

Driver Drowsiness and Alcohol Detector With Real-Time GPS Tracking

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Abstract

Driver drowsiness and alcohol consumption are major causes of road accidents worldwide. This paper presents an integrated driver safety system that combines real-time drowsiness detection and alcohol detection to prevent impaired driving. Computer vision techniques using OpenCV analyse facial features such as eye closure and yawning to identify driver fatigue, while an embedded alcohol sensor detects alcohol presence in the driver's breath and restricts vehicle ignition when thresholds are exceeded. GPS and GSM modules provide location tracking and emergency alerts. The proposed system improves road safety through early detection and timely intervention and is suitable for intelligent transportation applications.

Keywords: Driver Drowsiness Detection, Alcohol Detection, Computer Vision, Embedded Systems, OpenCV, Machine Learning, GPS, GSM, Road Safety, Intelligent Transportation Systems

1. Introduction

Road traffic accidents pose a serious threat to public safety, with driver drowsiness and alcohol consumption being two of the leading causes [1]. Fatigue reduces alertness and reaction time, while alcohol impairs judgment and motor coordination, significantly increasing the risk of accidents. Existing safety measures are often reactive rather than preventive and fail to detect driver impairment in real time [2]. To address these challenges, this project proposes an integrated driver safety system that combines computer vision-based drowsiness detection with sensor-based alcohol detection [3]. By continuously monitoring driver behavior and alcohol levels, the system enables early detection of impairment and timely intervention, thereby improving road safety and supporting intelligent transportation systems [4].

2. Related Work

Previous research on driver drowsiness detection has explored various approaches, including physiological signal monitoring, vehicle behavior analysis, and computer vision-based methods [5].

Among these, vision-based techniques using facial features such as eye closure, blink rate, and yawning have gained popularity due to their non-intrusive nature and real-time capability [6]. Machine learning and image processing algorithms implemented with OpenCV have shown promising accuracy; however, their performance can be affected by lighting variations, head movements, and occlusions [7]. Alcohol detection systems have primarily been developed using embedded platforms with gas sensors such as MQ-series sensors to detect alcohol concentration in the driver's breath [8]. These systems typically prevent vehicle ignition or send alerts using GSM and GPS modules when alcohol levels exceed predefined limits [9]. While effective in detecting drunk driving, most existing systems operate independently of driver behavior monitoring. Limited research has focused on integrating both drowsiness and alcohol detection in a unified system [10]. The proposed work builds upon existing studies by combining computer vision-based

drowsiness detection with embedded alcohol sensing to provide a more reliable and comprehensive driver safety solution [11].

3. System Architecture

The overall architecture of the proposed integrated

driver safety system is illustrated in **Fig. 1**. The system is designed to monitor driver drowsiness and alcohol consumption simultaneously and to initiate preventive actions in real time [12].

