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Smart Transportation Safety System with IoT-Based Alcohol Monitoring

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Abstract

The paper aims to design a vehicle safety system that improves protection by integrating alcohol detection with the ignition system. If the driver is intoxicated, the engine is prevented from starting. The system detects alcohol levels beyond the allowed limit using a sensor connected to a time-delay switch. When excessive alcohol is sensed, the switch activates and disables the ignition until the delay period ends. A reset option restores normal operation once safe conditions return. Although intended for vehicles, this concept can also be applied to other machinery where impaired operation may cause harm. Additionally, GSM technology is included so that upon detecting alcohol, the sensor signals a microcontroller, which turns off the ignition and sends an alert message to the owner or family members. This helps identify unsafe situations and reduce accident risks.

Keywords: Alcohol Detection Sensor, Automotive Safety, Ignition Control System, Time Delay Mechanism, GSM Communication, Microcontroller System

1. Introduction

An AGM-based alcohol detection system with vehicle control is designed to identify alcohol consumption by a driver and prevent the vehicle from operating if the detected level exceeds the permissible limit. When alcohol is detected, the system not only stops the vehicle from starting but also uses GSM technology to notify the driver's guardian or concerned authority. Drunk driving is a serious issue in many parts of the world. For instance, in 2009 alone, over 10,000 traffic fatalities were directly linked to drivers with blood alcohol levels above the legal limit. Many accidents occur due to driver negligence, particularly when individuals consume alcohol and then operate vehicles. Such behavior is a criminal offense, and

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intoxicated drivers pose a significant threat to society. Although laws exist to prevent drunk driving, their effective implementation is still inconsistent in many regions.

To address this problem, a system is designed to assist traffic authorities in determining whether a driver is fit to drive. This system is an embedded solution combining both hardware and software components, typically using a microcontroller such as ATMEGA or Arduino. The alcohol sensor (such as MQ-3) detects ethanol levels in the driver's breath and provides an analog output to the microcontroller. Based on this input, a message is displayed on an LCD, and the vehicle can be stopped if alcohol concentration exceeds the limit. Additionally, relevant information is transmitted to nearby locations or authorities via GSM technology.

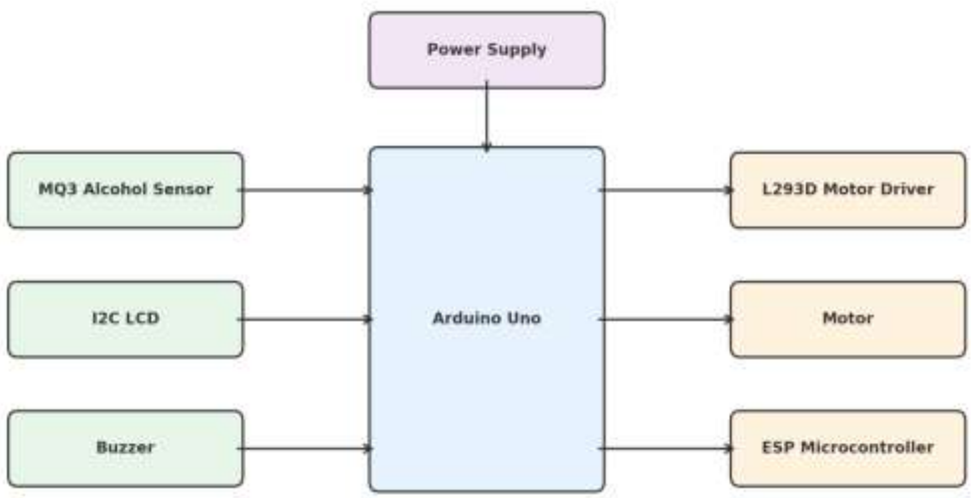

Figure 1: Block diagram

Modern alcohol detection systems may include breath analyzers integrated with the ignition system to measure Blood Alcohol Concentration (BAC) and prevent engine startup if it exceeds the allowed limit. Advanced features can include GPS tracking, GSM alerts, and accelerometers for crash detection, all managed by microcontrollers for real-time safety monitoring.

2. Core Components

- Alcohol Sensor (MQ-3): Detects ethanol in the driver's breath and requires preheating for stable operation.

