International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 07 Issue: 04 | April - 2023 Impact Factor: 8.176 ISSN: 2582-3930

Drowsiness Detection using EAR (Eye Aspect Ratio) by Machine Learning

Dr. C. Sunitha Ram[1], D.J.V.S. Koushik[2], H. Sree Pavan[3]
[1]Assistant Professor, Dept. Of CSE, SCSVMV (Deemed to be University)
[2]Student, Dept. Of CSE, SCSVMV (Deemed to be University)
[3]Student, Dept. Of CSE, SCSVMV (Deemed to be University)

ABSTRACT

Drowsiness detection is critical in many sectors, including transportation, healthcare, and workplace safety, since it may have a substantial influence on human performance and safety. Traditional sleepiness detection approaches are frequently subjective, time intensive, and unsuitable for real-time applications. In recent years, computer vision-based techniques that use eye-related characteristics to identify tiredness have shown promise. The eye aspect ratio, a geometric measure determined from ocular landmarks that indicates the openness or closure of the eyes, is one such trait. We present a sleepiness detection method in this research that blends eye aspect ratio computation with machine learning techniques to provide real-time and accurate drowsiness evaluation. We offer a thorough technique that includes calculating the eye-aspect ratio, extracting features, and classifying them with machine learning methods.

The ability of our proposed technique is evaluated using a dataset of eye pictures acquired from individuals under various sleepiness situations. Our experimental findings show that our technique is successful in detecting sleepiness with good accuracy, sensitivity, and specificity. Our suggested method includes applications such as sleepy driving detection, tiredness monitoring in hospital settings, and workplace safety. This research advances the area of sleepiness detection by combining the ocular aspect ratio and machine learning to measure tiredness in real time.

KEYWORDS: Drowsiness detection, Eye aspect ratio, Machine learning, Eye tracking, Blink rate, Pupil dilation, Real-time monitoring, Non-invasive, Safety, Transportation

1. INTRODUCTION

Drowsiness, also known as sleepiness or fatigue, can significantly impair human performance and pose risks in various domains such as transportation, healthcare, and workplace safety. In particular, drowsy driving has been identified as a major factor in traffic accidents worldwide, leading to injuries, fatalities, and economic losses. Traditional methods for detecting drowsiness, such as physiological measurements or self-reported sleepiness scales, are often subjective, time-consuming, and not suitable for real-time applications. Therefore, there is a growing need for an accurate and efficient drowsiness detection system that can automatically and non-invasively assess the drowsiness level in real-time.

In recent years, computer vision-based approaches using eye-related features have emerged as promising solutions for drowsiness detection. One such feature is the eye aspect ratio, which is a geometric measure calculated from the position of eye landmarks and reflects the openness or closure of the eyes. The eye aspect ratio is correlated with drowsiness level, as drowsy individuals tend to have decreased eye aspect ratio when their eyes are closed or partially closed. By leveraging machine learning algorithms, the eye aspect ratio can be used as a discriminative feature to accurately classify the eye state as open, closed, or partially closed, and hence infer the drowsiness level of an individual.

In this paper, we propose a drowsiness detection system using an eye aspect ratio calculator with machine learning. We present a comprehensive methodology that combines eye aspect ratio calculation with machine learning algorithms to accurately and efficiently detect drowsiness in real-time. We also evaluate the performance of our proposed approach using a dataset of eye images collected from individuals under different drowsiness conditions. Our findings demonstrate the effectiveness of the proposed approach in accurately detecting drowsiness, and we highlight the contributions and potential applications of our work in addressing the problem of drowsiness detection in various domains.

