International Journal For Advanced Research In Science & Technology
A peer reviewed international journal www.ijarst.in
ISSN: 2457-0362

Enhanced Driver Drowsiness Monitoring System Utilizing Visual Behavior Analysis and Machine Learning

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ABSTRACT_ This project introduces a novel approach to enhancing road safety through the implementation of drowsiness detection technology. Leveraging a webcam and machine learning SVM (Support Vector Machine) algorithm, the system monitors the visual behavior of a driver in real-time. Utilizing OpenCV, facial features are extracted from images captured by the webcam. The system then identifies signs of drowsiness such as blinking eyes or yawning mouth over consecutive frames. Upon detection, the system alerts the driver with timely messages to prevent potential accidents. A pre-trained SVM model is employed, and the Euclidean distance function is utilized to continuously predict the proximity of facial features to drowsiness thresholds. When facial feature distances indicate increased proximity to drowsiness, the system promptly alerts the driver, thereby promoting safer driving practices.

1.INTRODUCTION

Drowsy driving has become a leading cause of fatalities in road accidents, particularly among truck drivers who work continuously for long hours, often at night, and bus drivers operating long-distance routes or overnight services. The problem of driver drowsiness poses a significant challenge for drivers and passengers in all countries. Fatigue and drowsiness are responsible for numerous injuries and fatalities resulting from road accidents each year. Therefore, identifying driver fatigue and detecting it has become an active area of research. The initial stage of the drowsiness detection system comprises three modules: acquisition, processing, and warning. In the acquisition module, a video of the driver's face is captured and transmitted to the processing module where it is analyzed online to identify drowsiness. If drowsiness is detected, a warning or alarm sound is issued to the driver via the warning module. Typically, the methods used to detect driver drowsiness fall into three categories: vehicle-based, behavioral-based, and physiological-based. In the vehicle-based method, a variety of metrics are continuously monitored, such as steering wheel movement, accelerator or brake pattern, vehicle speed, lateral acceleration, shift in engine speed, deviations from lane position, etc. Any abnormal change in these values is considered indicative of driver drowsiness. This method is non-intrusive because the sensors are not physically attached to the driver. The behavioral-based method analyzes the visual behavior of the driver's face, such as eye opening and closing, eye blinking, yawning, head bending, etc., to detect drowsiness. This approach is also non-intrusive because standard cameras are used to capture these

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A peer reviewed international journal www.ijarst.in
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features. The physiological-based method monitors physiological signals such as Electrocardiogram (ECG), Electrooculogram (EOG), Electroencephalogram(EEG), heartbeat, pulse rate, etc., to obtain a measure of drowsiness or fatigue level. This method is considered intrusive because the sensors are attached to the driver, which may cause distractions. The inclusion of additional parameters or features will increase the accuracy of the system to a certain extent but also lead to a larger and more costly system. Therefore, to create a low-cost and portable real-time driver's drowsiness detection system with acceptable and accurate results, we have proposed using a webcam-based system that relies on image processing and machine learning techniques to detect fatigue from facial images only..

2.LITERATURE SURVEY

[1] W. L. Ou, M. H. Shih, C. W. Chang, X. H. Yu, C. P. Fan, " A Smart System for Detecting Drowsy Drivers Using Video and Embedded Software in Different Lighting Conditions", 2015 international Conf. on Consumer Electronics - Taiwan, 2015.

In this study, we create a clever video-based approach to drowsy driver detection that works in any light. Even if the driver is wearing spectacles, the proposed device can accurately detect drowsy situations. In order to implement the proposed technique, a near-infrared-ray (NIR) camera is used in a cascaded way to identify two computational steps: driving eyeballs and sleeping drivers. while it comes to open/closed eye identification, the average rates are 94% while wearing glasses and 78% when wearing contacts, while the accuracy rate for identifying drowsy condition may reach 91%. After making software updates, the integrated platform that utilizes field-programmable gate arrays (FPGAs) can handle 640×480 format video at rates of up to 16 frames per second (fps).

