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IoT-Enabled Smart Alcohol Sensing and Engine Control with GPS/GSM Alerts

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ABSTRACT: The Smart Alcohol Detection and Automatic Engine Locking System aims to improve road safety by blocking intoxicated individuals from operating vehicles and reducing reckless driving behaviours. By combining an alcohol sensor that measures breath alcohol concentration with an accelerometer that detects sudden and erratic acceleration the system identifies reckless driving behaviour. The system engages a relay to lock the engine by disabling the vehicle's ignition when alcohol levels surpass a set threshold. The system responds to rash driving by reducing speed or shutting down the engine and sends immediate alerts through a GSM module to inform authorities or emergency contacts. The system includes GPS tracking to provide location information when alerts are activated. The LCD display shows real-time updates about the system status directly to the driver. An Arduino Uno microcontroller serves as the project component that manages sensor inputs and executes appropriate output actions with efficiency.

KEYWORDS: Global positioning system (GPS), Global system for mobile communications (GSM), Blood alcohol content (BAC), Arduino.

I. INTRODUCTION

Driving under the influence of alcohol has become a major cause of road accidents worldwide. Alcohol consumption impairs a driver's judgment, coordination, and reaction time, significantly increasing the risk of collisions. According to national statistics, nearly 12,000 people lose their lives every year due to drunk-driving incidents, while approximately nine lakh individuals are arrested annually for alcohol-related driving offenses. As a result, road safety has emerged as a serious social concern, highlighting the urgent need for effective preventive solutions.

To address this issue, an automated alcohol detection and engine locking system is proposed that operates continuously without limitations of time or location. The system is designed using an alcohol sensor integrated with an Arduino Uno microcontroller to monitor the driver's breath alcohol concentration in real time. When the detected alcohol level exceeds a predefined threshold, the ignition system is automatically disabled, preventing the vehicle from being operated. Additionally, a GPS module transmits the live location of the vehicle to authorized contacts, ensuring timely intervention. Recent studies indicate that road accidents are not only caused by alcohol consumption but also by reckless driving behavior and improper use of safety equipment such as seat belts. Seat belts play a crucial role in minimizing injury severity during accidents, and advanced safety technologies, including electronic stability control, have demonstrated the potential to significantly reduce fatal crashes. Driver negligence remains a primary cause of accidents in urban regions, while alcohol impairment is more prevalent in rural areas. With the advancement of embedded systems and wireless communication technologies, microcontroller-based solutions offer an efficient approach to enhancing vehicle safety. The proposed system combines alcohol detection with seat belt monitoring, ensuring that the engine does not start if the driver is intoxicated or if the seat belt is not fastened. Furthermore, GSM technology is used to send alert messages to family members or concerned authorities, while GPS enables real-time vehicle tracking for safety and theft prevention. The primary objective of this project is to reduce traffic-related fatalities, particularly in developing countries such as India. While advanced safety features are often limited to high-end vehicles, this system aims to provide an affordable and scalable solution suitable for all types of vehicles. By integrating intelligent sensing, automation, and communication technologies, the proposed system contributes to safer roads and improved traffic discipline. The development process involves both software and hardware components, with Proteus used for system simulation and Arduino employed for microcontroller programming and hardware integration.

