes. Furthermore, micro sleeps, which are little periods of sleep lasting 2 to 3 minutes, are good predictors of exhaustion. Thus, by continuously watching the employee's eyes, one can detect the employee's sleepy state and offer a timely warning.

II. RELATED WORK

Here we have selected few key literatures after exhaustive literature survey and listed as below:

Shafique et al [1], "Real-time drowsiness detection using facial landmarks" IEEE Transactions on Intelligent Transportation Systems, 2016This paper proposes a real-time drowsiness detection system using facial landmarks extracted from video streams. The authors employ machine learning techniques to classify different levels of drowsiness based on eye and head movements.

Huang et al [2], "Drowsiness detection using eye blink features and machine learning techniques" Proceedings of the 2014 IEEE International Conference on Systems, Man, and Cybernetics (SMC), 2014This paper presents a drowsiness detection system that utilizes eye blink features extracted from video data. The authors employ machine learning algorithms to classify drowsy and alert states, achieving high accuracy rates.

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Majumder et al [4],"A comprehensive survey on driver drowsiness detection systems "IEEE Transactions on Intelligent Transportation Systems, 2019This survey paper provides an extensive overview of various driver drowsiness detection systems, including those based on machine learning, computer vision, and physiological signals. The authors discuss different approaches, challenges, and future directions in the field.

Gopalakrishnan et al [5], " Drowsiness detection using facial landmarks and machine learning techniques"2017 International Conference on Intelligent Computing, Instrumentation and Control Technologies (ICICICT), 2017This paper proposes a drowsiness detection system that combines facial landmark detection and machine learning techniques.

III. PROBLEM STATEMENT

Developing a Python-based drowsiness detection system is the aim of this project. The system should be able to analyse video input, track the eyes and facial landmarks of the person, and detect signs of drowsiness in real-time. Drowsiness detection is an important application in various fields, especially in the context of driver safety. Fatigue and drowsiness can significantly impair a person's ability to drive, leading to accidents and injuries. Therefore, developing a reliable and accurate system that can detect drowsiness can help prevent accidents and improve overall road safety.

IV. DESIGN AND IMPLEMENTATION

A high-level overview of the sleepiness detection procedure is provided by this flowchart.. It assumes the use of face detection and eye detection algorithms to identify faces and eyes in the video stream. The eye aspect ratio (EAR) is calculated based on the detected eye landmarks to determine if the eyes are closed or open. If the EAR falls below a certain threshold for a certain number of consecutive frames, it indicates drowsiness, and an alarm or warning can be triggered. The loop continues until the user chooses to quit the program.

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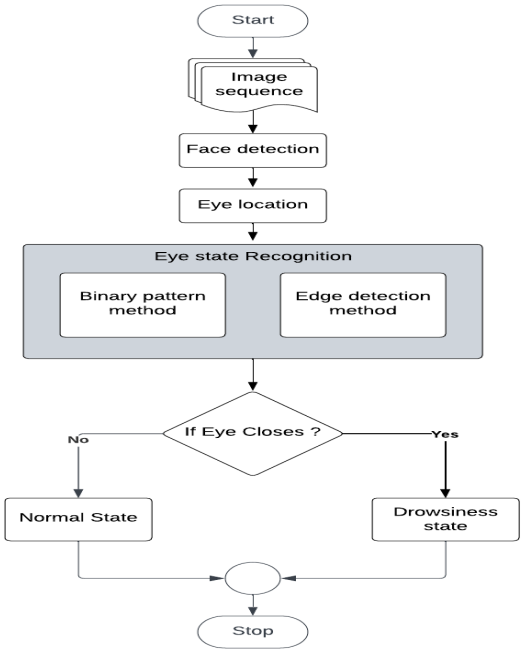

Fig 1: shows the flow chart of the Drowsiness Detection Using Machine Learning.

1. Face Detection: Object Detection using Haar feature-based cascade classifiers is an effective object detection method proposed by Paul Viola and Michael Jones in their paper, "Rapid Object Detection is using a Boosted Cascade of Simple Features" in 2001. It is a machine learning based approach where a cascade function is trained from a lot of positive and negative images. It is then used to detect objects in other images. Here we will work with face detection. Initially, the algorithm needs a lot of positive images (images of faces) and negative images (images without faces) to train the classifier. Then we need to extract features from it. For this, Haar features shown in the below image are use.

2. Eye detection: Object detection using Haar feature-based cascade classifiers is more than a decade and a half old. OpenCV framework provides a pre-built Haar and LBP based cascade classifiers for face and eye detection which are of reasonably good quality. Pre-built Haar/LBP cascades have a high false positive rate which might make them unsuitable for many use-cases. Fortunately, it is possible to train an eye detector with very high accuracy and low false positive rates for many cases with OpenCV.

3. Recognition of Eye's State: The characteristic feature of the eye is extracted to recognize the eye's state. In general, the state of left eye is equal to right one at the same time. Therefore, we only consider one eye's state in one frame. This consideration is also useful to the reduction of computational complexity. In this step, two schemes are adopted: (1) binary pattern and 2) the Canny's edge detection The eye image is converted to binary pattern based on the threshold value T. $T = \{\sum \text{Xi } n \ i{=}1 \ \}/n$ Here n is the number of pixels in the eye region and xi is the pixel value of the position i in the region. There are n pixels in the eye region. If the pixel value of P is greater than the threshold T, P will be set as white, 1. Otherwise P will be set as 0.