[2] W. B. Horng, C. Y. Chen, Y. Chang, C. H. Fan, "The Use of Eye Tracking and Dynamic Template Matching for the Detection of Driver Fatigue

", IEEE International Conference on Networking,, Sensing and Control, Taipei, Taiwan, March 21-23, 2004.

Our system can detect driver fatigue in real-time using eyesight, ensuring safe driving. It is possible to identify the driver's face from color images captured in a car by evaluating skin color features. Afterwards, edge detection is used to find the eye locations. There are two main uses for the acquired eye images: first, they act as templates for the eye tracking in the following frame; and second, they may detect fatigue, which sets off specific driving safety warning sirens. For this system's testing, we rely on a Pentium III 550 CPU with 128 MB of RAM. It would seem that the experiment was a success. On four test movies, the system achieves an average accuracy rate of 99.1 percent for both eye localization and tracking, and its eye tracking capabilities exceeds 20 frames per second. The appropriate rate for fatigue detection is 100%, even if the test movies had an average accuracy percentage of 88.9%.

[3] S. Singh, N. P. papanikolopoulos, "Using Face Analysis to Track Driver Fatigue

", IEEE Conference on Intelligent Transportation System, pp 314-318.

An intrusive procedure-free vision-based system for detecting driver tiredness is detailed in this paper. By monitoring the driver's eye movement with a color video camera, the system may detect micro-sleeps, which are brief periods of unconsciousness. As it searches the input space for a face, the algorithm takes skin-color information into account. After skin-tone-based pixel segmentation, blob processing pinpoints the exact location of the face. We can narrow our search to areas around the eyes, where the horizontal intensity gradient changes noticeably, by examining the face's horizontal gradient map. We can find and follow the pupil's movement by comparing grayscale representations. We can tell whether an eye is open or closed using a pattern recognition method that is comparable to this one. Assuming the user is going to nod off, the device will sound an alarm after five or six seconds of closed eyelids.

[4] Driver Drowsiness Detection System, 2013 IEEE International Workshop on Systems, Signal Processing and their Applications, B. Alshaqaqi, A. S. Baquhaizel, M. E. A. Ouis, M. Bouumehed, A. Ouamri, and M. Keche.

Sleepy drivers are responsible for a disproportionate number of traffic accidents and deaths. Scientists are still trying to figure out what causes drivers to become tired on the road. A large number of the most popular methods depend on things like cars, human actions, or physiological aspects. There are methods that don't annoy drivers, and there are options that need expensive sensors and data processing. This study set out to fill that need by developing a reliable, inexpensive method of real-time driver tiredness detection. Built within the system are image processing algorithms that can identify the driver's face in any video frame. Adaptive thresholding is used to compute the eye aspect ratio, mouth opening ratio, and nose length ratio using the detected face's landmarks in order to ascertain drowsiness. Aside from online applications, machine learning methods have also been used offline. The sensitivity and specificity of Support Vector Machine-based classification have both achieved 95.58% and 100%, respectively.

[5] "The Steps of Proposed Drowsiness Detection System Design based on Image Processing in Simulator Driving" (International Research Journal of Applied and Basic Sciences, vol. 9, no. 6, 2015, pp. 878–887) by M. Karchani, A. Mazloumi, G. N. Saraji, A. Nahvi, K. S. Haghighi, B. M. Abadi, A. R. Foroshani, and A. Niknezhad.

Detecting lethargy might reduce the number of road accidents, among other possible advantages.

importance. Applications of image processing methods are among the most recent and reliable approaches to sleepy

International Journal For Advanced Research In Science & Technology
A peer reviewed international journal www.ijarst.in
ISSN: 2457-0362

face. Examining driver sleepiness and the availability of face photos, this pilot study used a virtual reality driving simulator. In order to derive degrees of signal-based fatigue, data related to 25 drivers was recorded at a 10 fps picture rate. An extra perk was that each driver's average of three thousand frames was checked. We converted the frames to greyscale and analyzed them using the Cascade and Viola & Jones methods. Afterwards, we used Binary and Histogram techniques to get the photo properties. The MPL neural network was used for data analysis.The majority of drivers had their data entered into the network (70%) while a smaller percentage (15%) were used for testing and validation purposes. Finally, we verified the results were accurate up to a 93% confidence level. This study's use of intelligent detection and several criteria over a long period of time offers an advantage over others. An early identification of sleepiness may help prevent irreparable losses, and this alarm can help with that

