Real-Time Driver Drowsiness &Distraction Detection with Live Monitoring & Emergency Alert System

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Keywords:

Driver Drowsiness Detection, Alcohol Detection, Eye Aspect Ratio, Machine Vision, MQ3 Sensor, ESP-32, RealTime Monitoring.

Introduction:

Road traffic accidents remain a major global safety challenge, with driver fatigue and alcohol consumption identified as leading causes. This project proposes the development of a smart, real-time embedded safety system designed to continuously assess driver alertness and detect alcohol impairment. Driver drowsiness is identified using computer vision–based facial analysis, where facial landmarks are tracked to compute the Eye Aspect Ratio (EAR). Alcohol presence is detected through breath analysis using an MQ3 alcohol sensor. When hazardous conditions are identified, the system immediately issues preventive alerts via a buzzer and an OLED display, enabling timely corrective action. The solution is implemented on an ESP32 platform and utilizes Python with OpenCV for real-time image processing. This cost effective and non-intrusive system bridges the gap between expensive commercial driver monitoring solutions and conventional reactive safety mechanisms. Experimental results indicate reliable real-time performance with high detection accuracy and reduced false alarms, making the system a practical and proactive approach to improving road safety.

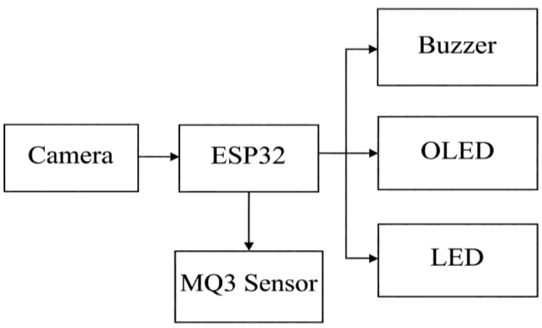

Figure 1: Architecture of the Proposed System.

Objectives:

1.To detect driver drowsiness using eye monitoring and the Eye Aspect Ratio.
2. To detect alcohol levels using the MQ3 sensor.
3. To alert the driver instantly using a buzzer and OLED display.
4. To develop the system using ESP32 to make it low-cost and Portable.
5. To reduce accidents by identifying drowsiness or intoxication early

Methodology:

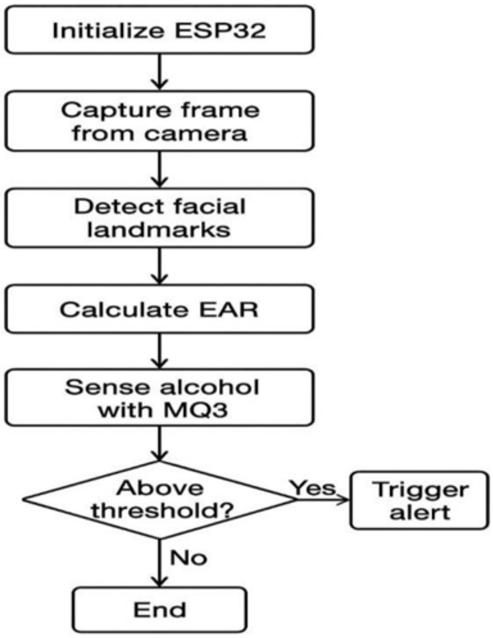

Figure 2: Methodology of Driver Drowsiness and Distraction Detection System.

Result and Conclusion:

In conclusion,

1. The system achieved up to 95% accuracy in detecting driver drowsiness.
2. 98% accuracy in normal conditions and 95% accuracy in both drowsy and low-light conditions.
3. Operates in real time with a fast response of ~0.2 seconds.
4. Minimal false positives, mainly during rapid blinking or sudden movements.
5. Performs well under slight head movement and partial occlusion.
6. Performance decreases when eyes are fully covered (e.g., heavy sunglasses).
7. Provides a **cost-effective and reliable solution** for driver safety.
8. Suitable for real-world implementation with scope for future improvements.

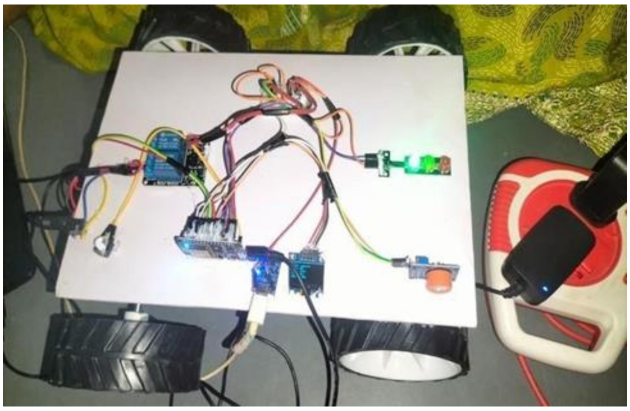

Figure *3*: Hardware Prototype Setup of the Proposed Real-Time Drowsiness & Distraction Detection System.

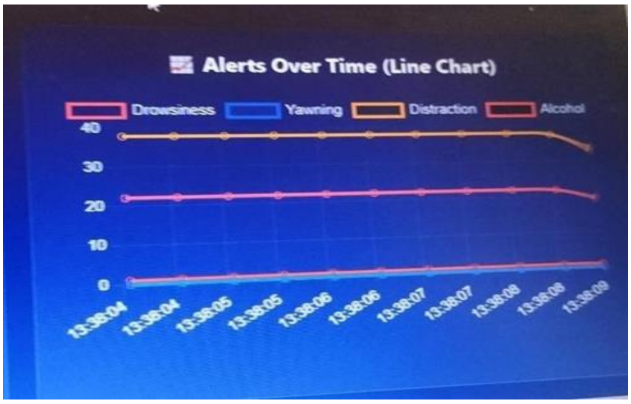

Figure *4*: EAR variation over time showing drowsiness detection and alert triggering.

Figure *5*: Detection accuracy under different test conditions.

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Future Scope:

The future scope of this project includes:

1. Integration of advanced machine learning and deep learning algorithms to improve detection accuracy under complex real-world conditions.
2. Incorporation of head pose estimation and facial expression analysis for enhanced driver monitoring.
3. Development of a mobile or cloud-based application for real-time data logging and remote monitoring.
4. Enhancement of performance under extreme conditions such as complete eye occlusion and poor lighting.
5. Integration with vehicle systems for automatic control actions such as speed reduction or lane correction.
6. Expansion to detect additional factors like driver distraction, alcohol consumption, and emotional state.
7. Implementation of IoT-based alert systems to notify emergency contacts in critical situations.
8. Optimization of the system for low-power embedded platforms to ensure cost-effectiveness and scalability.