II. RELATED WORK

Traditionally, law enforcement officers use breathalyzers to detect alcohol consumption in drivers. Although these devices have proven to be effective, they are not always practical. Conducting roadblocks at all times and checking every driver is not feasible, especially during peak traffic hours. This approach can lead to traffic congestion and delays. Additionally, there is a possibility that drivers may attempt to avoid penalties through unethical means. If an intoxicated driver manages to bypass a checkpoint, they continue to pose a serious threat to other road users. Several earlier research studies have proposed alcohol detection systems integrated into vehicles. Many of these systems use the MQ-3 alcohol sensor to detect alcohol vapor in a driver's breath. The MQ-3 sensor is specifically designed to detect alcohol with higher sensitivity and better accuracy compared to general gas sensors such as the MQ-2, which is primarily used to detect combustible gases like LPG. Due to its improved selectivity for alcohol vapor, the MQ-3 sensor is widely used in automotive alcohol detection applications. Some studies have also explored alternative detection methods, such as monitoring alcohol levels through a driver's sweat using infrared (IR) sensors. However, this approach has certain limitations. The accuracy of sweat-based detection may vary depending on individual perspiration rates, which differ from person to person. Environmental factors, such as air conditioning or open windows, may also affect the system's reliability. These variations can lead to inconsistent or inaccurate results. In addition, many existing systems focus solely on alcohol detection without incorporating alert mechanisms such as buzzers or LED indicators. Visual indicators, such as LEDs, can display the driver's sobriety status to nearby vehicles, while buzzers provide immediate warnings when alcohol levels exceed the threshold. The absence of such alert features reduces the overall effectiveness of the safety mechanism, as timely warnings can help prevent potential accidents. Another limitation of previous systems is the lack of real-time tracking and communication features. While some systems prevent the vehicle from starting if alcohol is detected, they do not address situations in which the driver consumes alcohol after the vehicle has already started. Moreover, certain prototypes were tested using butane gas from cigarette lighters instead of ethanol, which does not accurately represent real-world alcohol detection conditions. To overcome these limitations, the proposed system integrates alcohol detection with engine locking, GSM communication, and GPS tracking. The MQ-3 sensor continuously monitors the driver's alcohol level. If the detected value exceeds the preset threshold at the time of ignition, the engine will not start. If alcohol is detected while the vehicle is in motion, the system can safely slow down the vehicle or initiate controlled engine locking. Simultaneously, the GSM module sends an alert message to authorized individuals, and the GPS module provides the vehicle's real-time location. By combining detection, prevention, and communication features, this system aims to significantly reduce accidents caused by drunk driving. It not only prevents intoxicated driving but also enables timely intervention by alerting concerned individuals or authorities. Thus, the proposed approach offers a more comprehensive and practical solution compared to earlier methods.

III. LITERATURE SURVEY

Several researchers have proposed alcohol detection systems integrated with vehicle ignition control to prevent drunk driving. Dahake and Bichkar presented an alcohol detection and engine locking system that employs GPS and GSM technologies to enhance vehicle safety. Their system uses a gas sensor to identify alcohol presence in the driver's breath and sends alert messages to the vehicle owner through GSM when intoxication is detected. Similarly, Liu et al. developed a smart vehicle safety system based on GPS and GSM communication, where alcohol concentration is continuously monitored using a gas sensor, and warning messages are transmitted to authorized users when unsafe conditions occur. Bhat and Shinde proposed an alcohol detection system that integrates engine locking with GPS and Wi-Fi communication. In their work, alcohol detection triggers a control signal that disables the engine ignition, preventing the vehicle from being operated under intoxicated conditions. Patil et al. also implemented a similar approach using GPS and Wi-Fi modules, focusing on improving the reliability of engine immobilization when alcohol levels exceed permissible limits. Furthermore, Kore and Dumbre introduced a real-time alcohol detection system that continuously monitors the driver's condition and immediately restricts engine operation upon detecting alcohol. Overall, these studies emphasize the effectiveness of combining alcohol sensors with engine control mechanisms and wireless communication technologies such as GPS, GSM, and Wi-Fi. The reported systems demonstrate significant potential in reducing alcohol-related road accidents by preventing vehicle operation during intoxication and enabling timely alerts, thereby contributing to improved road safety.

IV. PROBLEM STATEMENT

Existing System

The existing system measures the alcohol content present in the driver's breath using an MQ-3 alcohol sensor. It consists of an LCD display, a force or seat-belt sensor, GPS and GSM modules, and a microcontroller. When the driver attempts to start the vehicle, the alcohol sensor evaluates the breath alcohol level. If alcohol concentration exceeds the predefined threshold, the engine ignition is automatically disabled, thereby reducing the risk of drunk-driving accidents. In addition, the system verifies whether the seat belt is properly fastened. If alcohol is detected or the seat belt is not engaged, an alert message is sent to an authorized person through the GSM module. The vehicle's current location is obtained using the GPS module and transmitted along with the alert message. The microcontroller processes sensor inputs and sends the GPS coordinates via SMS. Overall, the system aims to improve road safety by preventing intoxicated driving and enabling timely notifications.

Disadvantages

- Alcohol sensors may produce false readings due to external substances such as perfumes, sanitizers, mouthwash, or smoke.
- The system may not be legally accepted as evidence of intoxication without certified calibration.
- System reliability may be affected by a weak or unstable vehicle battery.
- GSM or IoT communication may be unreliable in remote areas with poor network coverage.