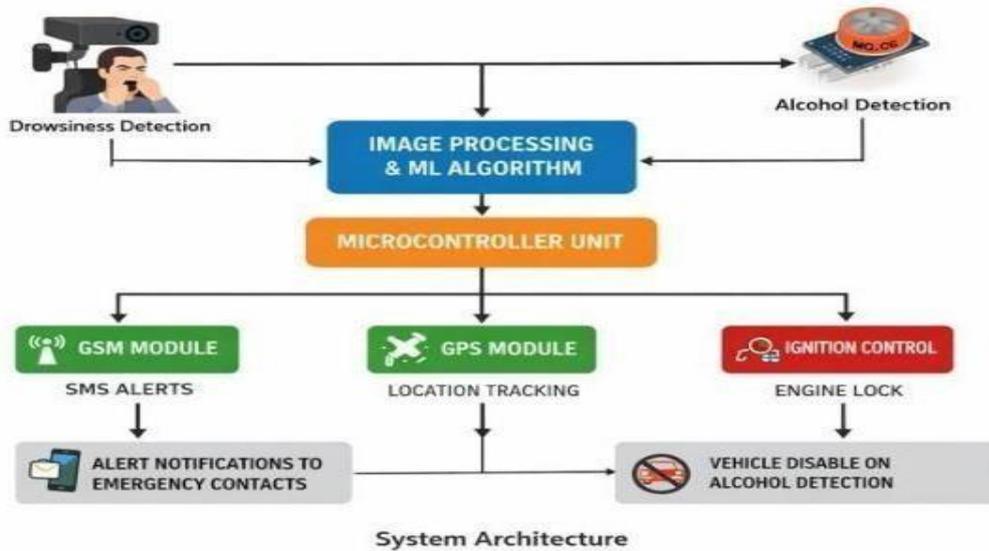


Figure 1 System Architecture of the Integrated Driver Drowsiness and Alcohol Detection System

A camera mounted inside the vehicle continuously captures the driver's facial images. These images are processed using computer vision techniques and machine learning algorithms to extract facial features such as eye closure duration, blink frequency, and yawning patterns for drowsiness detection. In parallel, an alcohol sensor (MQseries) placed near the driver detects the presence of alcohol in the driver's breath. The sensor outputs are compared against predefined threshold values to determine intoxication levels [13]. The final stage is the Early Detection and Diagnosis System, which integrates patient demographics, cognitive assessment scores, and extracted biomarkers. The system generates a risk score indicating the likelihood of early Alzheimer's. A clinician-friendly interface presents a detailed report, helping support early diagnosis and intervention. Both the drowsiness detection results and alcohol sensor readings are forwarded to a central microcontroller unit, which acts as the decision-making module [14]. When drowsiness or alcohol presence is detected beyond safe limits, the

system activates alert mechanisms. A GSM module is used to send warning messages to predefined emergency contacts, while a GPS module provides real-time location information. Additionally, an ignition control unit is integrated to restrict or disable vehicle operation when alcohol consumption is detected. This unified architecture enhances system reliability, ensures timely intervention, and improves overall road safety [15].

4. System Overview

The proposed system aims to enhance road safety by integrating driver drowsiness detection and alcohol detection into a single unified framework. The system continuously monitors the driver's physical condition and alcohol consumption level in real time and initiates appropriate preventive actions when unsafe conditions are detected. By combining software-based vision analysis with hardware based sensing, the system improves reliability and reduces accident risks. This fig 2 illustrates the overall architecture of the integrated driver safety system, showing the interaction between the drowsiness

detection module, alcohol detection module, control and communication module, and safety intervention mechanisms.

