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Driver Drowsiness Detection using AI

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ABSTRACT: Driver drowsiness is a leading cause of road accidents, often resulting in serious consequences due to delayed human response. This project proposes a real-time Driver Drowsiness Detection System that uses facial landmark tracking and behavioural analysis to identify signs of fatigue. The system employs OpenCV and dlib libraries to monitor facial features such as eyes and mouth, calculating metrics like Eye Aspect Ratio (EAR) and blink rate to detect prolonged eye closure, yawning, and head nodding. When drowsiness is detected, the system issues an audio alert and, if necessary, sends an SMS notification to a predefined emergency contact via an integrated API. Designed with affordability and scalability in mind, this solution utilizes standard webcams and open-source technologies, making it both practical and accessible. By combining computer vision with real-time alert mechanisms, the system enhances road safety, especially for long-distance drivers.

Keywords: Driver drowsiness, Eye Aspect Ratio (EAR), OpenCV, dlib, facial landmark detection, SMS alert, computer vision, real-time monitoring, road safety.

1. Introduction

Drowsy driving is one of those silent dangers on the road that often goes unnoticed—until it's too late. Unlike distractions like phones or loud music, fatigue creeps in slowly, reducing a driver's focus, slowing down their reaction time, and affecting their judgment without them even realizing it. It's a major cause of road accidents worldwide, leading to serious injuries, fatalities, and property damage.

Thanks to recent advancements in computer vision and AI, we now have the tools to detect signs of fatigue in real time. This project takes advantage of those tools to build a Driver Drowsiness Detection System that's not only effective but also affordable and easy to implement. Unlike high-end commercial systems that rely on expensive hardware, our solution uses open-source libraries like OpenCV and dlib, along with a standard webcam, to monitor the driver's facial expressions and behaviour.

The system keeps an eye on key indicators like eye aspect ratio, blinking rate, and head movement to figure out when a driver might be getting too tired to drive safely. And it doesn't stop there—if signs of drowsiness are detected, it immediately triggers an audio alert. If the drowsiness continues or the driver doesn't respond, the system sends an SMS notification to a pre-set emergency contact using an API. This extra layer of safety ensures that help can be called in if needed.

By focusing on accessibility and real-time response, this system can make a real difference—whether it's for solo drivers on long trips, fleet management, or even public transport. The goal is simple: catch drowsiness before it turns into danger and give drivers the chance to act before an accident happens.

2. Recent Works

2.1 VigilEye – Artificial Intelligence-based Real-time Driver Drowsiness Detection (Sengar et al., 2024)

Sengar, Kumar, and Singh (2024) introduced VigilEye, an AI-powered system designed to detect driver drowsiness in real time. The system incorporates deep learning and computer vision techniques to monitor facial cues indicative of drowsiness, such as eye closure and yawning frequency. It aims to alert drivers before fatigue impairs their driving performance, contributing to road safety**.**

2.2 Drowsiness Detection in Real-Time via Convolutional Neural Networks (2024)

This 2024 study proposes a real-time drowsiness detection framework that leverages Convolutional Neural Networks (CNNs) to process video input and classify driver alertness. The CNN model is trained to identify facial landmarks and blinking patterns, providing an efficient and accurate solution for on-the-fly detection in automotive environments.

2.3 Drowsiness Detection in Drivers Using Facial Feature Analysis (2025)

Published in 2025, this research focuses on the use of facial feature analysis to detect drowsiness in drivers. The system captures facial landmarks such as eyelid movement, eyebrow positioning, and head tilt. By analyzing these features in real time, it offers an effective way to identify signs of fatigue and prevent accidents caused by driver inattention.

2.4 Early Detection of Driver Drowsiness Using Ensemble Machine Learning Based on Hybrid Sensing (Gwak et al., 2020)

Gwak, Hirao, and Shino (2020) developed a system that combines ensemble machine learning models with hybrid sensing inputs, including visual and biometric data. This approach enhances early detection accuracy by integrating multiple sensor streams. The system was developed at the University of Tokyo and demonstrates strong potential for commercial deployment in smart vehicles.

2.5 Drowsiness Detection with OpenCV (Rosebrock, 2017)

Adrian Rosebrock (2017) presented a tutorial-based approach using OpenCV for drowsiness detection. His work demonstrates a lightweight, real-time solution using computer vision techniques to detect prolonged eye closure. The approach is suitable for prototyping and demonstrates how accessible tools can be employed in developing practical driver monitoring systems.

2.6 Driver Drowsiness Detection using ANN Image Processing (Vesselenyi et al., 2017)

In 2017, Vesselenyi et al. proposed a driver drowsiness detection method utilizing Artificial Neural Networks (ANN) and image processing techniques. The system processes facial images to detect patterns associated with fatigue. Developed at the University of Oradea, this method laid the groundwork for early AI-based fatigue detection systems in the automotive sector.

