

Alcohol Detection and Engine Cut-Off System using MQ-3 Sensor with GPS and Telegram Alert

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Abstract

This project is proposed to enhance road safety by preventing drunk driving via an automated method. The proposed method detects alcohol on the driver's breath using an alcohol sensor, a GPS module, a Telegram notification, and a microcontroller (ESP32). When the system detects the issue, it cuts off the vehicle's engine and transmits real-time notifications with position information to chosen contacts. The process includes designing and integrating hardware components, programming the microcontroller for alcohol detection, and implementing GPS tracking and Telegram alert integration. Testing happens in controlled situations to confirm the performance and dependability of the alcohol detecting system, engine lock, GPS accuracy, and Telegram notifications. The findings show that the system successfully prevents vehicle operation while under the influence of alcohol and provides timely notifications, guaranteeing increased safety for drivers and the public. In conclusion, this project demonstrates that integrating alcohol detection with engine control and communication technologies can be an effective solution to reduce drunk-driving incidents and enhance road safety.

1. Introduction

This project aims to enhance road safety by preventing drunk driving. It uses an MQ-3 alcohol sensor, GPS module, Telegram alerts, and an ESP32 microcontroller to detect alcohol on the driver's breath and automatically disable the vehicle engine. If alcohol is detected, the system sends real-time location and warning messages to designated contacts via Telegram, improving emergency response and accountability [1-5]. This aligns with advancements in connected car safety systems, where real-time data sharing is vital to reducing accidents [6-8]. By integrating these technologies, the project offers a smart, automated solution to prevent drunk driving, save lives, and reduce alcohol-related traffic incidents [9-11].

2. Methodology

The project's research methodology outlines a systematic approach to developing and testing a system to prevent drunken driving. The methodology begins with a thorough literature review to assess existing technologies and identify spaces in current safety solutions. The system design is then designed, with alcohol detection sensors, GPS modules, and Telegram alert systems chosen accordingly. The alcohol detection system is designed to measure the driver's blood alcohol concentration (BAC) and automatically cut-off the vehicle's engine if it exceeds the legal limit. GPS tracking is utilized to track the precise position and movement of the vehicle in real time, while Telegram alert integration is used to send immediate alerts to specific contacts or authorities in the event of alcohol problems. To guarantee the system's functionality and reliability, it is tested in several stages, including

unit testing, testing for integration, and real-world field testing. Finally, the system is evaluated and adjusted based on testing feedback, with a final report detailing the entire process and outcomes. This methodology ensures the development of a reliable and efficient solution for improving vehicle safety and reducing alcohol-related accidents.

The system's block diagram in Fig. 1 shows how the ESP32 microcontroller connects and controls all components. It receives inputs from the MQ-3 alcohol sensor to detect alcohol levels, the GPS module to track location, and a power supply. If alcohol is detected above the legal limit, the ESP32 displays the level on the LCD, sounds a buzzer, and sends a Telegram alert with the location. It also signals the Driver IC to cut off the DC motor, stopping the vehicle. This setup ensures real-time alcohol detection, alerting, and engine control for improved driver safety.

The procedural logic of the system is illustrated in the flowchart shown in Fig. 2. The process begins with the system initialization, during which the microcontroller displays a status message. Once active, the MQ-3 alcohol sensor begins detecting alcohol concentration from the driver's breath. The sensor data is processed by the microcontroller to determine the alcohol level. This value is displayed, and a comparison is made against a predefined BAC threshold. If the detected alcohol level is low, the engine remains active and no alert is triggered. If a high alcohol level is detected, the system sends a Telegram alert with GPS coordinates to designated contacts. Simultaneously, it cuts off the vehicle's ignition system to prevent operation. This automated cycle ensures real-time monitoring and immediate intervention to enhance road safety.

