IARJSET ISSN (O) 2393-8021, ISSN (P) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

Impact Factor 8.311 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 12, Issue 11, November 2025

DOI: 10.17148/IARJSET.2025.121130

SMART DROWSY DETECTION USING IOT INTEGRATION

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Abstract: Driver drowsiness is a major contributor to road accidents worldwide, leading to numerous injuries and fatalities each year. This project aims to develop a real-time drowsiness detection system using Python and Google's MediaPipe framework. By analyzing facial landmarks, particularly the eyes, the system can detect signs of drowsiness such as frequent blinking or prolonged eye closure. The Eye Aspect Ratio (EAR) is calculated to monitor eye state, triggering alerts when drowsiness is detected. This low-cost, non-invasive solution enhances road safety by preventing accidents due to driver fatigue. The project emphasizes real-time processing, ease of deployment, and accuracy.

Keywords: Drowsiness detection, MediaPipe, Python, Eye Aspect Ratio (EAR), Driver safety, Realtime monitoring, Facial landmarks, Computer vision, OpenCV.

I. INTRODUCTION

In today's fast-paced world, road transportation plays a crucial role in commuting and logistics. However, fatigue-related accidents remain a serious concern, especially among long-distance drivers. Drowsiness impairs a driver's ability to focus and react, increasing the risk of accidents. This project introduces a solution that uses computer vision techniques to detect signs of drowsiness based on facial landmark tracking. Utilizing the MediaPipe library in Python, the system identifies and monitors eye movements to determine the driver's state. If signs of drowsiness are detected, the system issues a timely alert, potentially preventing dangerous situations.

A. Problem Statement

Many road accidents are caused by drivers falling asleep or becoming inattentive due to fatigue. Traditional systems such as steering behavior or lane monitoring are not always reliable or fast enough to detect early signs of drowsiness. There is a need for a low-cost, efficient, and real-time solution that can accurately detect driver drowsiness based on facial features without requiring expensive hardware.

B. Motivation

Drowsiness while driving is a leading cause of road accidents, often resulting in severe injuries and fatalities. With the increasing reliance on road transport for both personal and commercial use, the need for intelligent systems that can detect fatigue early and alert the driver is more critical than ever. Many accidents occur due to a lack of immediate awareness when drivers begin to lose alertness. Existing solutions can be expensive or lack realtime responsiveness. This project is motivated by the goal of creating a cost-effective, accurate, and nonintrusive drowsiness detection system that enhances road safety by identifying early signs of driver fatigue and taking timely preventive action.

C. Objectives

- To develop a real-time drowsiness detection system using MediaPipe and Python.
- To track and analyze facial landmarks, especially eye movements, using the Eye Aspect Ratio (EAR).
- To issue alerts when signs of drowsiness such as prolonged eye closure are detected.
- To ensure system efficiency, accuracy, and suitability for basic hardware like webcams.
- To explore the adaptability of the system across various vehicle types, including personal and commercial use.
- To minimize false positives and ensure userfriendly, real-time responsiveness.

II. LITERATURE REVIEW

"Driver Drowsiness Detection Using Swin Transformer and Diffusion Models for Robust Image Denoising" This study presents a robust driver drowsiness detection system using a Swin Transformer-based deep learning model combined with a denoising diffusion model for enhanced realworld performance. Focused on detecting prolonged eye closure, it employs a U-Net-based preprocessing stage to reduce noise and resist adversarial attacks. Adversarial training

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(FGSM and PGD) further boosts model resilience. Evaluated on Eye-Blink and CEW datasets, the system achieves high accuracy (up to 99.82%) and strong image quality metrics (PSNR, SSIM), outperforming existing models. Its real-time capabilities and robustness make it highly suitable for practical deployment in driver monitoring applications[1].

