

Alcohol Detection Based Vehicle Speed Limits and Notification System

Gopika Sri M¹, Jayakarhika K², Karthiga G³, Dr. P. Umaeswari⁴

^{1,2,3}UG, Computer Science and Business Systems, R. M. K. Engineering College, Thiruvallur, Tamil Nadu, India.

⁴Associate Professor, Computer Science and Business Systems, R. M. K. Engineering College, Thiruvallur, Tamil Nadu, India.

Email ID: gopi21111.cb@rmkec.ac.in¹, jaya21117.cb@rmkec.ac.in², kart21122.cb@rmkec.ac.in³, pui.csbs@rmkec.ac.in⁴

Abstract

The Internet of Things (IoT) plays a vital role in enhancing safety systems, particularly in the automotive sector. One of the major concerns in road safety is the risk posed by drunk driving and driver fatigue, which can lead to fatal accidents. Existing systems primarily focus on either alcohol detection or drowsiness detection but lack comprehensive solutions that address both issues simultaneously. Our proposed system, "Alcohol Detection-Based Vehicle Speed and Notification System," aims to mitigate road accidents caused by intoxicated or drowsy drivers. By integrating a gas sensor, the system detects alcohol consumption and automatically reduces the vehicle's speed while simultaneously sending an alert notification to the driver's family. Additionally, the system incorporates a blinking sensor that detects when a driver's eyes are closed for more than four seconds, triggering a buzzer alarm, which operates independently of alcohol consumption. This dual-function system enhances overall safety by addressing two major risk factors, making roads safer for all.

Keywords: Internet of Things (IoT), Alcohol detection, Vehicle speed control, Driver drowsiness detection, Road safety system.

1. Introduction

The Internet of Things (IoT) has transformed road safety by enabling real-time monitoring of driver behaviour and vehicle conditions. Alcohol consumption and driver fatigue are leading causes of traffic accidents, resulting in impaired judgment, slower reaction times, and loss of control. To address these issues, IoT-based solutions integrate advanced sensors and intelligent systems to detect impairment early and implement safety measures. The proposed system continuously monitors the driver's breath for alcohol levels and analyzes eye movement patterns to detect drowsiness. If impairment is detected, the system triggers alerts, gradually reduces vehicle speed, or prevents ignition. Additionally, it sends emergency notifications to designated contacts, ensuring timely intervention. By leveraging IoT connectivity, data is processed and transmitted efficiently, enhancing safety measures [1][6]. These

advancements not only improve individual driver safety but also contribute to public road safety by reducing accidents caused by human error. The integration of IoT in transportation minimizes risks associated with impaired and fatigued driving, ultimately lowering accident-related economic and social burdens [2].

2. Existing System

The existing system for addressing drinking and driving, such as the Driver Alcohol Detection System for Safety (DADSS), involves technologies like breath-based and touch-based alcohol sensors integrated into vehicle controls to measure Blood Alcohol Content (BAC) and prevent the vehicle from starting if the BAC exceeds legal limits. These systems are non-invasive, ensuring driver comfort, and aim to provide fast, accurate, and reliable measurements to enhance public safety by reducing

alcohol-impaired driving fatalities. However, they come with challenges like high implementation costs, potential privacy concerns, and technical difficulties in maintaining accuracy across various conditions.

3. Proposed System

The proposed system aims to enhance road safety by integrating IoT-based technologies that enable real-time monitoring and intervention in cases of alcohol impairment and driver fatigue. The system utilizes high-precision alcohol sensors to continuously monitor the driver's breath and measure Blood Alcohol Content (BAC) levels. If the BAC exceeds the legal limit, the system takes immediate action by preventing ignition if detected before starting or regulating the vehicle's speed if detected while driving. Additionally, a warning alarm and visual alerts notify the driver of impairment, reducing the chances of accidents caused by drunk driving. To further enhance safety, the system incorporates a driver drowsiness detection mechanism using facial recognition or eye-tracking technology. A camera module continuously analyzes the driver's blinking patterns, yawning frequency, and eye closure duration. If signs of drowsiness are detected, the system alerts the driver through audible warnings or vibrations. In severe cases, if the driver remains unresponsive, the system gradually slows down the vehicle to prevent potential accidents. This proactive measure ensures driver awareness and reduces the risks associated with fatigue-related crashes [3][7]. In addition to monitoring, the system features an emergency notification module that sends real-time alerts to designated emergency contacts, such as family members or law enforcement agencies. Using IoT-based platforms like Adafruit IO or Firebase, notifications are transmitted via SMS or email, providing live updates on the driver's condition and location. In case of extreme impairment or an accident, an automatic distress call is triggered to ensure timely assistance. This real-time communication enhances emergency response efficiency, potentially saving lives in critical situations [4]. To further improve road safety, the system integrates real-time safety interventions, such as disabling the vehicle's ignition when high alcohol levels are detected and gradually decelerating the