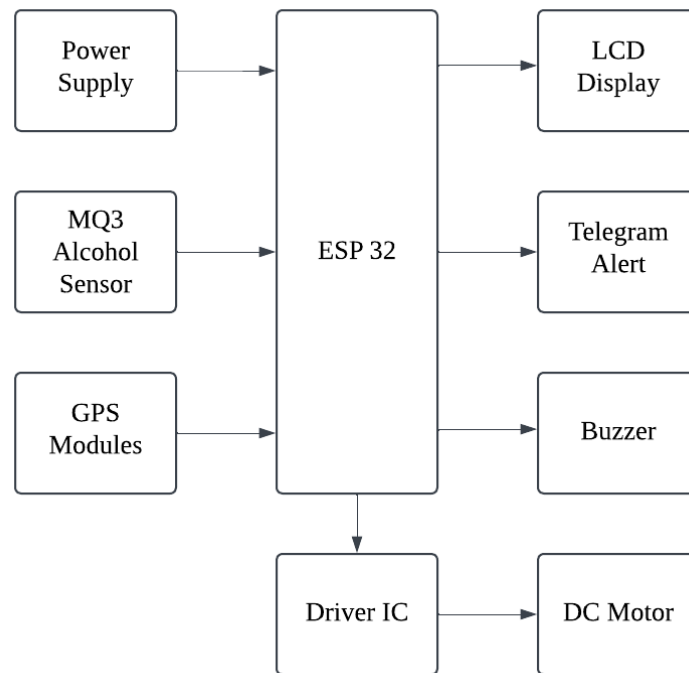


Fig. 1 Block diagram of Alcohol Detection Engine Lock with GPS Tracking and GSM Alert for Vehicle Safety

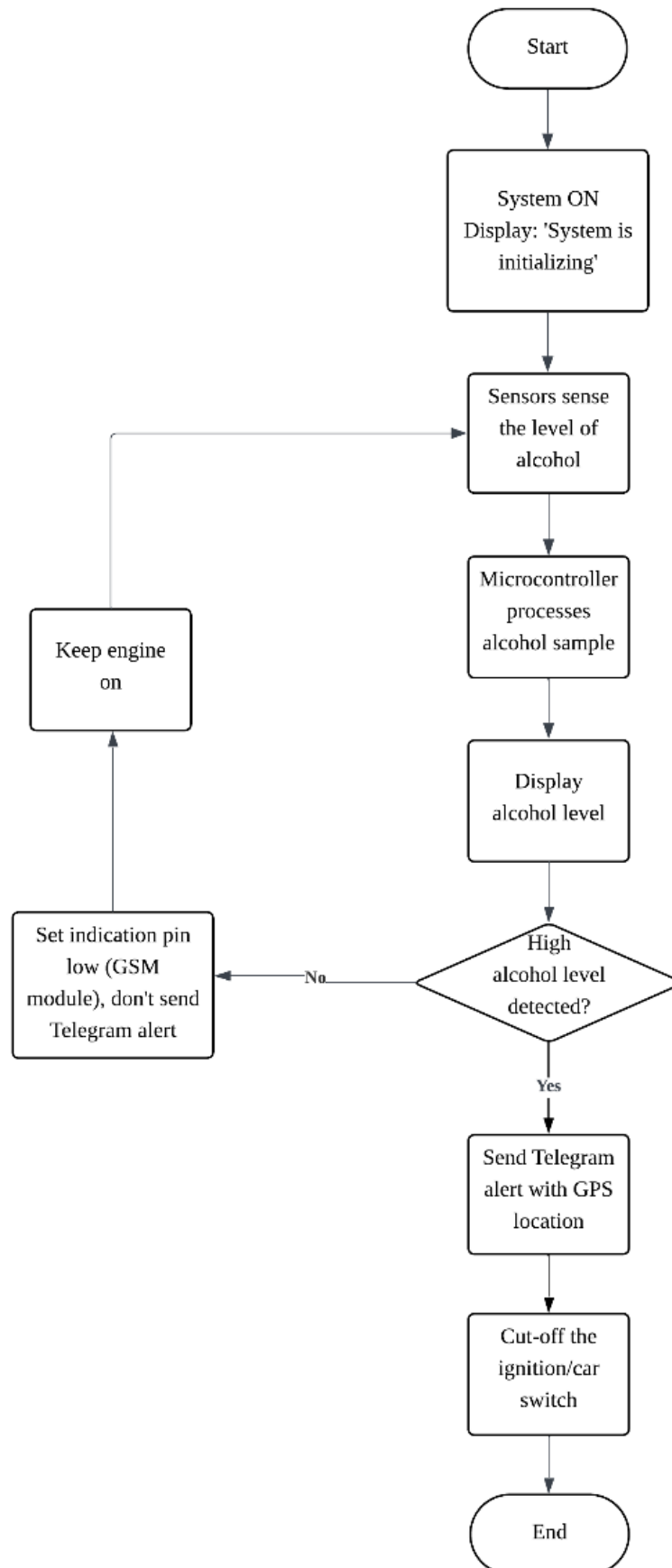


Fig. 2 Flowchart of the alcohol detection system

2.1 Prototype Setup

The prototype was built using an ESP32 microcontroller to demonstrate real-time alcohol detection and engine control. It included an MQ-3 sensor to detect alcohol, a Neo-6M GPS module for location tracking, a 16x2 I2C LCD for displaying data, and a relay connected to a DC motor to simulate the engine. A buzzer and LED were added for alerts. All components were assembled neatly in a compact protective casing for easy handling and portability.

