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Smart Anti-Theft Vehicle Locking System with Alcohol Detection

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ABSTRACT—

This project focuses on the development of a smart vehicle locking system that enhances both driver safety and vehicle security. The system monitors the driver's breath, and when the detected alcohol level exceeds the permissible limit, the ignition is automatically disabled to prevent the vehicle from starting. To improve security, the project includes a mechanism that uses tracking and remote locking, allowing the owner to locate and control the vehicle through a wireless module. Additional features include a sensor that detects suspicious activity or forced entry, which immediately sends an alert to the user's mobile device. The entire system is controlled through an embedded unit that enables seamless integration of monitoring and real-time notifications. Testing shows that combining safety and security functions significantly improves reliability compared to traditional locking systems. Overall, this project demonstrates an effective approach to preventing drunk driving while providing strong protection against vehicle theft, contributing to smarter and safer transportation.

Index Terms— Alcohol Detection, Anti-Theft Mechanism, GPS Tracking, Vehicle Locking, Alcohol Sensor, IoT-Based Monitoring, Wireless Communication, Smart Vehicle Security, Ignition Control, Real-Time Alerts.

I. INTRODUCTION

A Smart Anti-Theft Vehicle Locking System with Alcohol Detection is an advanced technology-based solution designed to improve vehicle security and road safety. In recent years, vehicle theft, unauthorized access, and accidents caused by drunk driving have become major concerns. These problems highlight the need for an intelligent system that can protect vehicles and ensure the safety of drivers and passengers.

The proposed system integrates modern technologies such as microcontrollers, sensors, electronic locking mechanisms, and wireless communication modules to provide an efficient and reliable vehicle protection system. It is designed to prevent unauthorized users from accessing or starting the vehicle while also detecting alcohol consumption by the driver before ignition.

The alcohol detection unit is one of the major components of the system.

It uses an alcohol sensor, such as the MQ-3 sensor, to detect the presence of alcohol in the driver's breath. The sensor sends signals to the microcontroller, which processes the detected alcohol level and compares it with a predefined threshold. If the alcohol level exceeds the set limit, the system prevents the engine from starting, thereby helping to reduce the risk of drunk-driving incidents.

The anti-theft mechanism provides an additional layer of vehicle security by allowing only authorized users to operate the vehicle. Technologies such as RFID cards, fingerprint recognition, passwords, or other authentication methods can be used to verify the identity of the user. If an unauthorized person attempts to start the vehicle, the system can prevent ignition and activate an alarm to alert the owner.

II. LITERATURE SURVEY

Researchers have explored various methods to improve vehicle safety and security, including alcohol detection sensors, automatic engine locking, fingerprint authentication, GPS tracking, GSM communication, and smart vehicle monitoring systems.

Researchers have explored alcohol detection and engine control systems for preventing drunk driving [1]. These systems improve road safety, but they may not include anti-theft features.

Prakash et al. developed an engine locking system based on alcohol detection [2]. It prevents vehicle operation when alcohol exceeds a predefined threshold, but additional user authentication can improve security.

Kadiri and Adegoke developed a GPS/GSM-based vehicle tracking system [3]. It helps locate stolen vehicles, but it does not detect alcohol consumption.

Bobade et al. proposed a vehicle security system using fingerprint authentication, GPS, and GSM [4]. It helps prevent unauthorized access and track vehicle location, but integrating alcohol detection with automatic ignition locking could provide more comprehensive protection.

TABLE I. SUMMARY OF RELATED APPROACHES

Approach	**Strength**	**Limitation**
Alcohol detection system[1]	Detects alcohol and improves driver safety	May lack anti-theft features
Alcohol-based engine locking [2]	Prevents engine starting when alcohol exceeds the threshold	May lack user authentication
GPS/GSM vehicle tracking [3]	Tracks vehicle location and supports theft recovery	Does not detect alcohol consumption
Fingerprint-based vehicle security [4]	Prevents unauthorized vehicle access	May lack alcohol detection
This work	Combines alcohol detection, automatic engine locking, and anti-theft protection	Performance depends on sensor accuracy and proper system integration

III. PROBLEM STATEMENT

Vehicle theft and drunk driving are major concerns affecting personal safety and public security. Existing systems often address these issues separately, creating a need for an integrated solution that combines vehicle security with alcohol detection and real-time monitoring.