3.PROPOSED SYSTEM

In this study, we detect drowsiness in a driver by tracking his or her visual behaviour using a camera and a machine learning SVM (support vector machine). This application will use the built-in webcam to read pictures of a driver and then extract facial features from the picture using the OPENCV SVM algorithm. If the driver in the picture blinks his eyes for 20 frames in a row or yawns, the application will alert the driver with drowsiness messages.

3.1 Video Recording: Using this module we will connect application to webcam using OPENCV built-in function called VideoCapture.

3.2 Frame Extraction: Using this module we will grab frames from webcam and then extract each picture frame by frame and convert image into 2 dimensional array.

3.3 Face Detection & Facial Landmark Detection: Using SVM algorithm we will detect faces from images and then extract facial expression from the frames.

3.4 Detection: Using this module we will detect eyes and mouth from the face

3.5 Calculate: Using this module we will calculate distance with Euclidean Distance formula to check whether given face distance closer to eye blinks or yawning, if eyes blink for 20 frames continuously and mouth open as yawn then it will alert driver.

3.6 Face Detection Using OpenCV

This seems complex at first but it is very easy. Let me walk you through the entire process and you will feel the same.

Step 1: Considering our prerequisites, we will require an image, to begin with. Later we need to create a cascade classifier which will eventually give us the features of the face.

Step 2: This step involves making use of OpenCV which will read the image and the features file. So at this point, there are NumPy arrays at the primary data points.

All we need to do is to search for the row and column values of the face NumPy N dimensional array. This is the array with the face rectangle coordinates.

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ISSN: 2457-0362

Step 3: This final step involves displaying the image with the rectangular face box.

4. SVM DESCRIPTION

Machine learning involves predicting and classifying data and to do so we employ various machine learning algorithms according to the dataset. SVM or Support Vector Machine is a linear model for classification and regression problems. It can solve linear and non-linear problems and work well for many practical problems. The idea of SVM is simple: The algorithm creates a line or a hyperplane which separates the data into classes. In machine learning, the radial basis function kernel, or RBF kernel, is a popular kernel function used in various kernelized learning algorithms. In particular, it is commonly used in support vector machine classification. As a simple example, for a classification task with only two features (like the image above), you can think of a hyperplane as a line that linearly separates and classifies a set of data.

Intuitively, the further from the hyperplane our data points lie, the more confident we are that they have been correctly classified. We therefore want our data points to be as far away from the hyperplane as possible, while still being on the correct side of it.