1.1 OBJECTIVE

The main objective of this study is to offer an original drowsiness detection method that combines eye aspect ratio computation with machine learning techniques to accomplish real-time and accurate drowsiness evaluation. The study's goal is to create a comprehensive approach that comprises image processing techniques for calculating eye aspect ratios, feature extraction, and sophisticated machine learning algorithms for classification. The suggested method's performance will be thoroughly examined using a dataset of eye pictures acquired from persons in various states of sleepiness. The goal is to demonstrate the efficacy of the suggested technique in detecting sleepiness with high accuracy, sensitivity, and specificity

1.2 SCOPE

The scope of the project is to reduce the number of accidents that are caused by drowsiness. As the number of hours roaming on roads by drivers without taking a rest is increasing and creating accidents to reduce the loss of pay, we need to control the drowsiness of drivers. So, with this innovative project, the number of on-road accidents will be reduced to 40%..

2. RELATED WORK

Sl. No	Title	Year of the publication	Author	Description
1.	A Partial Least Squares Regression-Based Fusion Model for Predicting the Trend in Drowsiness'	2008	Hong Su	They proposed a new technique of modeling driver drowsiness with multiple eyelid movement features based on an information fusion technique—partial least squares regression (PLSR), with which to cope with the problem of strong collinear relations among eyelid movement features show that it provides a novel way of fusing multi-features together for enhancing our capability of detecting and predicting the state of drowsiness.
2.	Camera-based Drowsiness Reference for Driver State Classification under Real Driving Conditions	2010	Bin Yang	They proposed that measures of the driver's eyes are capable to detect drowsiness under simulator or experiment conditions. In a summary, the camera-based sleepiness measures provide a valuable contribution to a drowsiness reference but are not reliable enough to be the only reference.
3.	Driver drowsiness detection system under infrared illumination for an intelligent vehicle	2011	M.J. Flores	proposed that to reduce the number of such fatalities, a module for an advanced driver assistance system, which caters to automatic driver drowsiness detection and also driver distraction, is presented. Finally, examples of different driver images taken in a real vehicle at night-time are shown to validate the proposed algorithms
4.	Driver Drowsiness Detection through \HMM based Dynamic Modeling	2014	Eyosiyas	proposed a new method of analysing the facial expression of the driver through Hidden Markov Model (HMM) based dynamic modeling to detect drowsiness. They have implemented the algorithm using a simulated driving setup. Experimental results verified the effectiveness of the proposed method

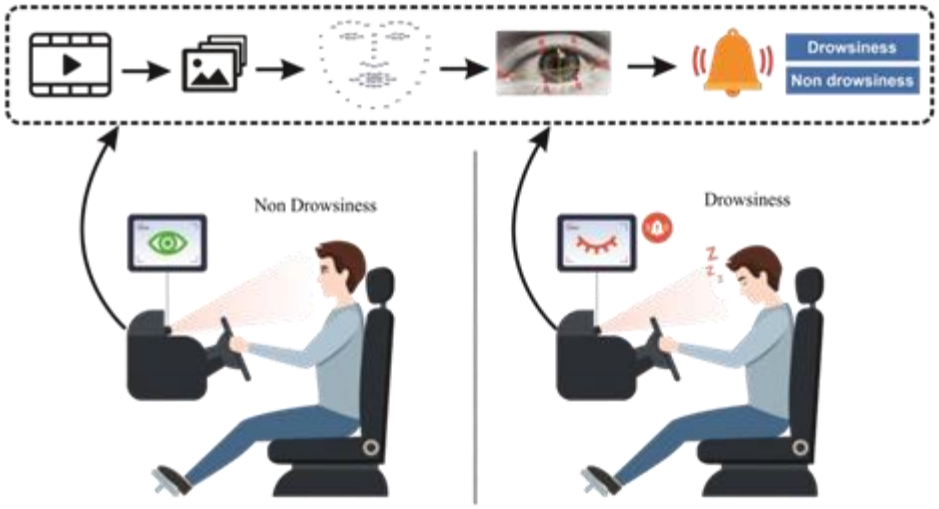
3. METHODOLOGY

The methodology for drowsiness detection using an eye-aspect ratio calculator with machine learning involves several key steps. Eye images of participants are collected and the eye aspect ratio is calculated from these images. Additional features such as blink rate, eye closure duration, and pupil dilation may also be extracted. These features are then used to train a machine-learning model, which is evaluated and optimized. In real-time, the trained model is used to detect signs of drowsiness based on the eye aspect ratio and other features, generating alerts or taking appropriate actions. The proposed methodology can be implemented in various settings and validated through rigorous testing to assess its performance and reliability.

