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# Alcohol and Accident Detection Based Automatic Car Engine Locking and Alert System

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*Abstract*—**The proposed project focuses on developing a smart and reliable safety system that aims to reduce the increasing number of road accidents caused by drunk driving and delayed emergency responses. This system integrates IoT and embedded technology using an Arduino UNO microcontroller as the central processing unit, along with an MQ-2 alcohol sensor for alcohol detection, a bump sensor for accident identification, a GSM module for communication, and a GPS module for real-time location tracking. The system functions automatically by detecting alcohol in the driver's breath and preventing the car engine from starting through a relay-based ignition lock mechanism, while a buzzer provides an immediate audio alert. In the event of an accident, the bump sensor detects the impact, the GPS module determines the coordinates of the accident location, and the GSM module sends an alert message with a Google Maps link to the registered emergency contact numbers. The overall goal of this system is to prevent drunk driving, ensure rapid emergency communication, and enhance road safety using low-cost and easily implementable electronic components.**

*Index Terms*—**Alcohol Detection, Accident Prevention, Arduino UNO, MQ-2 Sensor, Bump Sensor, GSM Module, GPS Tracking, Engine Locking System, Embedded Systems, IoT-based Vehicle Safety, Real-Time Alert, Road Safety System. Alcohol Detection, Accident Prevention, Arduino UNO, MQ-2 Gas Sensor, Bump Sensor, GSM Module, GPS Module, Engine Locking System, Embedded System, IoT, Vehicle Safety, Real-Time Alert.**

## I. INTRODUCTION

Road safety has become one of the most critical challenges faced by modern society due to the rapid increase in vehicle usage and the growing number of road accidents that claim thousands of lives every year. Among the major causes of road accidents, drunk driving remains one of the most dangerous and preventable factors contributing to serious injuries and fatalities. Despite several government laws and awareness campaigns, incidents caused by driving under the influence of alcohol continue to rise due to human negligence and lack of preventive technologies. Traditional vehicle systems are designed primarily for driving performance and comfort, but they do not incorporate automatic detection or prevention mechanisms to stop a driver who is unfit to drive. The alarming statistics related to drunk driving highlight the urgent need for intelligent and automated systems that can detect alcohol consumption and take corrective action in real time before any harm occurs. This project, titled "Alcohol Detection and Accident Prevention with Automatic Car Engine Locking and Alert System," aims to address this crucial issue by integrating Internet of Things (IoT) and embedded system technologies to create a smart, reliable, and low-cost safety mechanism for vehicles. The system uses an MQ-2 gas sensor to detect the presence of alcohol in the driver's breath. If the driver has consumed alcohol, the sensor immediately detects it and sends a signal to the Arduino UNO, which acts as the main controller of the system. The Arduino processes this data and triggers appropriate actions, such as activating the buzzer to warn the driver and nearby people and sending a control signal to the relay module to cut off the ignition, thereby locking the engine and preventing the vehicle from starting or continuing to run.

## II. LITERATURE REVIEW

In recent years, IoT and embedded system integrations have picked up huge importance in vehicle safety. Several researchers have proposed various smart systems to reduce road accidents, either due to the influence of alcohol consumption or delayed response in case of an emergency. This section reviews related studies and technologies that form the basis of the Alcohol Detection and Accident Prevention with Automatic Car Engine Locking and Alert System.

2.1 Alcohol Detection Systems:
Rajesh et al. (2018) developed an Arduino-based Alcohol Detection and Vehicle Locking System that uses an MQ-3 gas sensor to sense the alcohol concentration in the driver's breath. When the sensor detects alcohol beyond a threshold, the engine ignition is automatically disabled. This study proved the feasibility of using low-cost sensors for safety applications. Gupta et al. (2020) then introduced the Microcontroller-Based Alcohol Sensing and Engine Locking System that worked toward enhancement in sensor calibration and improvement in accuracy under variable environmental conditions. Both the systems provided the pathway for alcohol detection to be integrated into the vehicle electronics directly.

2.2 Accident Detection and Alert Mechanisms:
Singh and Verma (2019) designed the Smart Accident Detection and Alert System Using IoT, which employed sensors to detect sudden impacts and used GSM technology to notify emergency contacts. Mehta and Sharma (2021) proposed the Accident Alert System that was capable of sending the exact location of the vehicle after an accident. This concept further evolved with Mukherjee et al. (2021) when they extended the previous works by developing the IoT-Enabled Accident Prevention and Alert System that was composed of various sensors for real-time monitoring. These studies, in combination, focused on automatic alert systems as crucial elements in ensuring timely responses to save lives.