When the system powers on, the ESP32 initializes all components and prompts the user to blow into the MQ-3 sensor. The sensor's analog readings are converted to BAC (Blood Alcohol Concentration) using pre-calibrated values. If the BAC exceeds 0.05% (raw value: 3750), the ESP32 cuts off the DC motor via relay, activates the buzzer and LED, and sends a Telegram message with the driver's GPS location to a set contact.

The LCD shows real-time updates including raw sensor readings, BAC percentage, and system status. The GPS module provides live location data, while the Telegram bot sends alerts over WIFI using the *UniversalTelegramBot* library. The system was tested in different conditions to check the accuracy of sensor readings, GPS response, and notification reliability. The tests confirmed that the system correctly detects alcohol levels, disables the motor, and sends alerts, proving it as a practical and affordable solution for preventing drunk driving.

Fig. 3 illustrates the complete hardware setup of the Alcohol Detection Engine Lock System, showcasing the integration of key modules including the MQ-3 alcohol sensor, ESP32 microcontroller, GPS tracking, and motor control. Components such as the I2C LCD display, L298 motor driver, buzzer, and DC motor are interconnected to enable real-time alcohol detection, engine response, and location reporting. This prototype highlights the feasibility of embedding IoT and sensor technologies into vehicle safety applications.

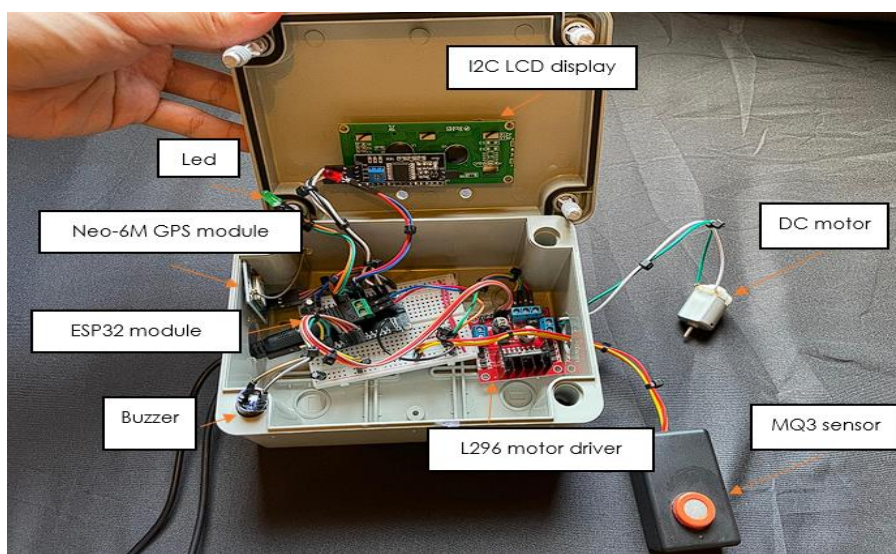


Fig. 3 The device prototype

3. Results and Discussion

This section presents the results of the project. It evaluates how well the system detects alcohol using the MQ-3 sensor, sends real-time notifications, and retrieves GPS location data. The performance of hardware components like the LCD, buzzer, motor driver, and LEDs is tested in different situations to check accuracy and response time. The section also looks at how well the alcohol threshold is calibrated, how the ESP32 connects with other services, and any problems faced during development.

3.1 Result

The performance of the proposed system was evaluated through hardware simulation and physical testing, focusing on alcohol detection accuracy, ESP32 communication reliability, GPS tracking response time, and overall system behavior under real-time vehicle scenarios. The system was tested to ensure accurate BAC level readings using the MQ-3 sensor, proper engine lock activation, and successful Telegram alert delivery with real-time GPS data, confirming the effectiveness and responsiveness of the integrated IoT-based safety features.