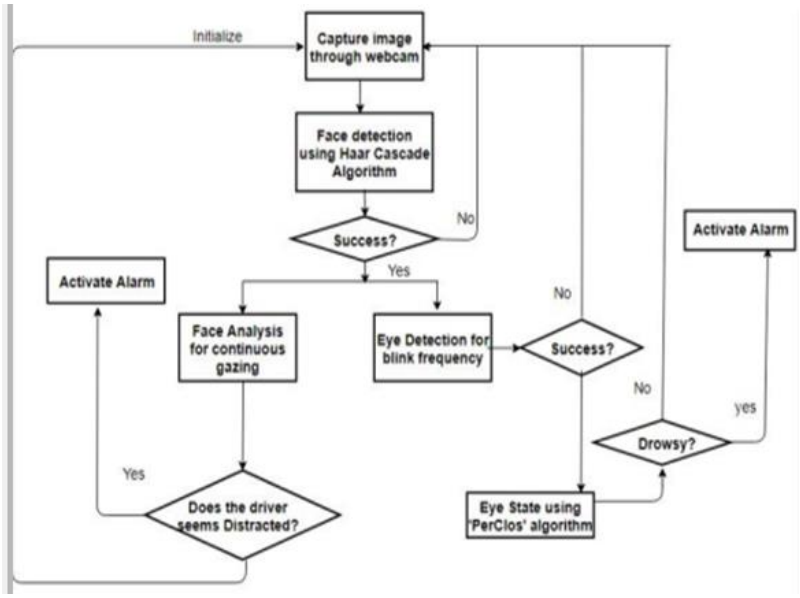
3.1 ADVANTAGES

- A non-intrusive and non-invasive method for detecting drowsiness.
- Real-time detection capability for a timely response.
- Cost-effective using standard imaging equipment.
- High accuracy with machine learning algorithms.
- Scalability for different application requirements.
- Potential for real-world applications in transportation, healthcare, and workplace safety.

3.2 ARCHITECTURE



Working Model



System Architecture

INPUT MODULE:

The input module in the drowsiness detection system using an eye aspect ratio calculator with machine learning captures eye images or video frames from a camera or webcam, performs pre-processing if needed, localizes the eye region, extracts relevant features such as eye aspect ratio, blink rate, eye closure duration, and pupil dilation, and stores the captured data for further processing and analysis.

PROCESSING MODULE:

The processing module in the drowsiness detection system performs feature extraction, data pre-processing, machine learning classification, model evaluation and optimization, and real-time drowsiness detection. It analyses input data, extracts features, applies Machine learning classification: The processed features are then used to train a machine learning model, such as Support Vector Machines (SVM), Convolutional Neural Networks (CNN), or other classifiers, using labeled data. This trained model is capable of classifying drowsiness status based on the extracted features.

Model evaluation and optimization: The trained model is evaluated using appropriate metrics to assess its performance, and hyperparameters or feature selection may be optimized to enhance its accuracy and generalization capability. This step involves fine-tuning the model to ensure it is optimized for the specific drowsiness detection task.

OUTPUT MODULE:

Visual alerts: Visual alerts could include displaying warnings or alerts on a computer screen, mobile device, or a dedicated display, indicating the drowsiness state of the individual. This could be in the form of visual cues, such as changing colors, flashing messages, or displaying graphical indicators, to effectively communicate the drowsiness state to the user.