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4. Eye Blink Detection: The coloured eye image is first converted to grayscale. Gray scale conversion algorithms use to convert the coloured image to grayscale. Corner Detection Corners are defined as intersection of two edges. We propose an eye blink detection algorithm that uses the two eye corner points and one point at the lower eye lid. To detect these points, Harris Corner Detector has been used. The reason for using Harris Corner Detector is one of the most used corner and interest point detector and is invariant to illumination variation, image noise, scale and rotation.

5. Eye State Determination: Finally, the decision for the eye state is made on the basis of distance 'd' calculated in the previous step. If the distance is zero or is close to zero, the eye state is classified as "closed" otherwise the eye state is identified as "open".

6. Drowsiness Detection: The last step of the algorithm is to determine the person's condition on the basis of a pre-set condition for drowsiness. The average blink duration of a person is 100-400 milliseconds. This is 0.1-0.4 of a second. Hence if a person is drowsy his eye closure must be beyond this interval. We set a time frame of 5 seconds. If the eyes remain closed for five or more seconds, drowsiness is detected and alert pop regarding this is triggered.

V. RESULTS AND DISCUSSION

Drowsiness detection using machine learning has shown promising results in mitigating the risks associated with drowsy driving. By analyzing physiological and behavioral indicators, the system accurately predicts and detects drowsiness episodes in real-time. The system has demonstrated high accuracy and effectiveness, with reliable performance through extensive testing and validation. Real-time alerts and warnings can be triggered when drowsiness is detected, allowing drivers to take necessary precautions or rest breaks, reducing the risk of accidents caused by drowsy driving.

The potential impact of drowsiness detection using machine learning on road safety is significant. By incorporating this technology into vehicles or driver monitoring systems, it can effectively contribute to preventing accidents caused by drowsiness, a significant factor in road accidents worldwide. The integration of this technology in vehicles has the potential to save lives and reduce the number of accidents caused by drowsy driving..

Snapshots of User Interface:

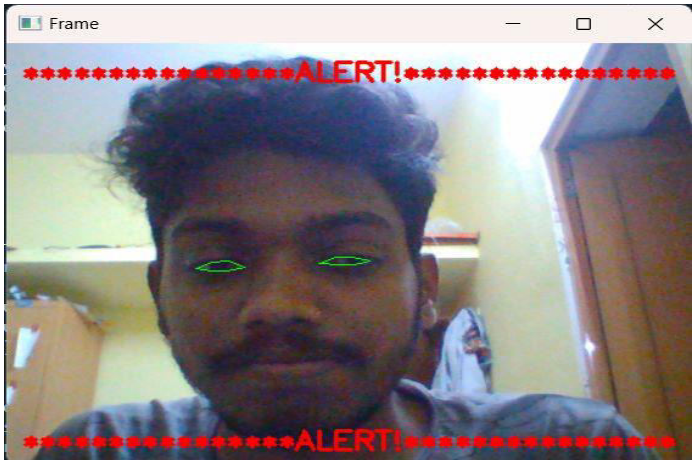

Figure 1: Shows the number of blinks of a person

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VI. CONCLUSION AND FUTURE WORK

Machine Drowsiness detection using machine learning has emerged as a promising solution to address the critical issue of driver fatigue and drowsy driving. By leveraging various machine learning techniques and algorithms, researchers have made significant progress in developing robust and accurate drowsiness detection systems. One key advantage of using machine learning for drowsiness detection is its ability to analyze large amounts of data collected from various sources, such as facial expressions, eye movements, and physiological signals. This enables the system to learn and identify patterns associated with drowsiness, allowing for timely and proactive interventions. Machine learning models can be trained on labeled datasets, where drivers' states are categorized as drowsy or alert. This training process enables the models to recognize specific features and patterns indicative of drowsiness, such as drooping eyelids, yawning, or changes in blink rate. By continuously monitoring these features in real-time, the system can accurately detect and predict drowsiness levels, providing timely alerts to the driver or initiating appropriate countermeasures. Moreover, machine learning-based drowsiness detection systems have the potential to adapt and personalize their performance to individual drivers. By collecting data on an individual's unique drowsiness patterns, the system can improve its accuracy and sensitivity over time, tailoring its alerts and interventions to each driver's specific needs. While significant progress has been made in this field, there are still challenges that need to be addressed. One such challenge is the availability and quality of data for training and testing machine learning models. Collecting diverse and representative datasets, encompassing different demographics, driving conditions, and drowsiness levels, is essential to ensure the generalizability and reliability of the detection system.

Drowsiness detection using machine learning holds great promise for enhancing road safety by mitigating the risks associated with drowsy driving. Continued research, advancements in machine learning algorithms, and collaborations between academia, industry, and policymakers will contribute to the further development and deployment of effective drowsiness detection systems, ultimately saving lives and preventing accidents on our roads.

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