3.1.1 Real-Time BAC Monitoring and Alert System

This alcohol detection system improves its efficacy by including real-time monitoring and alerting functions. Based on MQ-3 sensor readings, the estimated BAC is continually shown and compared to specified parameters. When the sensor detects a raw value equal to or greater than 3690, the system calculates a BAC of 0.05% or higher, triggering the engine cut-off and sending an alarm with GPS coordinates to the Telegram bot. Table 1 shows how

the MQ-3 sensor responds to different alcohol concentrations by displaying the raw sensor values and the estimated Blood Alcohol Concentration (BAC). At 0% alcohol, the sensor gave a reading of 3550, which equals 0.00% BAC meaning the driver is sober. As the alcohol concentration increases, the raw values also increase. At 5% and 15% alcohol, the sensor readings were 3630 and 3690, corresponding to BAC levels of 0.03% and 0.05%. When the alcohol concentration reached 15%, the sensor value rise to 3690, which equals 0.05% BAC, the legal limit for driving in many places. At 95% alcohol, the sensor gave a reading of 3750, translating to a BAC of 0.12%. These results show that the MQ-3 sensor is effective in detecting rising alcohol levels and can help prevent drunk driving by measuring when a driver has exceeded the safe limit.

Table 1 Full alcohol detection system response (with passive GPS)

Alcohol %	Raw MQ3	BAC %	LED	Notification	Motor	GPS Action
0	3550	0.00	Green	No	ON	GPS active (no action)
5	3630	0.03	Green	No	ON	GPS active (no action)
15	3690	0.05	Red	Yes	OFF	Send location + trigger alert
40	3750	0.08	Red	Yes	OFF	Send location + trigger alert
95	3800	0.12	Red	Yes	OFF	Send location + trigger alert

3.1.2 GPS Module Functionality and Location Accuracy Test

Alcohol detection and GPS tracking performance were evaluated under various conditions to assess response accuracy and reliability. The MQ-3 sensor consistently detected alcohol presence with a response time of less than 2 seconds and accurate BAC conversion after calibration. The GPS module showed reliable performance, achieving coordinates and Google Maps link generation under all tested conditions. As summarized in Table 2, outdoor tests under clear skies achieved the fastest fix at 3 seconds with ~1.5m accuracy, while indoor locations such as a living room or bedroom window showed slightly longer fix times (~5–7s) and ~4.0m accuracy.

When alcohol is detected, the alcohol detection system delivers out alerts, as seen in Fig. 4, which shows a Telegram notification alerting the recipient that alcohol has been detected, along with a link to view the location of the vehicle on Google Maps. This makes it possible for the user or emergency contact to see the location of the vehicle in real time. The system shares the location in both coordinate and map formats within the Telegram app, as depicted in Fig. 5. The shared location is always up to date because of this feature, which updates in real time. By making it simple to follow and react to the driver's location in the event that they are discovered to be intoxicated, these alerts and navigation links contribute to increased safety.

Table 2 GPS module performance under different environmental conditions

GPS Status	Time to First Fix (s)	Coordinates Received	Accuracy (meters)	Google Maps Link Generated
Outdoor (clear sky)	3	Yes	~1.5	Yes
Outdoor (under garage)	7	Yes	~4.0	Yes
Weak Signal (living room)	7	Yes	~4.0	Yes
Near Window (bedroom)	5	Yes	~4.0	Yes