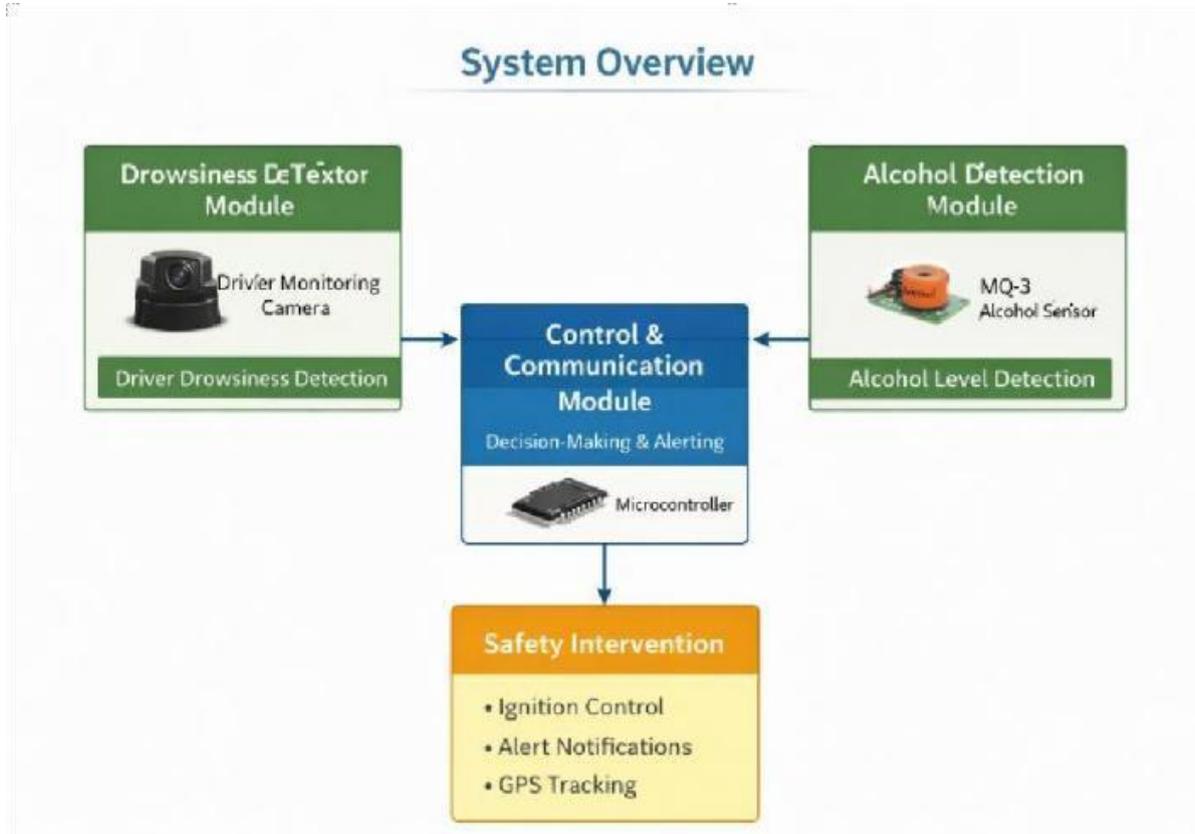


Figure 2 The Flowchart Image for System Overview

5. Proposed System

The proposed system is an integrated intelligent driver safety solution designed to detect driver drowsiness and alcohol consumption in real time and to initiate preventive actions to reduce road accidents. The system combines computer vision-based software analysis with embedded hardware sensing to improve reliability and detection accuracy. For drowsiness detection, a camera installed inside the vehicle continuously captures the driver's facial images. These images are processed using OpenCV and machine learning algorithms to analyze facial features such as eye closure duration, blink rate, and yawning frequency. When the extracted features exceed predefined thresholds, the driver is identified as drowsy. In parallel, an alcohol detection module based on an MQ-series gas sensor monitors the driver's breath for alcohol presence. If the detected

alcohol level exceeds the permissible limit, the system restricts vehicle ignition to prevent unsafe driving. All sensor outputs are handled by a central microcontroller unit that performs decision-making and control operations. Upon detecting unsafe conditions, the system activates alert mechanisms using a GSM module to send notifications and a GPS module to transmit real-time location data. The proposed system ensures early detection, timely alerts, and effective intervention, making it suitable for deployment in intelligent transportation and advanced driver assistance.

5.1. Drowsiness Detection Module

The drowsiness detection module employs a camera mounted inside the vehicle to capture continuous facial images of the driver. Computer vision techniques using OpenCV are applied to extract facial features such as eye aspect ratio,

blink rate, and yawning frequency. Machine learning-based classification is used to determine the drowsiness state by comparing these features

with predefined threshold values.