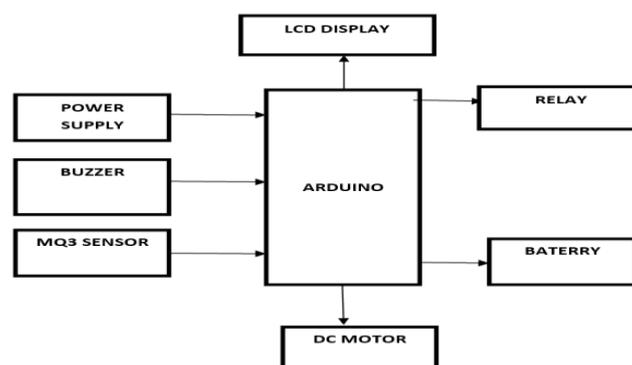
Proposed System

The proposed system enhances road safety by integrating alcohol detection, rash-driving monitoring, engine immobilization, and real-time alert communication into a single unified solution. Before the vehicle is started, the driver is required to undergo a breath alcohol test. If the detected alcohol level exceeds the permissible limit, the ignition system is locked using a relay mechanism, preventing the engine from starting. Once the vehicle is in operation, an accelerometer continuously monitors driving behavior. Sudden acceleration, sharp turns, or harsh braking are identified as rash-driving patterns. If alcohol presence is detected or unsafe driving behavior persists, the system immediately sends alert messages to emergency contacts or authorities through the GSM module. The alerts include real-time vehicle status and location information obtained via GPS. An LCD display provides continuous feedback to the driver regarding alcohol level, driving behavior, and system status.

Advantages

- Automatically prevents drunk driving
- Provides real-time alerts and monitoring
- Low-cost and easy to install
- Helps reduce road accidents and fatalities
- Can be integrated into existing vehicles

BLOCK DIAGRAM



V. RESULT AND DISCUSSION

The objective of this project is to design an advanced vehicle safety system that prevents driving under the influence of alcohol. The proposed system integrates an alcohol detection sensor with the vehicle's ignition control unit to restrict engine operation when the detected alcohol concentration exceeds the permissible limit. Upon sensing alcohol, the sensor transmits a signal to the microcontroller, which activates a delay-based control mechanism to temporarily disable the ignition system. A reset feature is provided to restore normal vehicle functionality once safe operating conditions are verified. Although the system is primarily intended for automotive applications, the underlying safety concept can be extended to other vehicles or machinery where impaired operation may lead to serious accidents or injuries. To further enhance safety, GSM communication technology is incorporated into the system. When alcohol consumption is detected, the system not only immobilizes the vehicle but also sends alert notifications to registered family members or the vehicle owner. By integrating sensing, control, and communication technologies, the proposed system offers an effective solution for accident prevention and improved road safety.

5.1. Experimental Setup

Road accidents remain a major public safety issue, and one of the biggest reasons behind them is driving under the influence of alcohol. When alcohol enters the body, a person's coordination, judgment, and reaction time become weak. As a result, the driver may lose control or make unsafe decisions. For traffic police, checking every driver all the time is not possible, so there is a need for an automatic method to identify drunk driving.

In this project, a small demonstration system has been created to show how alcohol detection can be linked with vehicle control. The model uses an Arduino Uno, an alcohol sensor, an LCD display, and a DC motor that acts as the engine. When the sensor notices alcohol in the surroundings, it sends the information to the controller. Based on the reading, the controller either shows a warning or stops the motor to prevent the vehicle from moving.

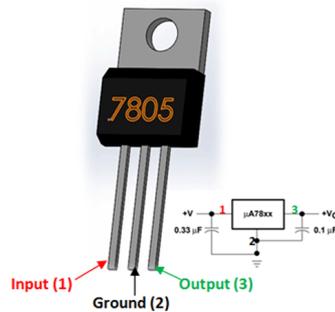
India continues to face a high number of road accidents every year, and many of these incidents are linked to alcoholic influence. If this issue is not addressed, the number of accidents may continue to rise. The aim of the proposed system is to reduce such accidents by acting quickly when alcohol is detected. The sensor continually monitors the inside of the vehicle. If a small amount of alcohol is found, a message is sent to selected emergency contacts. If a high amount is found, the motor is turned off immediately and the system sends the vehicle's location along with the alert message. This helps in getting timely help and also prevents the vehicle from being driven by someone who is not fit to drive.

Since alcohol directly affects the brain and nervous system, even a low Blood Alcohol Concentration (BAC) can reduce a driver's control of the steering wheel. In public transport vehicles, the buzzer alert also helps passengers identify unsafe conditions. The GSM and GPS modules work together to send the alcohol reading and vehicle coordinates to the nearest police or safety authority for fast action.

7805 Applications

- Supplies a stable 5V output to microcontrollers and sensors in embedded circuits
- Can be used as part of adjustable voltage circuits when paired with external components
- Limits current in certain low-power applications
- Helps create dual regulated power supplies for electronic projects
- Protects connected components from damage caused by accidental reverse voltage

2D model



IN4007 DIODE

Hello everyone! I hope you are doing well. Today, I would like to share some information about the 1N4007 diode. The 1N4007 is a PN junction diode. A diode is formed by combining two types of semiconductor materials: P-type and N-type. The junction formed between these two materials is known as a PN junction. This junction allows current to flow in only one direction, which is the fundamental working principle of a diode.