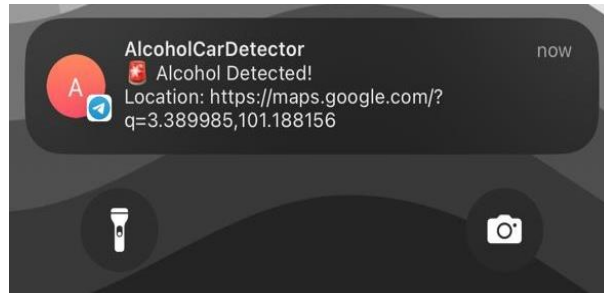


Fig. 4 Alert notification with navigation for the user

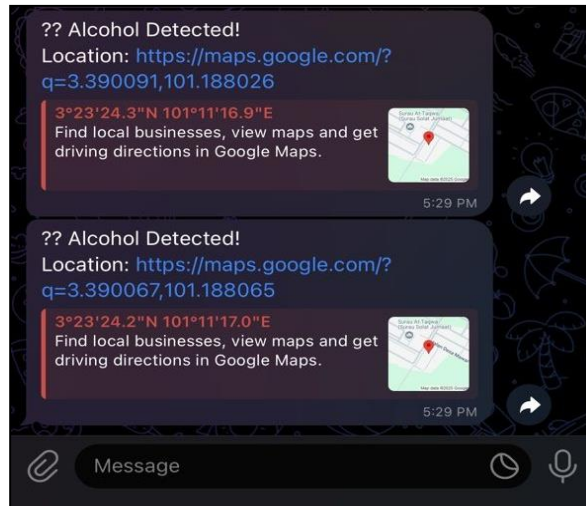


Fig. 5 Navigation link

After the user clicks the location link in the alert message, Fig. 6 shows the Google Maps interface with the vehicle's exact location. This feature is important for the safety system as it allows the recipient to quickly see where the vehicle is on a real map, including nearby roads and landmarks. It is especially useful for authorities or family members who need to respond quickly. The link opens directly in the Google Maps app or browser, allowing users to view directions, track the live location, or share it with others. This improves real-time monitoring and ensures help can reach the driver faster.

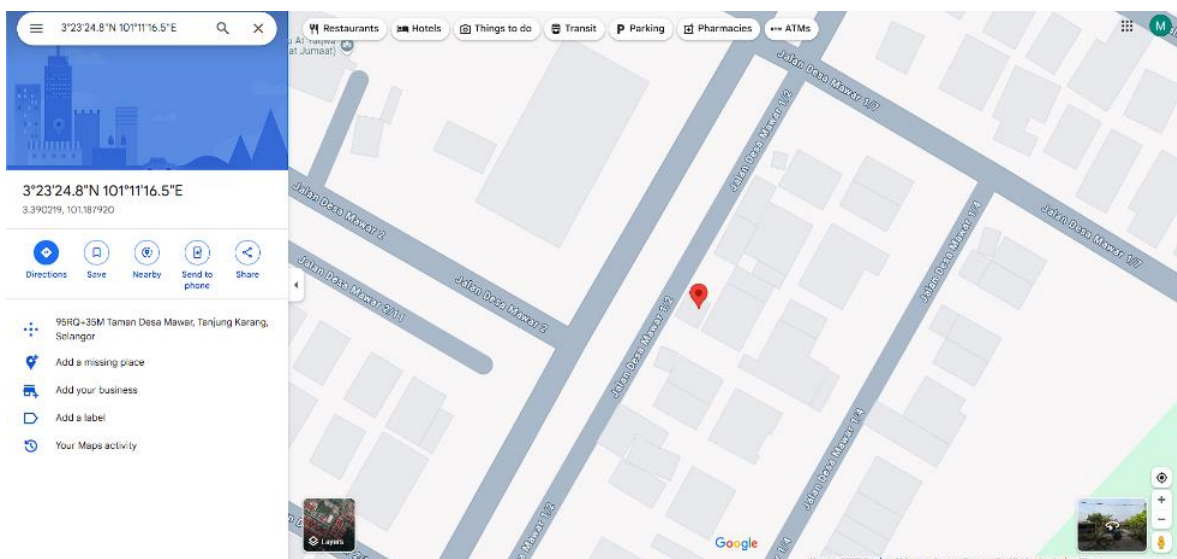


Fig. 6 Google Maps location

4. Conclusion

This project successfully developed and tested an IoT-based car safety system that detects alcohol levels using the MQ-3 sensor, prevents engine ignition when levels exceed a safe limit, and sends real-time location updates via GPS and Telegram. The system uses the ESP32 microcontroller to integrate sensor readings, engine control, and wireless communication. Key features include alcohol detection, engine lock, GPS tracking, LCD feedback, and Telegram alerts for remote monitoring. The system proved effective in promoting safer driving by reducing the risk of alcohol-related accidents through automation and real-time communication.

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Conflict of Interest

Authors declare that there is no conflict of interest regarding the publication of the paper.

Author Contribution

*The authors confirm contribution to the paper as follows: **study conception, design, data analysis and manuscript preparation:** Muhammad Fikri Rahimi; **manuscript verification:** Jais Lias. All authors reviewed the results and approved the final version of the manuscript.*

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