vehicle if impairment or drowsiness is identified while driving. Additionally, it continuously monitors driver behaviour and environmental conditions, ensuring adaptive safety responses. The system is also designed to store and analyse driving data through cloud-based IoT platforms. By tracking historical data, it can identify high-risk driving behaviours, offer predictive analytics, and enable remote monitoring by authorities or designated guardians [5]. By combining alcohol detection, speed regulation, drowsiness monitoring, emergency notifications, and automated interventions, this intelligent IoT-powered system provides a comprehensive and proactive solution to prevent road accidents. It enhances individual driver safety while also contributing to public safety by reducing the risks associated with impaired driving and fatigue-induced crashes. The implementation of such technology can revolutionize road safety standards, making transportation safer and more reliable for all.

4. Methodology

4.1 Alcohol Detection and Speed Regulation

Alcohol sensors are installed in the vehicle to continuously monitor the driver's breath and detect Blood Alcohol Content (BAC) levels. If the BAC exceeds the predefined legal limit, the system immediately triggers a response by regulating the vehicle's speed or preventing ignition to minimize accident risks.

4.2 Driver Drowsiness Detection

A driver drowsiness detection system is implemented using image processing techniques through a camera module. The system analyzes the driver's eye movements and facial expressions. If signs of drowsiness are detected, an audible warning is issued, and necessary corrective actions are taken to ensure driver alertness.

4.3 Real-Time Data Processing and Control

A microcontroller (such as Arduino or Node MCU) serves as the central processing unit, collecting data from sensors and executing safety measures accordingly. The vehicle's speed control mechanism, utilizing a servo motor or relay module, ensures a gradual reduction in speed rather than an abrupt halt, maintaining road safety.

4.4 Emergency Notification System

To enhance safety further, the system integrates wireless communication technologies. An emergency notification module sends automated alerts to designated emergency contacts, including family members or relevant authorities, via SMS or cloud-based services like Adafruit IO. This ensures timely intervention in critical situations.

4.5 System Testing and Validation

Rigorous testing is conducted under various environmental conditions to ensure reliability and accuracy. Different scenarios, such as alcohol consumption, drowsiness, and emergency alerts, are simulated to validate system performance. This comprehensive testing ensures that the system operates efficiently and effectively in real-world applications.

5. System Designing

The system design consists of multiple interconnected modules that work together to ensure road safety by monitoring driver impairment, regulating vehicle speed, and sending real-time alerts. The design is structured into hardware components, software integration, data processing, and communication modules to achieve effective functionality [8].

5.1 System Architecture

- **Perception Layer:** Includes sensors for alcohol detection, drowsiness monitoring, and speed regulation.
- **Processing Layer:** A microcontroller (Arduino/Node MCU) processes sensor data and triggers appropriate actions.
- **Communication Layer:** Uses Wi-Fi or GSM modules for real-time alert transmission.
- **Application Layer:** Manages alerts, notifications, and cloud storage for monitoring and analysis.

5.2 Hardware Components

- **MQ3 Alcohol Sensor:** Detects alcohol levels in the driver's breath and measures BAC.
- **DC Motor/Servo Motor:** Controls vehicle speed by limiting acceleration if impairment is detected.
- **Microcontroller (Arduino/Node MCU):** Processes sensor inputs and executes control

actions.

- **GSM Module/Wi-Fi Module:** Sends notifications to emergency contacts via SMS or cloud-based alerts.
- **Buzzer and LED Indicators:** Provide real-time alerts to the driver in case of detected impairment.

5.3 Software Integration

- **Embedded C/Python for Microcontroller Programming:** Handles sensor data, speed control, and alert mechanisms.
- **Cloud Platforms (Adafruit IO, Firebase, or Thing Speak):** Stores and manages real-time data for remote monitoring.

5.4 Workflow of the System

- The alcohol sensor continuously scans the driver's breath for alcohol levels.
- If alcohol is detected beyond the threshold, the system triggers speed regulation or disables ignition.
- The blinking sensor monitors eye movement to detect drowsiness, activating an alert if needed.
- The microcontroller processes sensor data and communicates with the vehicle control unit.
- If impairment is detected, the system automatically notifies designated contacts via SMS or IoT-based alerts.
- The speed regulation mechanism ensures gradual deceleration, preventing sudden stops and enhancing safety.
- All detected events and driver behavior data are stored on a cloud platform for further analysis.

5.5 Real-Time Alert Mechanism

- When impairment is detected, an SMS alert is sent to registered emergency contacts.
- A buzzer alarm sounds inside the vehicle to alert the driver.
- The vehicle gradually slows down or prevents ignition, depending on when the impairment is detected.
- If the driver does not respond to drowsiness warnings, an automatic emergency notification is sent [9].

5.6 Flow Diagram

Figure 1 shows Driver Safety Monitoring System

Flowchart.