This project proposes a smart anti-theft vehicle locking system with alcohol detection using sensors and a microcontroller. The system detects alcohol consumption and unauthorized access, controls the vehicle ignition, and uses GPS and GSM modules to track the vehicle and send alerts to the owner, thereby improving vehicle security and promoting safe driving.

IV. OBJECTIVES

The main objectives are:

a) To develop a smart vehicle locking system to prevent vehicle theft.

b) To detect alcohol consumption using an alcohol sensor.

c) to automatically disable the vehicle ignition when alcohol exceeds a predefined threshold.

d) to prevent unauthorized vehicle access using a security mechanism.

e) to integrate a microcontroller for real-time sensor monitoring and system control.

f) to use GPS and GSM modules for vehicle tracking and alert notifications.

g) to improve vehicle security, prevent drunk driving, and enhance road safety.

V. PROPOSED SYSTEM

The system has four main parts: sensing, processing, location and alerting, and communication [1]-[4].

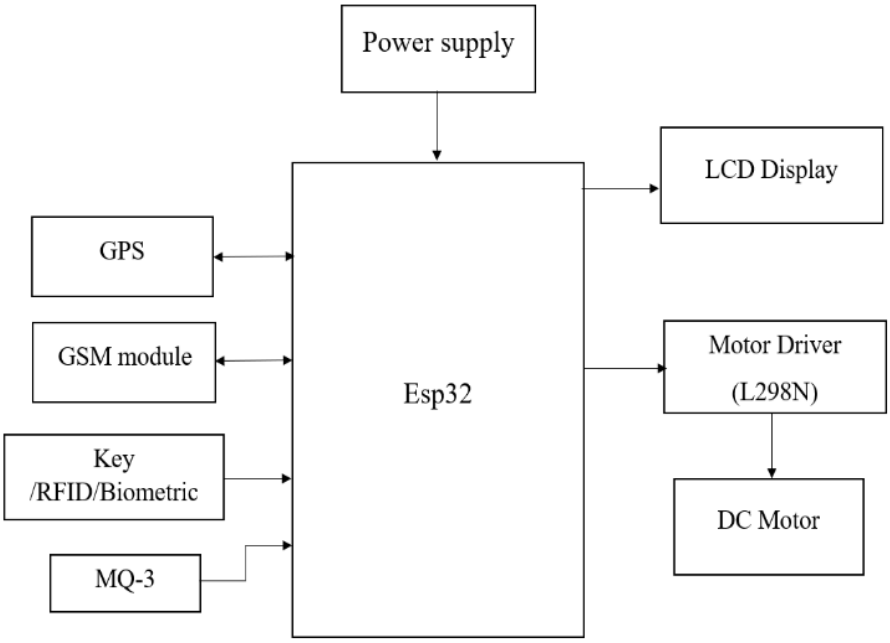
A. System Architecture

The system consists of four main units: sensing, processing, vehicle control, and location and communication. An alcohol sensor detects alcohol concentration in the driver's breath, while a security sensor or authentication module detects unauthorized access.

An Arduino UNO or ESP32 processes the sensor signals and compares them with predefined conditions. Based on these inputs, the controller operates a relay to enable or disable the vehicle ignition.

When alcohol is detected above the set threshold or unauthorized access is identified, the controller activates the vehicle locking mechanism and triggers a buzzer or warning indicator. The GPS module determines the vehicle's location, and the GSM module sends an alert message containing relevant information to the owner.

Fig. 1. Block diagram of the proposed system



B. Key Components

ESP32 Microcontroller: The main control unit that receives data from sensors and modules, processes it, and controls the output devices.

Power Supply: Provides the required electrical power to the ESP32 and connected components.

GPS Module: Determines the geographical location of the system.

GSM Module: Enables wireless communication for sending alerts, messages, or location information over a cellular network.

RFID/Biometric Module : Provides identification and authentication using RFID cards or biometric data, such as fingerprints.

MQ-3 Alcohol Sensor: Detects alcohol vapor and helps identify alcohol consumption through breath analysis.

LCD Display: Displays system status, sensor readings, and alert messages.

Motor Driver (L298N) : Controls the DC motor by regulating its operation based on commands from the ESP32.

DC Motor: Performs the mechanical action controlled by the motor driver.