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- Microcontroller (Arduino/ATMEGA): Processes sensor data, compares it with threshold values, and controls other modules.
- Engine Lock (Relay): Disables the ignition system if alcohol levels exceed the limit.
- Display (LCD): Shows real-time BAC levels and system status.

3. Working Principle

- Detection: The driver blows into a breath analyzer or interacts with a sensor integrated into the steering wheel or ignition.
- Measurement: The sensor measures breath alcohol concentration (BAC).
- Decision: The microcontroller compares the BAC value with the legal limit (e.g., 0.08%).
- Action: If the level exceeds the limit, the engine is prevented from starting, alarms are triggered, and alerts are sent via GSM.

4. Existing system

Conventional approaches to preventing drunk driving mainly rely on manual enforcement and basic detection techniques. Traffic authorities typically use handheld breath analyzers to measure a driver’s Blood Alcohol Concentration (BAC) during roadside inspections. These checks are performed only at specific locations and times, making continuous monitoring impossible. As a result, many intoxicated drivers go undetected.

In some vehicles, basic ignition control systems are available, but they do not include integrated alcohol detection. The responsibility of safe driving is largely dependent on the driver’s judgment, which can be unreliable under the influence of alcohol or drugs. Although strict laws and penalties exist to discourage drunk driving, their implementation is often inconsistent and limited in real-time effectiveness.

Additionally, traditional systems lack **automation and communication capabilities**. There is no provision for automatically disabling the vehicle or alerting concerned individuals when unsafe conditions are detected. Emergency response is also delayed because no immediate notification system is present.

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5. Proposed Method

To address the drawbacks of traditional systems, an intelligent and automated alcohol detection mechanism is proposed for vehicles. This system integrates a sensitive alcohol sensor with a microcontroller-based control unit to continuously monitor the driver's condition in real time. The alcohol sensor measures the concentration of alcohol in the driver's breath and sends the data to the microcontroller. The controller evaluates this value against a predefined safe limit. If the detected level exceeds the permissible threshold, the system immediately restricts the vehicle's ignition, preventing the engine from starting or stopping it if already running under unsafe conditions.

To improve responsiveness and safety, the system incorporates a communication module such as GSM. When an unsafe condition is detected, alert messages are automatically sent to registered contacts, such as family members or vehicle owners. This ensures timely awareness and possible intervention.

Additional features like an LCD display provide real-time information about system status, while a buzzer generates warning signals to alert the driver. Unlike conventional methods, this approach operates continuously and independently, reducing reliance on manual checks.

6. Results and Discussion

The implemented system was evaluated to determine its effectiveness in detecting alcohol and controlling vehicle operation. The alcohol sensor accurately measured breath alcohol levels and transmitted data to the microcontroller for analysis. When the detected value exceeded the predefined threshold, the system successfully prevented engine ignition, demonstrating reliable control over vehicle access. In scenarios where the engine was already running, the system responded promptly by restricting operation, ensuring safety.

The GSM module performed efficiently by sending alert messages to registered contacts without noticeable delay, enabling quick awareness and response. The LCD display provided clear, real-time updates of system status, while the buzzer generated immediate warnings to notify the driver.

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Although the system showed consistent performance, slight variations were observed due to environmental factors affecting sensor readings, indicating the need for proper calibration. Overall, the system proved to be dependable, offering continuous monitoring and significantly improving road safety compared to traditional methods.

7. Conclusion

This paper presents an automatic alcohol detection and reporting system designed to enhance vehicle safety. When alcohol is present, it is detected by the alcohol sensor, which continuously monitors the driver's condition. If the alcohol level exceeds the defined limit, a short message is transmitted through the GSM network so that appropriate action can be taken promptly. The system significantly improves safety for vehicle users by providing continuous monitoring and quick response. Although implementing such a system may slightly increase the cost of the vehicle, it is more beneficial to have improved safety rather than no protection at all. The IoT-based alcohol detection system offers an effective solution for reducing accidents caused by drunk driving. By integrating alcohol sensors, a microcontroller, and communication modules, the system ensures enhanced safety and real-time monitoring. Overall, this paper establishes a practical and efficient approach to developing intelligent vehicle safety systems.

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