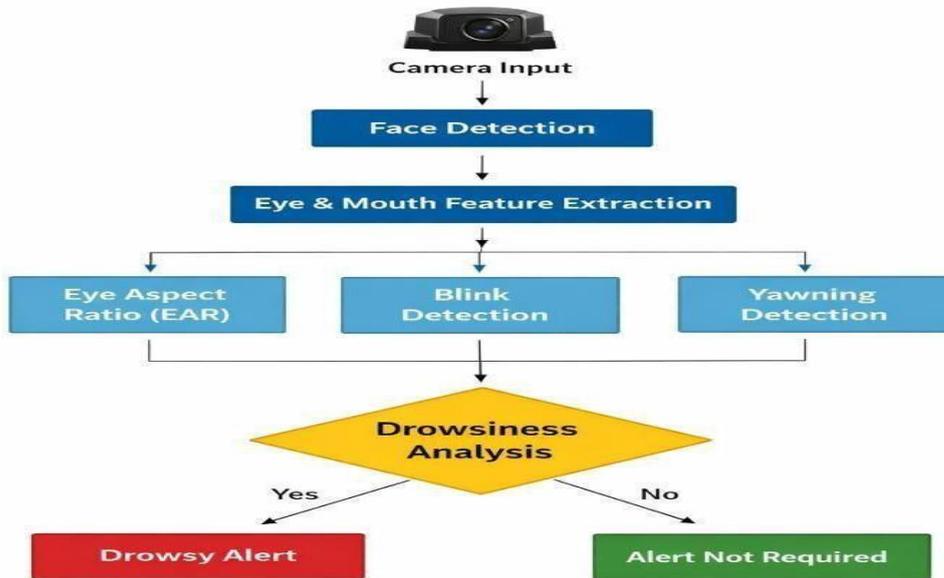


Figure 3 Drowsiness Detection Module With Workflow

This figure 3 shows the workflow of the drowsiness detection process, where camera input is processed to extract facial features such as eye aspect ratio, blink frequency and yawning patterns, followed by analysis.

5.2. Alcohol Detection Module

The alcohol detection module utilizes an MQ-series alcohol sensor positioned near the driver to

detect alcohol concentration in the breath. The sensor output is analyzed by the microcontroller to determine whether the detected level exceeds the permissible limit. If alcohol presence is confirmed, the system immediately restricts vehicle ignition to prevent unsafe driving.

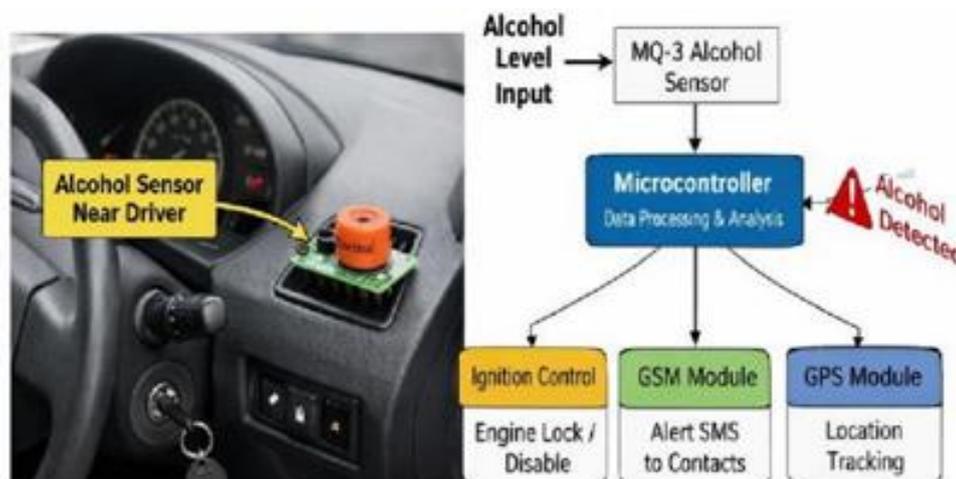


Figure 4 Alcohol Detection Module With Workflow

This fig 4 shows the MQ-3 alcohol sensor detecting alcohol in the driver’s breath and sending the data to the microcontroller, which triggers ignition control and alert mechanisms when the threshold is exceeded. triggers ignition control and alert actions when thresholds are exceeded.

5.3. Control and Communication Module

A central microcontroller unit acts as the decision

making component, integrating inputs from the drowsiness and alcohol detection modules. When abnormal conditions are detected, a GSM module sends alert messages to predefined contacts, while a GPS module provides real time location tracking for emergency response.