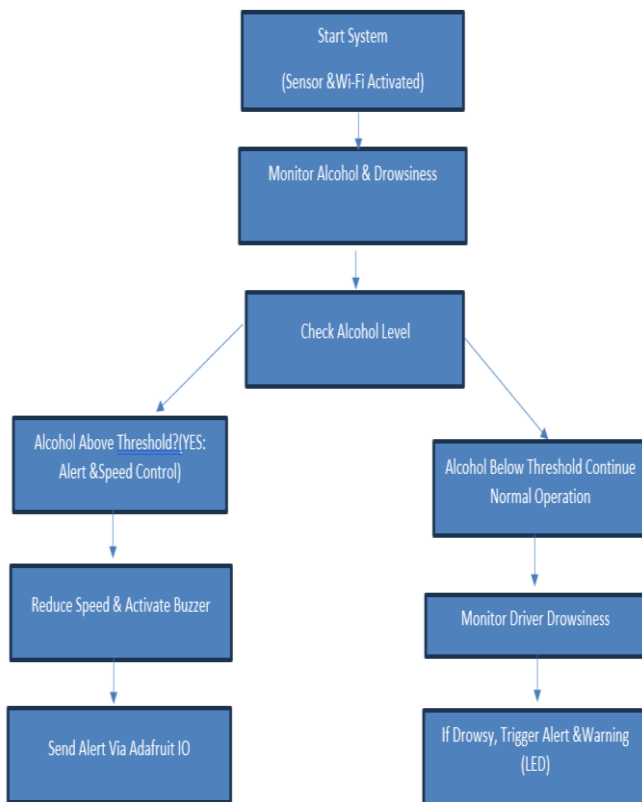


Figure 1 Driver Safety Monitoring System Flowchart

6. Result

The implementation of the IoT-based alcohol detection and driver safety system has demonstrated significant effectiveness in identifying alcohol-impaired driving and drowsiness-related risks. The system successfully detects Blood Alcohol Content (BAC) levels using the alcohol sensor and promptly triggers necessary actions, such as preventing ignition or regulating vehicle speed [10] [15]. The drowsiness detection module accurately monitors the driver's eye movements and facial expressions, issuing timely alerts to prevent accidents. The emergency notification feature efficiently sends real-time alerts to registered contacts, ensuring immediate intervention when needed. The integration of IoT-based communication enables remote monitoring, enhancing overall safety. Testing under different environmental conditions has validated the system's accuracy and reliability, proving it to be an efficient solution for reducing accidents caused by impaired

and fatigued driving. Figure 2 shows Sensor Output.



Figure 2 Sensor Output

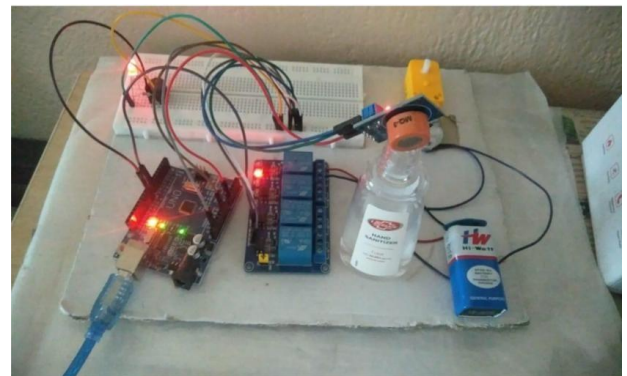


Figure 3 Arduino-Based Alcohol Detection and Control System Prototype

Conclusion

This project presents an innovative approach to improving road safety by leveraging IoT and sensor technology for real-time alcohol detection and driver monitoring. By integrating multiple safety measures, including BAC detection, speed regulation, drowsiness monitoring, and emergency alerts, the system provides a comprehensive solution to prevent accidents [11-13]. The automation of vehicle control based on driver impairment ensures proactive intervention, reducing human error and enhancing public safety. The system is cost-effective, scalable, and can be integrated into existing vehicles to promote responsible driving behaviour. Overall, this project contributes to minimizing road accidents caused by alcohol consumption and fatigue, offering a practical and technology-driven solution for safer transportation. Figure 3 shows Arduino-Based Alcohol Detection and Control System Prototype.

Future Enhancements

To further enhance the system, several improvements

can be implemented. The integration of AI-powered behaviour analysis can improve drowsiness detection accuracy by considering multiple parameters such as head position and yawning frequency. Additionally, GPS-based location tracking can be incorporated to provide emergency responders with real-time location updates in case of an accident or driver impairment [14]. Future versions of the system can include voice commands and AI assistants to interact with the driver, providing safety recommendations. Enhanced machine learning algorithms can improve BAC estimation and drowsiness prediction, ensuring greater accuracy. Moreover, collaboration with automobile manufacturers for built-in vehicle integration can enable wider adoption of this technology, making it a standard safety feature in modern vehicles.

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