2.3 IoT-Based and Embedded Vehicle Safety Systems:
On one hand, Patel and Kumar (2020) introduced the IoT-Based Smart Vehicle Safety System, where microcontrollers and sensors could be interfaced for making decisions in real time. Das and Prasad (2020) came forward with Cost-Effective IoT Solutions for Road Safety, which addressed the affordability and scalability of safety systems for public use. Khan et al. (2021) introduced the Smart Vehicle Monitoring System that demonstrates IoT's role in continuous vehicle condition monitoring. These works show the valuable contribution of hardware-software integrations in the development of intelligent safety

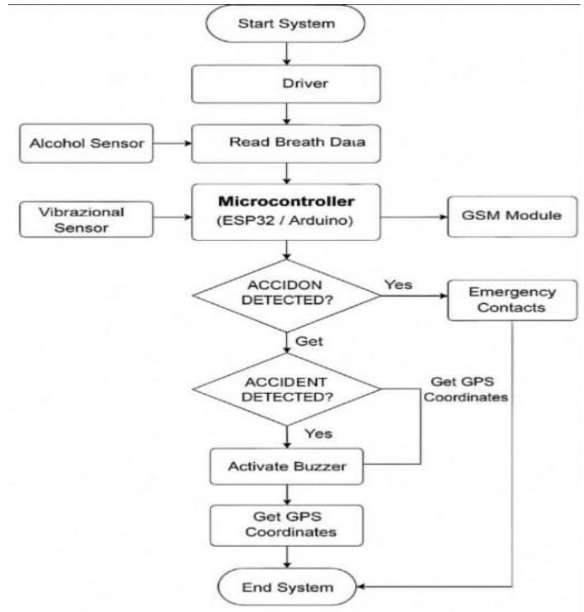
## III. METHODOLOGY

The methodology of the Alcohol and Accident Detection-Based Automatic Car Engine Locking and Alert System involves a systematic and structured approach, ensuring that the system objectives are met effectively. It includes the requirement gathering stage, the design and development stage, the testing stage, deployment, and maintenance. Each phase in the process is very important for the system to function correctly, reliably, and with efficiency under realistic conditions. It is outlined as follows:

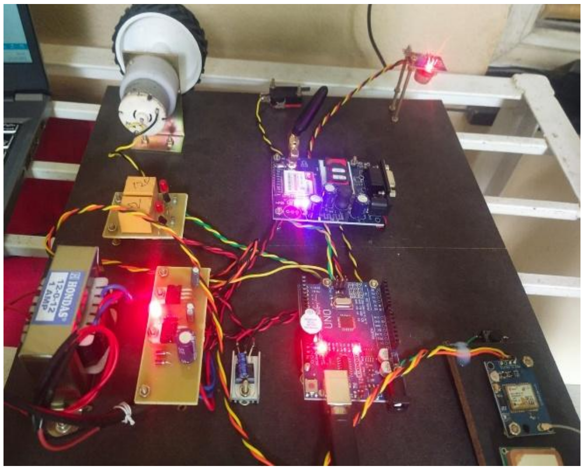
3.1 Requirement Analysis:
Research existing vehicle safety systems, pinpointing the gaps in accident detection and alcohol-monitoring technologies.
Gather requirements for hardware and software components required for system implementation: sensors, microcontrollers, communication modules, and software interfaces.
Define functional requirements such as alcohol detection, identifying an accident, GPS tracking, engine locking, and GSM alerting.
Establish performance requirements for real-time response, accuracy of sensor readings, and system reliability under various conditions.
Analyze user needs and expectations, especially those of drivers, emergency services, and automobile safety applications to make sure the design addresses the real-world challenges.