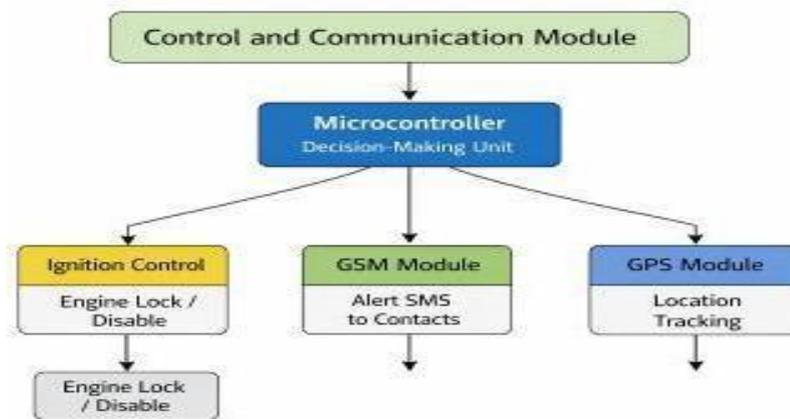


Figure 5 Control and Communication Module With Workflow

This figure 5 illustrates the control and communication module in which a central microcontroller receives inputs from the drowsiness and alcohol detection modules and coordinates system responses through GSM-based alert messaging, GPS- based location tracking, and ignition control for vehicle safety enforcement.

5.4. Safety and Intervention Mechanism

The safety mechanism initiates immediate action

when drowsiness or alcohol presence is detected. It triggers driver alerts, sends emergency notifications with location details, and disables vehicle ignition when necessary to prevent unsafe driving. The integrated response ensures early intervention and reduces the risk of accidents. This mechanism enhances overall system reliability and supports intelligent transportation safety applications.

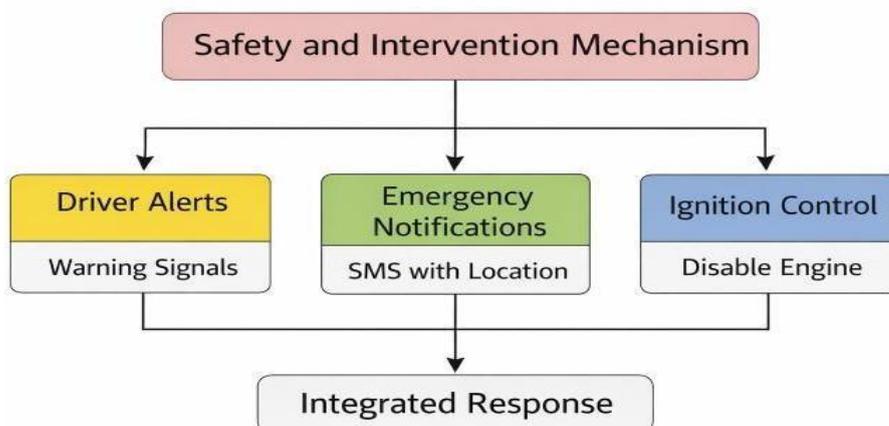


Figure 6 Safety and Intervention Mechanism

This figure 6 illustrates the safety response of the system, where driver alerts, emergency notifications, real-time location tracking, and ignition control are activated when drowsiness or alcohol detection exceeds safe limits.

6. Detection Analysis and Performance Evaluation

The detection analysis evaluates the effectiveness of the proposed system in identifying driver drowsiness and alcohol consumption under real-time conditions. The system performance was analyzed based on continuous monitoring, threshold-based detection, and timely response

mechanisms.

6.1. Drowsiness Detection Analysis

The drowsiness detection module analyzes facial features such as eye closure, blink rate, and yawning using OpenCV- based computer vision techniques. Eye Aspect Ratio (EAR) is monitored in real time, and prolonged eye closure or abnormal blinking patterns are classified as drowsiness. The system effectively detected fatigue during testing and triggered timely alerts, though performance may be affected under poor lighting conditions.