3. Proposed System

The Driver Drowsiness Detection System uses real-time computer vision techniques to monitor a driver's facial features for signs of fatigue. A standard webcam captures the driver's face, and OpenCV along with dlib are used to detect facial landmarks, such as the eyes, mouth, and nose. The system calculates the Eye Aspect Ratio (EAR) to assess eye closure, which is a key indicator of drowsiness. It also monitors blink rate, head pose, and yawning— additional signs of fatigue— ensuring a comprehensive analysis of the driver's alertness.

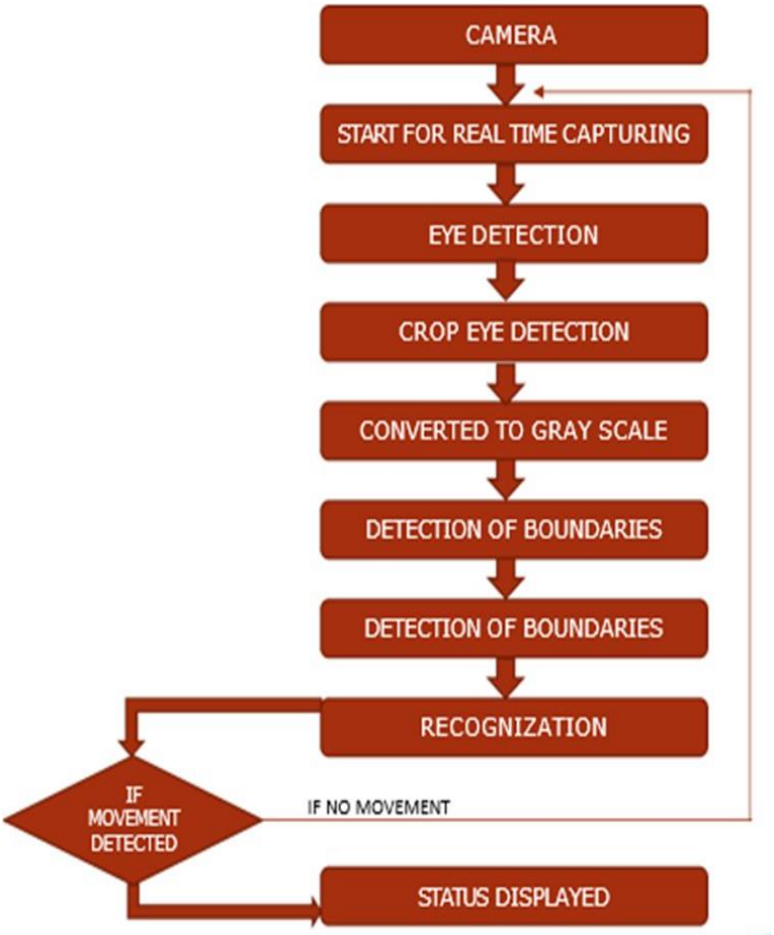
If the system detects prolonged eye closure or abnormal blinking patterns, it triggers an audio alert to warn the driver. In addition to the audio alert, SMS notifications are sent to a predefined emergency contact. These notifications contain vital information, including the driver's status and

location (if GPS integration is used), ensuring timely assistance if the driver does not respond to the initial alert. This dual-alert system provides an extra layer of safety by notifying others in case of an emergency.

Designed to be affordable and non-invasive, the system uses open-source libraries and standard hardware, making it cost-effective and easy to integrate into any vehicle. Its use of readily available technology makes it accessible to a broad range of users, from individual drivers to fleet operators. The system is scalable, providing a flexible solution that can be expanded for large-scale deployment, ensuring improved safety on the road.

3.1 Advantages of the Driver Drowsiness Detection System:

- **Cost-Effective:** Uses affordable webcams and open-source libraries, making it accessible without expensive hardware.
- **Real-Time-Analysis:** Processes video input instantly, enabling immediate alerts and minimizing accident risks.
- **Enhanced-Driver-Safety:** Provides audio and visual alerts, plus SMS notifications to emergency contacts for added safety.
- **Easy-Integration:** Simple setup with just a webcam and processing unit, making it easy to implement in vehicles.
- **Scalability-and-Flexibility:** Can be adapted for various applications and customized alerts for different user needs.
- **Increased-Awareness-of-Driver-Behaviour:** Tracks driver alertness patterns, offering insights for improved safety practices.
- **Improved-Road-Safety:** Reduces drowsiness-related accidents, enhancing road safety and reducing costs.