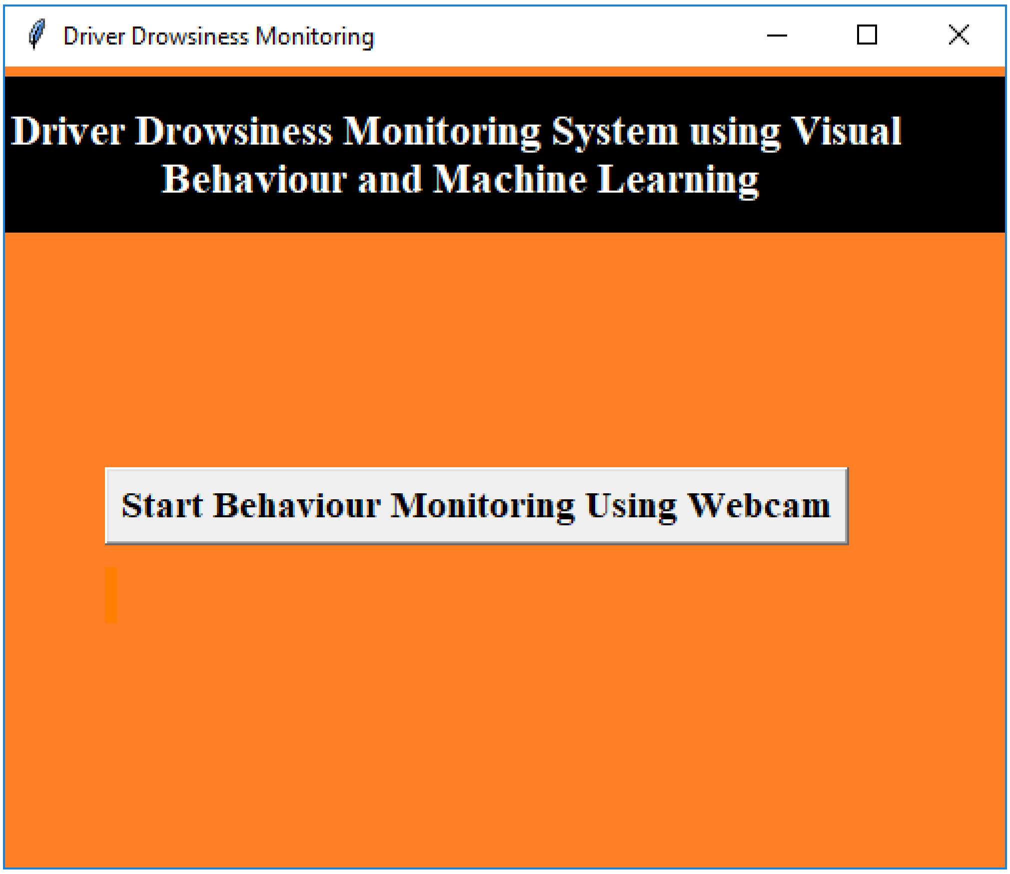
So when new testing data is added, whatever side of the hyperplane it lands will decide the class that we assign to it.

How do we find the right hyperplane?

Or, in other words, how do we best segregate the two classes within the data?

The distance between the hyperplane and the nearest data point from either set is known as the margin. The goal is to choose a hyperplane with the greatest possible margin between the hyperplane and any point within the training set, giving a greater chance of new data being classified correctly.

5.RESULTS AND DISCUSSIONS



5.1 In above screen click on 'Start Behaviour Monitoring Using Webcam' button to connect application with webcam, after clicking button will get below screen with webcam streaming