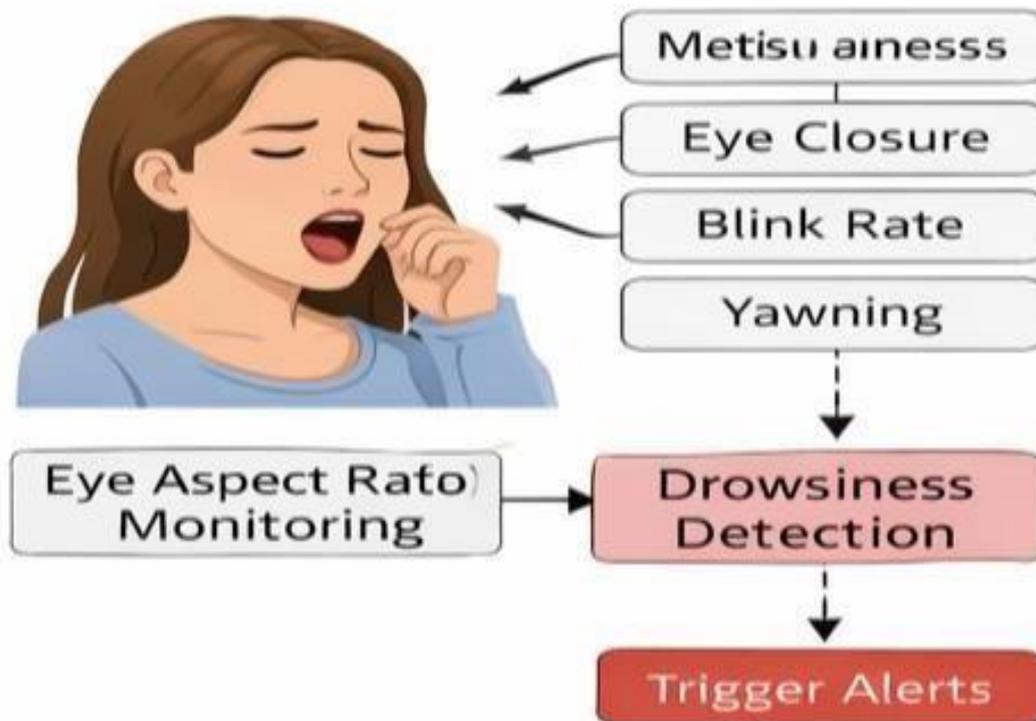


Figure 7 Drowsiness Detection Analysis

This figure 7 depicts the drowsiness detection process based on facial feature analysis, where eye closure duration, blink rate, and yawning patterns are monitored using computer vision techniques to identify driver fatigue in real time.

6.2. Alcohol Detection Analysis

The alcohol detection module employs an MQ-

series gas sensor to monitor alcohol concentration in the driver's breath. The sensor output is compared with a predefined threshold, and when exceeded, the system disables vehicle ignition and activates alert mechanisms. Testing confirmed reliable alcohol detection and effective prevention of vehicle operation under intoxicated conditions.