"Enhancing convolutional neural networks in electroencephalogram driver drowsiness detection using human inspired optimizers" This study investigates EEG-based driver drowsiness detection using deep neural networks optimized with two metaheuristic algorithms: Teaching Learning-Based Optimization (TLBO) and Student Psychology-Based Optimization (SPBO). Both improved CNN performance in modeling EEG temporal patterns, achieving high AUC scores—0.926 for TLBO and 0.920 for SPBO. TLBO produced a simpler model, while SPBO optimized faster but resulted in a more complex architecture. The results demonstrate the potential of human-inspired optimization methods to enhance drowsiness detection, supporting the development of safer driving technologies[2].

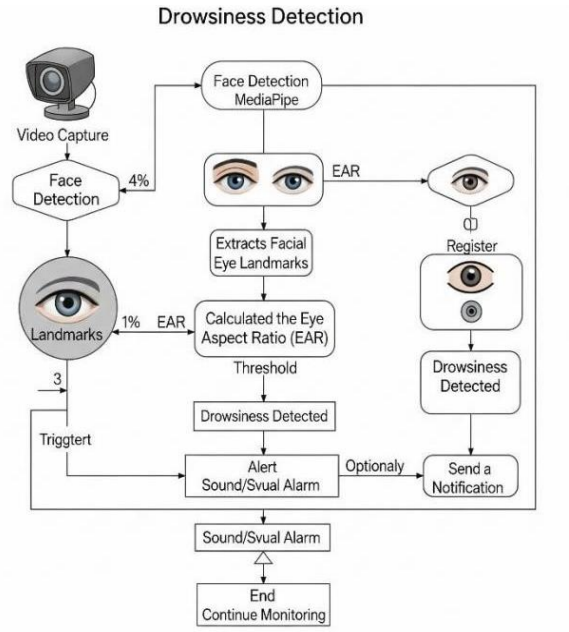
"Validation and interpretation of a multimodal drowsiness detection system using explainable machine learning" This study enhances drowsy driving detection by combining EEG, EOG, and ECG signals with machine learning models (KNN, SVM, RF), emphasizing robustness and explainability. Multiple validation techniques were used to assess performance, while SHAP and partial dependency analysis helped interpret model decisions, making the system more trustworthy and transparent for realworld applications[3].

"Real-Time Driver Drowsiness Detection Using CNN, MediaPipe, and ML Classifiers" This study addresses the critical issue of driver drowsiness by comparing deep learning and machine learning techniques for effective detection. Transfer learning using pretrained CNN models (VGG16 and ResNet50)was applied, with ResNet50 achieving 95% validation accuracy.

Additionally, 52 facial features extracted via MediaPipe were used with traditional classifiers, where Random Forest achieved 97% test accuracy. The study highlights the impact of data format, model architecture, and hyperparameter tuning, demonstrating strong potential for real-time drowsiness detection and enhanced road safety[4].

"IoT-Enabled Drowsiness Detection Systems for Enhanced Road Safety Across Diverse Vehicle Types" This study proposes three versatile driver drowsiness detection systems aimed at enhancing road safety across various vehicle types. The models include an IR sensor-based prototype, a wearable device for two/three-wheelers, and a webcam-based solution using computer vision techniques like EAR and MAR. Each model detects drowsiness through eye and mouth movements, triggering alarms or alerts. The webcam model also supports real-time performance monitoring and emergency notifications, making these systems effective for both personal and commercial use [5].

III. METHODOLOGY



IV. CONCLUSION

The drowsiness detection system developed using MediaPipe and Python provides a real-time, efficient, and non-intrusive solution to enhance driver safety by monitoring eye movements and identifying signs of fatigue such as prolonged eye closure or frequent blinking. By calculating the Eye Aspect Ratio (EAR) from facial landmarks, the system

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accurately detects drowsiness and triggers alerts to prevent potential accidents. Its lightweight and cost-effective design make it suitable for realworld deployment without the need for expensive hardware. This project demonstrates the practical application of computer vision in addressing a critical road safety issue and lays the foundation for future enhancements like yawning detection, head pose estimation, and integration with advanced driver assistance systems.

ACKNOWLEDGMENT

Author is thankful to Department of CCE, K S. Institute of Technology, Bengaluru for assisting and supporting in the preparation of this by providing conceptual contributions and evaluating key data.

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