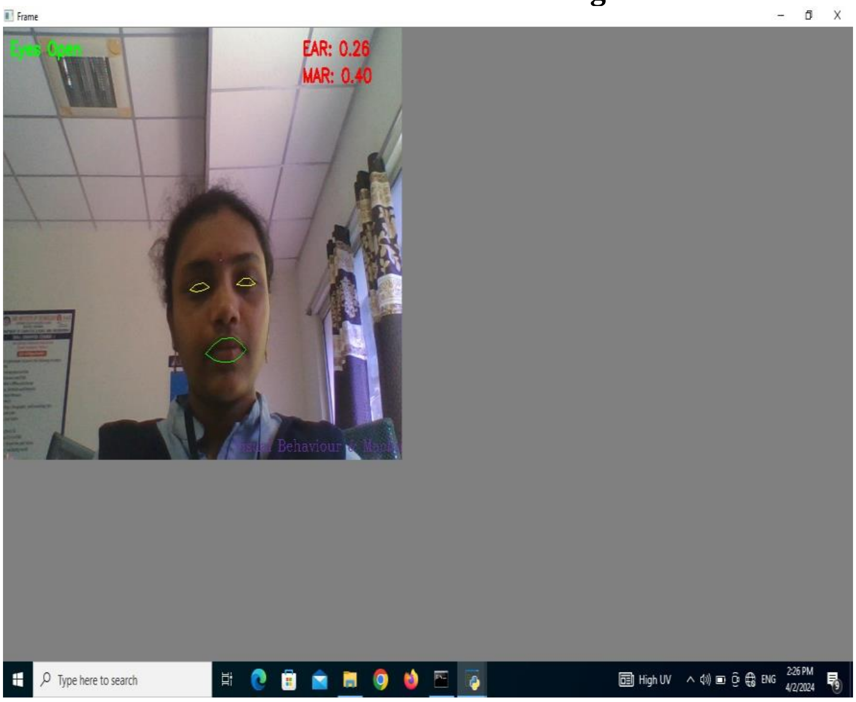


FIG 5.2 The webcam feed is shown on the above screen, and the program checks each frame to determine if the person's eyes are open or closed. If they are, the following message will be displayed.

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ISSN: 2457-0362

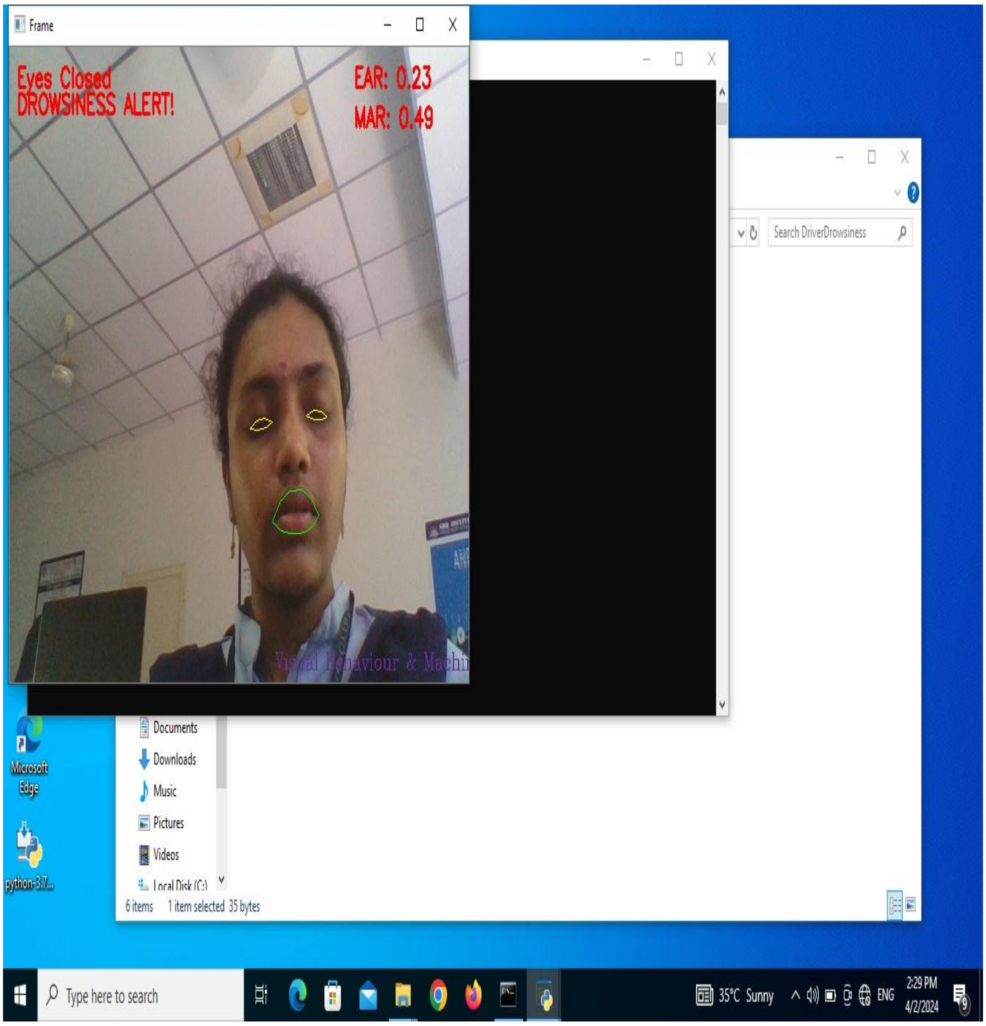
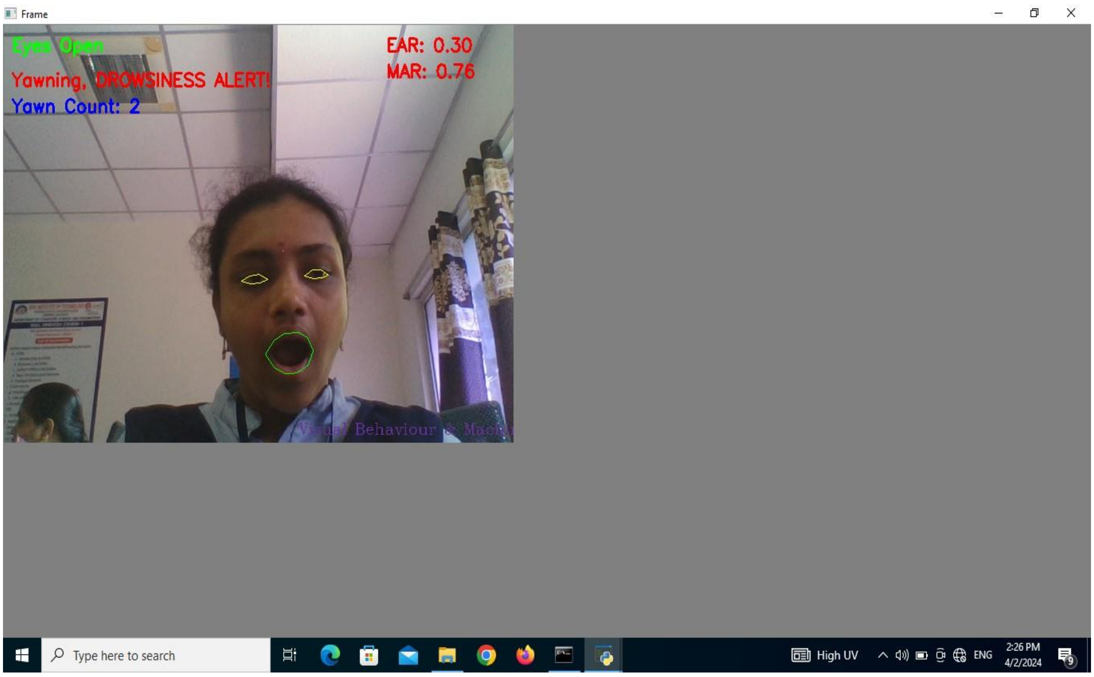