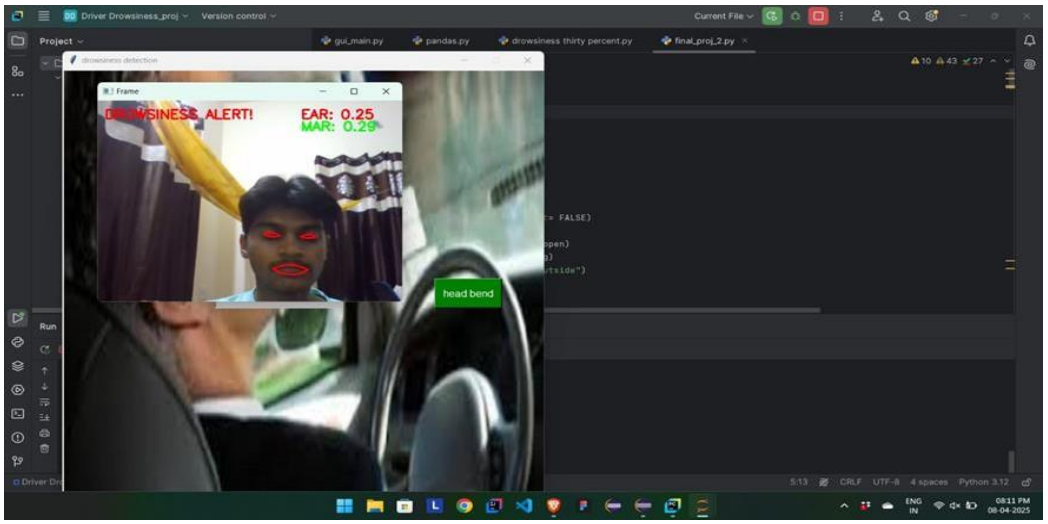


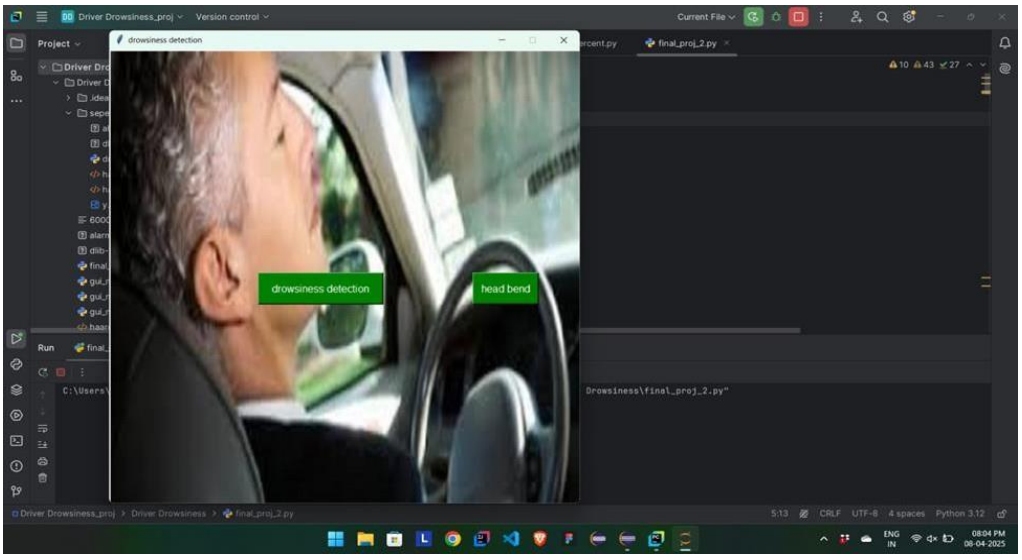
4. Result

The Drowsiness Detection System effectively identifies signs of fatigue in real time using facial landmark detection and a Convolutional Neural Network (CNN). By analysing key features such as eye closure, blink rate, and yawning frequency through a standard webcam, the system achieves high accuracy in detecting drowsiness across varying lighting conditions and facial orientations. Once signs of drowsiness are detected, it triggers an immediate audio alert and sends an SMS notification to a predefined emergency contact using integrated APIs.

The system requires no specialized hardware or microcontrollers, relying solely on general computing resources for processing. Thism ensures cost efficiency, easy deployment, and portability. The use of CNN enhances the robustness of detection and minimizes false alarms, making it a practical and scalable solution for improving road safety through early fatigue detection.

4.1 Preparation of Figures





5. Conclusion

The proposed driver drowsiness detection system leverages deep learning and computer vision techniques to monitor real-time facial cues and accurately identify signs of fatigue. By utilizing Dlib, OpenCV, and CNN, the system offers a reliable and efficient way to reduce the risk of road accidents caused by drowsy driving. This project not only enhances driving safety but also demonstrates the practical application of AI in real-world scenarios. With further optimization,

the model can be integrated into vehicles as a life-saving assistant.

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