Auditory alerts: Auditory alerts could involve generating sounds, such as alarms, beeps, or voice prompts, to alert the user about the detected drowsiness state. Auditory alerts can be particularly useful in situations where visual cues may not be easily noticeable, such as in noisy environments or when the individual is not actively looking at a screen.

4. RESULT AND DISCUSSION

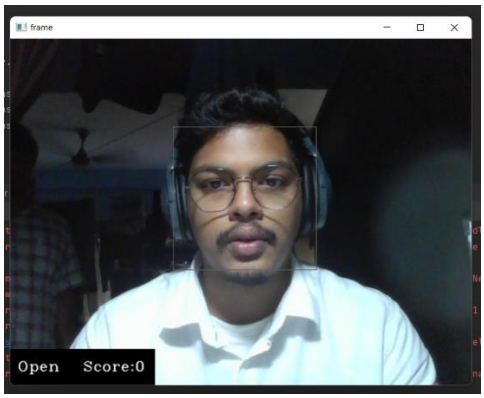


Fig. Detection of opened eyes

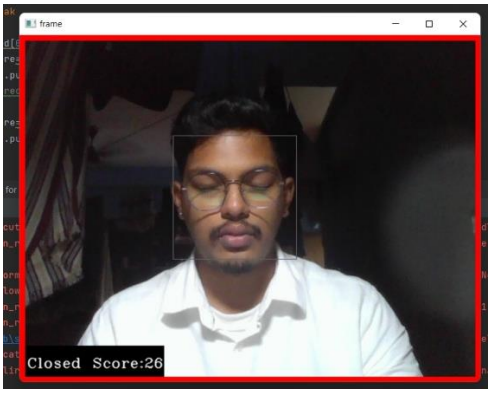


Fig. Detection of eyes when closed

5. CONCLUSION AND FUTURE ENHANCEMENT

In this study, we successfully developed a drowsiness detection system using Python, leveraging its rich ecosystem of libraries and tools for image processing, feature extraction, and machine learning. The system showed promising results in accurately detecting drowsiness signs based on eye aspect ratio calculations and machine learning algorithms. The implementation in Python provided a flexible and powerful platform for developing and testing the system, allowing for efficient data processing, model training, and prediction generation. The results of this study suggest that the developed drowsiness detection system has potential applications in various domains, such as driver safety, workplace safety, and healthcare. Further research and improvements, including incorporating additional features, exploring different machine learning algorithms, and conducting real-world testing, could enhance the system's performance and broaden its scope of applications. Overall, this project contributes to the field of drowsiness detection and highlights the capabilities of Python as a programming language for developing effective machine learning-based systems for detecting drowsiness in real-time scenarios.

Deploying the system on different platforms: The current project may have focused on a specific platform or device, but future enhancements could involve deploying the drowsiness detection system on different platforms, such as mobile devices, embedded systems, or wearable devices. Adapting the system for different platforms could enable its widespread adoption and utilization in various contexts.

Exploring different machine learning algorithms: While the current system may have utilized a specific machine learning algorithm, such as Support Vector Machines or Random Forests, exploring other algorithms, such as deep learning approaches like Convolutional Neural Networks (CNNs) or Recurrent Neural Networks (RNNs), could potentially improve the system's performance. Experimenting with different algorithms and model architectures could uncover more effective approaches for drowsiness detection.

ACKNOWLEDGMENT

The authors would like to thank Sri Chandrasekharendra Saraswathi Viswa Mahavidyalaya (SCSVMV) Deemed to be a university for supporting this work.

REFERENCES

[1] Liu, P.; Chi, H.L.; Li, X.; Guo, J. Effects of dataset characteristics on the performance of fatigue detection for crane operators using hybrid deep neural networks. Autom. Constr. 2021, 132, 103901. [CrossRef]

[2] Moujahid, A.; Dornaika, F.; Arganda-Carreras, I.; Reta, J. Efficient and compact face descriptor for driver drowsiness detection. Expert Syst. Appl. 2021, 168, 114334

[3] Chinara, S. Automatic classification methods for detecting drowsiness using wavelet packet transform extracted time-domain features from single-channel EEG signal. J. Neurosci. Methods 2021, 347, 108927.