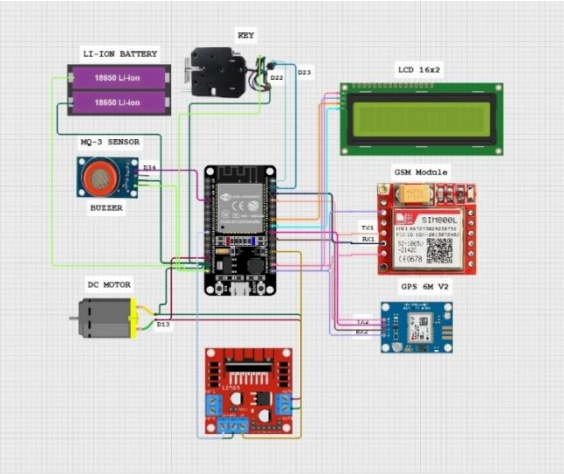
VI. IMPLEMENTATION

A. Hardware Implementation

The system uses two 18650 Li-ion batteries connected in series to provide approximately 7.4V, with a DC-DC converter supplying the required voltage to the ESP32 and peripherals. The ESP32 acts as the main controller, interfacing with the MQ-3 alcohol sensor at D34, a buzzer at D13, and a DC motor through the L298N motor driver to control the vehicle locking mechanism.

The GPS NEO-6M V2 provides real-time location tracking, while the SIM800L GSM module sends SMS alerts. Magnetic door contacts and vibration sensors enhance theft detection. All components share a common ground and use filtered power to reduce electrical noise. Finally, the hardware is enclosed in a durable casing and securely installed inside the vehicle.

Fig. 2. Circuit connection diagram



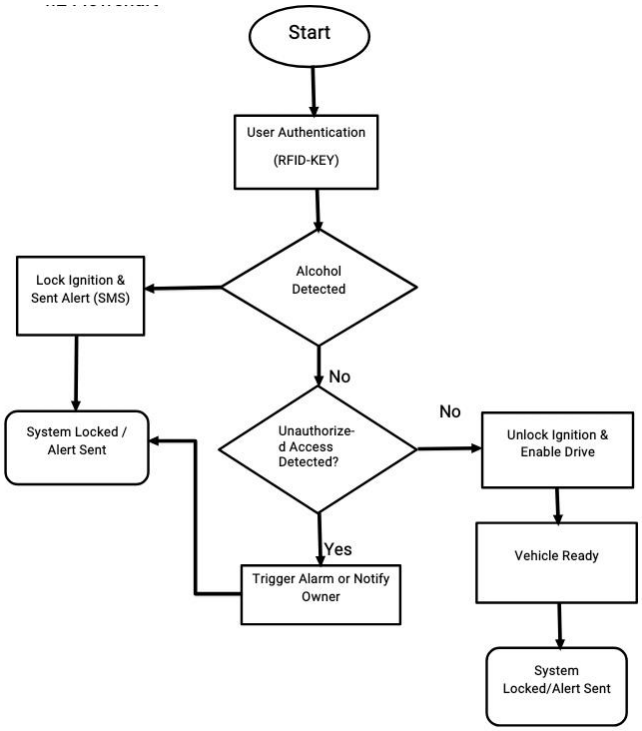
B. Software Implementation

The primary software used for developing the Smart Anti-Theft Vehicle Locking System with Alcohol Detection is the Arduino Integrated Development Environment (Arduino IDE). Arduino IDE is an open-source software platform that allows users to write, compile, and upload programs to Arduino microcontroller boards. It provides a simple and user-friendly interface that supports coding in embedded C/C++, making it suitable even for beginners while offering enough flexibility for advanced projects.

Arduino IDE includes an inbuilt code editor, compiler, and uploader, giving developers an all-in-one environment for programming the system. Through the IDE, the program controlling the alcohol sensor (MQ-3), relay module, buzzer, RFID/password module, and other electronic components is written and tested. The IDE also supports numerous libraries, such as Liquid Crystal for LCD displays, MFRC522 for RFID readers, and Software Serial for communication modules, which greatly simplify sensor interfacing and reduce programming complexity.

Another important feature of Arduino IDE is its Serial Monitor, which allows real-time observation of sensor values and system responses. During testing, this tool was essential for verifying alcohol sensor readings, checking authentication accuracy, and ensuring proper relay operation. It enabled quick debugging and calibration of thresholds used for alcohol detection.