The 1N4007 belongs to the 1NXXXX series of devices. This numbering system follows the American standard used for semiconductor components, which has now been widely adopted worldwide. In the name 1N4007:

1N indicates a single PN junction semiconductor device.

1 represents one junction.

N stands for semiconductor diode.

4007 is the specific identification number of this diode.

From an electrical perspective, the 1N4007 is compatible with other rectifier diodes in the 1N400X series. In many applications, it can replace other diodes in this series. The 1N4007 is commonly used in power supplies, rectifier circuits, and embedded system projects.

1N4007



In-Depth Overview of the 1N4007 Diode

The primary function of the 1N4007 diode is to convert alternating current (AC) into direct current (DC) in electronic circuits. It is widely used in rectification applications, particularly in power supply circuits.

The 1N4007 is the highest-rated diode in the 1N4001 to 1N4007 series. It can withstand a peak repetitive reverse voltage of up to 1000V, which is higher than the other diodes in the same series. This makes it suitable for high-voltage applications.

Because of its high voltage tolerance, reliability, and low cost, the 1N4007 diode is widely used in electronic circuit design, repairs, and various technological applications.

MQ5 SENSOR

Gases such as LPG, methane, and hydrogen are frequently used for cooking, heating, and industrial purposes because they provide energy efficiently. However, leaks of these gases can be very dangerous since they can catch fire easily.

The MQ-5 sensor is a device that can sense the presence of flammable gases, including LPG, methane, hydrogen, and carbon monoxide. It is used in devices that warn people when gas is leaking, helping prevent fires and other hazards.

By connecting the MQ-5 sensor to a microcontroller like an Arduino, it can measure the amount of gas in the surrounding air. When the concentration rises, the sensor produces an electrical signal. This signal can be used to trigger alarms, show readings on a display, or switch off devices to prevent accidents. Because of this, the MQ-5 sensor is a valuable tool for making homes, workplaces, and factories safer.



MQ-5 Sensor Module – Overview

The MQ-5 gas sensor module is commonly used in Arduino-based projects for detecting combustible gases. It is especially suitable for beginners because it is affordable, easy to interface, and offers a wide detection range. The sensitivity of the sensor can be adjusted using the onboard potentiometer, allowing users to set a specific detection threshold. The MQ-5 sensor is capable of identifying gases such as LPG, methane, hydrogen, and other flammable gases. It provides both analog and digital outputs, making it flexible for different types of applications. Due to its simplicity and reliability, the MQ-5 sensor is widely used in gas leakage detection and safety systems.

VI. CONCLUSION

This project presents an intelligent vehicle safety system designed to detect alcohol levels in a driver's breath and respond appropriately. The system is built around a microcontroller platform, with key components including an MQ-3 alcohol sensor, GPS module, and GSM communication module. When alcohol levels exceed the preset threshold, the system restricts engine operation to prevent unsafe driving. At the same time, the GSM module sends alerts to pre-registered contacts, while the GPS module provides real-time vehicle location data. The compact design, reliability, and efficient communication features make the system suitable for practical implementation. The primary goal of this project is to reduce road accidents caused by drunk driving. By combining alcohol detection, engine control, and location tracking, the system enhances vehicle safety and supports quicker emergency response. Overall, this development contributes to improving road safety standards and modernizing automotive safety technologies.

VII. FUTURE SCOPE

The alcohol detection and engine locking system integrated with GPS and ESP-01S Wi-Fi module offers significant opportunities for future enhancement. Potential improvements include:

Integration with Advanced Vehicle Safety Systems:

The system can be connected with airbags, anti-lock braking systems (ABS), and electronic stability control to improve overall vehicle protection.

Artificial Intelligence Integration:

AI-based algorithms can analyze driving behaviour and alcohol detection patterns to predict potential risks and prevent accidents more effectively.

Advanced Detection Technologies:

Future versions may incorporate sensors capable of detecting additional impairing substances, such as narcotics or other harmful chemicals.

Cloud-Based Monitoring and Data Storage:

Real-time vehicle data can be stored on cloud platforms for monitoring, analysis, and emergency response management.

Mobile Application Development:

A dedicated mobile application can provide instant alerts, vehicle tracking, and system status updates to authorized users. With further development, this system can become more intelligent, efficient, and widely applicable in modern automotive safety systems.

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