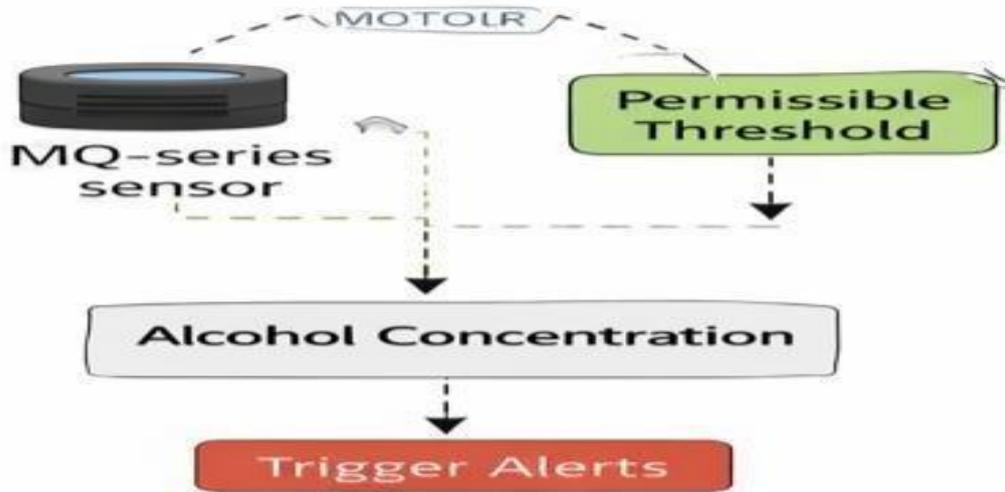


Figure 8 Alcohol Detection Analysis

This figure 8 illustrates the alcohol detection mechanism using an MQ-series sensor, which measures alcohol concentration in the driver’s breath and triggers ignition control and alert actions when the threshold is exceeded.

6.3. Integrated System Analysis

The integrated system combines drowsiness and alcohol detection to improve reliability and decision

accuracy. A central microcontroller processes inputs from both modules and triggers alerts, ignition control, and emergency notifications using GSM and GPS. This combined approach enables real-time monitoring, early intervention, and enhanced road safety.

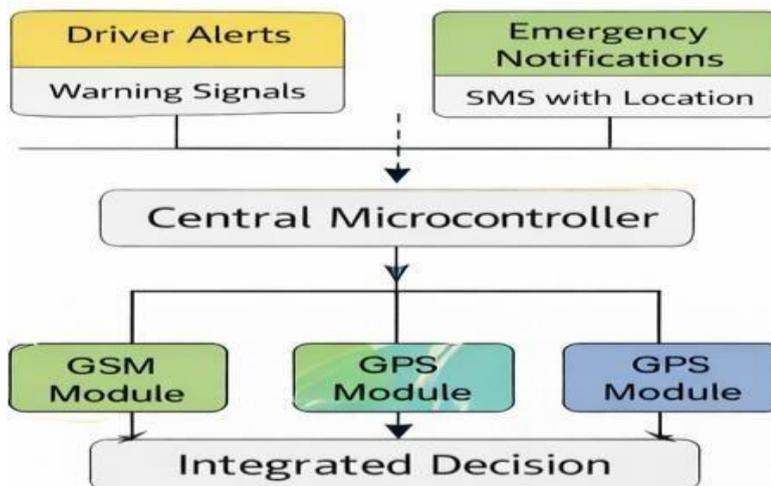


Figure 9 Integrated System Analysis

This figure 9 shows the integrated analysis of drowsiness and alcohol detection modules, where a central microcontroller processes inputs and activates alerts, ignition control, and emergency notifications through GSM and GPS modules.

Conclusion

This paper proposed an integrated driver safety system that combines vision-based drowsiness detection and sensor-based alcohol detection for real-time monitoring. The drowsiness detection

module employs OpenCV-based facial feature extraction and Eye Aspect Ratio (EAR) analysis to identify fatigue-related behaviors such as prolonged eye closure and abnormal blinking. The alcohol detection module utilizes an MQ-series gas sensor with threshold-based decision logic to prevent vehicle operation under intoxicated conditions. A central microcontroller processes inputs from both modules and activates safety interventions including driver alerts, ignition control, and emergency notifications through GSM and GPS modules. Experimental evaluation confirms that the system provides timely detection, low-latency response, and reliable performance under controlled conditions. Future work will focus on improving robustness under varying illumination and head pose conditions by incorporating deep learning-based facial analysis techniques. Sensor fusion with additional physiological signals, cloud-based data logging, and mobile application integration can further enhance system accuracy and scalability. Additionally, real-world vehicle testing and adaptive threshold optimization are planned to improve reliability and practical deployment.

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