Fig. 3. Flow diagram



C. Sensor Calibration and Threshold Selection

In the Smart Anti-Theft Vehicle Locking System with Alcohol Detection, the MQ-3 alcohol sensor is calibrated by connecting it to the ESP32 and observing its readings through the Arduino IDE Serial Monitor. The sensor is allowed to warm up according to its datasheet, and its readings are recorded under normal air conditions and controlled alcohol-vapour conditions. These readings help determine the sensor's response and improve the reliability of alcohol detection.

A threshold is a predefined sensor reading used to identify possible alcohol vapour. The ESP32 compares the MQ-3 sensor reading with the selected threshold. If the reading reaches or exceeds the threshold, the buzzer is activated and vehicle starting is prevented according to the program. If the reading remains below the threshold and RFID authentication is successful, the vehicle can be started. The threshold must be determined through practical testing because sensor readings vary with temperature, humidity, and sensor conditions.

VII. RESULTS AND DISCUSSION

The Smart Anti-Theft Vehicle Locking System with Alcohol Detection was successfully developed and tested. The system combines alcohol detection and anti-theft protection in a single embedded system. The ESP32 acts as the main controller and receives inputs from the MQ-3 alcohol sensor and security/authentication system. Based on the detected condition, the controller operates the locking mechanism, buzzer, and communication modules.

During testing, the MQ-3 sensor successfully detected the presence of alcohol. When the detected alcohol level crossed the predefined threshold, the ESP32 activated the buzzer and prevented the vehicle from starting by controlling the ignition/locking mechanism. This demonstrates that the system can help prevent driving when alcohol is detected.

The anti-theft section was also tested using authorized and unauthorized access conditions. An authorized RFID tag/password allowed the vehicle to proceed, whereas an incorrect or unauthorized attempt triggered the alarm and kept the vehicle locked.

TABLE II. RECOMMENDED TESTS (RESULTS TO BE RECORDED)

Test Condition	**Expected Decision**	**Measured Result**
Normal air condition, no alcohol detected	No alcohol alert; vehicle operation depends on RFID authentication	To be measured
Alcohol vapour detected by MQ-3 sensor above the selected threshold	Buzzer ON and vehicle starting prevented	To be measured
Unauthorized RFID card presented	Access denied; vehicle starting prevented	To be measured
GPS module receives a valid signal	Latitude and longitude recorded	To be measured
GSM module sends an alert after an abnormal event	Alert message sent to the registered mobile number	To be measured

The GPS and GSM modules are tested to verify location tracking and alert-message transmission. When the GPS receives a valid signal, the system records the vehicle's latitude and longitude. If an abnormal event occurs, the GSM module attempts to send an alert to the registered mobile number. The system is also checked during power-on and when the alcohol reading falls below the threshold. The measured-result column is completed after practical testing to confirm that each component and the overall system operate as expected.

VIII. ADVANTAGES AND LIMITATIONS

A. Advantages

The system provides enhanced vehicle security by preventing unauthorized access and theft. It detects alcohol in the driver's breath and automatically prevents the vehicle from starting when the alcohol level exceeds the safe limit. The system provides automatic ignition locking during theft attempts or alcohol detection. GPS and GSM modules enable real-time vehicle tracking and instant SMS alerts to the owner. It reduces the risk of drunk driving and accidents by ensuring that an intoxicated driver cannot operate the vehicle. The system is automated and requires minimal manual intervention. It is cost-effective, reliable, and can be adapted to different types of vehicles.

B. Limitations

The system may produce inaccurate alcohol readings due to environmental conditions and requires proper sensor calibration. GPS and GSM depend on signal availability, while RFID cards may be vulnerable to misuse. Power consumption, false alerts, and hardware failures can affect reliability. The MQ-3 sensor cannot directly measure blood-alcohol concentration, so further testing is required before real vehicle use.

IX. CONCLUSION AND FUTURE SCOPE

A. Conclusion

The Smart Anti-Theft Vehicle Locking System with Alcohol Detection provides an effective solution for improving vehicle security and road safety. The system successfully detects alcohol using the MQ-3 sensor and prevents vehicle ignition when the alcohol level exceeds the set limit. It also prevents unauthorized access using authentication and anti-theft mechanisms. GPS and GSM modules enable real-time vehicle tracking and SMS alerts during security or safety events. The integration of sensing, automation, and communication makes the system reliable and practical.

B. Future Scope

The system can be enhanced by adding fingerprint or facial recognition for stronger user authentication. IoT and cloud connectivity can provide real-time monitoring and remote control through mobile applications. AI-based driver monitoring can also be introduced to detect drowsiness and distraction.

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