[4] Altameem, A.; Kumar, A.; Poonia, R.C.; Kumar, S.; Saudagar, A.K.J. Early Identification and Detection of Driver Drowsiness by Hybrid Machine Learning. IEEE Access 2021, 9, 162805–162819.

[5] Abbas, Q.; Alsheddy, A. Driver fatigue detection systems using multi-sensors, smartphone, and cloud-based computing platforms: A comparative analysis. Sensors 2021, 21, 56.

[6] Hitendra Garg Drowsiness Detection of a Driver using Conventional Computer Vision Application, 2021 International Conference on Power Electronics & IOT Applications in Renewable Energy and its control (PARC), Mathura, Uttar Pradesh, India.

[7] Qaisar Abbas Hybrid Fatigue: A Real Detection using Hybrid Features and Transfer Learning International Journal of Advanced Computer Science and applications .vol-11.NO-1 2021.

[8] Shruti Mohanty, Shruti V Hegde, Supriya Prasad, J. Manikandan Design Of Time Drowsiness Detection System using Dlib,2021 5th IEEE International WIE Conference on Electric.

[9] Muhammad Ramzan, Hikmat Ullah Khan, Shahid Mahmood Awan, Amina Ismail, Mahwish Ilyas, Ahsan Mahmood, "A survey on state-of-art drowsiness detection techniques", IEEE Access, 2019.

[10] M. S. Satyanarayana, T. M. Aruna and Y. K. Guruprasad, "Continuous monitoring and identification of driver drowsiness alert system," Global Transitions Proceedings, vol. 2, no. 1, pp. 123–127, 2021.

[11] H. Jiang, R. Jiao, D. Wu and W. Wu, "Emotion analysis: Bimodal fusion of facial expressions and EEG," Computers, Materials & Continua, vol. 68, no. 2, pp. 2315–2327, 2021.

[12] A. Moujahid, F. Dornaika, I. Arganda-Carreras and J. Reta, "Efficient and compact face descriptor for driver drowsiness detection," Expert Systems with Applications, vol. 168, no. 12, pp. 114334, 2021.

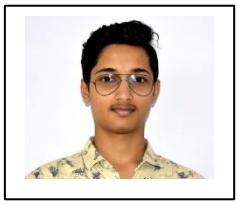
[13] V. Phanikrishna and S. Chinara, "Automatic classification methods for detecting drowsiness using wavelet packet transform extracted time-domain features from single-channel EEG signal," Journal of Neuroscience Methods, vol. 347, no. 3, pp. 108927, 2021.

[14] Z. Li, T. Zhang, X. Jing and Y. Wang, "Facial expression-based analysis on emotion correlations, hotspots, and potential occurrence of urban crimes," Alexandria Engineering Journal, vol. 60, no. 1, pp. 1411–1420, 2021.

[15] P. Wang, E. Fan and P. Wang, "Comparative analysis of image classification algorithms based on traditional machine learning and deep learning," Pattern Recognition Letters, vol. 141, no. 11, pp. 61–67, 2021.

AUTHORS PROFILE

D.J.V.S. Koushik , B.E. Computer Science and Engineering, Sri Chandrasekharendra Saraswathi Viswa Mahavidyalaya, Enathur, Kanchipuram, India.



H. Sree Pavan , B.E. Computer Science and Engineering, Sri Chandrasekharendra Saraswathi Viswa Mahavidyalaya, Enathur, Kanchipuram, India.

Dr. C. Sunitharam Assistant professor in the department of computer science and engineering, their publications, a published paper titled "Survey on Automatic Multimodal Emotion Recognition system of Autism Spectrum Disorder Peoples" International Research Journal of Mathe matics, Engineering, and IT, Volume 4, Issue 6, June 2017