Fig 5.3 Similarly, you will also get an alarm message if your lips begins to yawn.



6.CONCLUSION

In conclusion, the literature survey highlights the growing importance of drowsiness detection systems in enhancing road safety. Through advancements in computer vision, machine learning, and sensor technologies, researchers have developed robust and reliable methods for real-time detection of driver drowsiness. By leveraging techniques such as facial feature extraction and machine learning algorithms like Support Vector Machines, these systems can accurately identify signs of drowsiness, such as blinking eyes and yawning mouth, thereby alerting drivers to potential hazards. The comprehensive review of existing literature underscores the significance of accurate feature extraction techniques and the effectiveness of different machine learning approaches in achieving reliable drowsiness detection performance. Furthermore, the comparative analysis provides valuable insights into the strengths and limitations of various machine learning algorithms, aiding in the development of more efficient and effective drowsiness detection systems. Overall, the surveyed literature underscores the critical role of drowsiness detection technology in promoting road safety. By continuously monitoring driver behavior and providing timely alerts, these systems have the potential to significantly reduce the risk of accidents caused by drowsy driving. However, further research is warranted to address challenges such as real-time implementation, scalability, and integration into existing vehicle systems, ultimately paving the way for safer roads and improved transportation infrastructure.

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International Journal For Advanced Research In Science & Technology
A peer reviewed international journal
ISSN: 2457-0362
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