3.2 Design and Prototyping:
The design and prototyping of the Alcohol Detection and Accident Prevention System is an effective, real-time, and reliable safety device that integrates alcohol detection, accident identification, and emergency alert mechanisms into one embedded system. This project revolves around the Arduino UNO microcontroller, which acts as the brain of the project by processing input signals obtained from sensors and managing output operations such as engine control, alerts, and communication. Alcohol concentration in a driver's respiration is detected using an MQ-2 gas sensor. The analog output from this sensor is connected to Arduino for analysis. If the alcohol level exceeds the threshold limit set within the program, the microcontroller will instantly drive the buzzer to alert the driver and send a

control signal to the relay module for gradual cutting of the DC motor-imitated engine locking without causing abrupt stops. At this time, the system will trigger the GSM module to send a message stating "ALERT! ALCOHOL DETECTED" along with real-time location details fetched from the GPS module to the registered contact number. For accident detection, a bump sensor or vibration sensor is used to identify the sudden shocks or collisions. Upon impact detection, an emergency sequence is initiated by Arduino, which will trigger the buzzer, halt the motor, and send a location-based SMS for alerting authorities or family members. This software logic developed in Arduino IDE with embedded C/C++ coordinates these hardware interactions through conditional statements, loops, and serial communication commands. Transmission of messages via GSM is achieved by using AT commands, and SoftwareSerial enables simultaneous data communication between GPS and GSM modules. The prototype was assembled on a breadboard using connecting wires, ensuring proper insulation and stable connections. Power supply is given using a step-down transformer, rectifier, and voltage regulator to maintain a constant 5V DC output for all components. Extensive testing was carried out under simulated conditions of alcohol exposure and impact to verify the accuracy, speed, and reliability of the responses obtained. Results showed precise detection, quick SMS delivery of alerts, and accurate GPS tracking, which proves the efficiency of the system. Overall, the design and prototype presented here show how embedded systems with IoT can be integrated into low-cost in-vehicle safety solutions that can automatically prevent drunk driving, detect accidents, and allow timely help through real-time communication. This prototype will give a better platform for further improvements that might involve mobile app connectivity, AI-driven driver monitoring, and cloud-based data analytics for Intelligent Road Safety Systems.




3.3 Testing:
Testing helps to confirm the accuracy of the system, its efficiency, and reliability. Several levels of testing were done in order to ensure proper functioning:
Unit Testing: Each sensor and component, including MQ3, GPS, GSM, accelerometer, relay, and buzzer, was individually tested to confirm accuracy of operation.
Integration Testing: Components were connected to the microcontroller to test for smooth data flow.
flow and synchronization between modules.
Functional Testing: The system was tested in real-world conditions by simulating alcohol detection and accident scenarios to check engine locking and the transmission of an alert message.
Performance Testing: Response time of the system, accuracy of messages, and reliability of GPS location
The data from the tracking were analyzed.
Error Handling: Several test cases were conducted with this system to ensure that it behaves correctly even when one of its modules (for example, a temporary loss of the GSM signal) fails.
Testing showed that the system could detect the presence of alcohol and accidents correctly, and when these events occurred, it could successfully lock engine mechanisms and quickly send notifications.



## IV. ARCHITECTURE

The architecture of the Alcohol Detection and Accident Prevention System will be based on an embedded IoT framework, which includes integration of a multitude of sensors and communication modules through an Arduino UNO microcontroller. The system gets input from the alcohol sensor MQ-2 and bump sensor, does the processing, and gives output to the relay module, buzzer, GSM, and GPS modules. In case of the detection of alcohol or an accident, the controller sends signals to lock the engine automatically, generates an alert, and sends the location to the emergency contact via SMS. The overall architecture is designed for real-time monitoring and response, with enhancements in vehicle safety to be reliable and cost-effective.

### 4.1 Overall Design of the System:

The architecture of the Alcohol Detection and Accident Prevention System is designed to integrate the necessary sensors and modules through a centralized control unit for real-time monitoring, prevention, and emergency communication. The system uses an Arduino UNO microcontroller as the main processing unit to receive signals from the MQ-2 alcohol sensor and bump sensor, and then it controls the outputs, such as the relay module, buzzer, GSM, and GPS modules. The design follows a modular approach for scalability, reliability, and ease of maintenance. Each module plays its own role, while all modules combine effectively to provide accurate detection and timely alerts.

### 4.2 Functional Architecture:

The complete system architecture is composed of three main sections:

Input Section: This contains the MQ-2 alcohol sensor and bump sensor. The alcohol sensor detects the presence of alcohol vapors in the driver's breath, while the bump sensor detects any sudden impact showing an accident. From the sensors, analog or digital signals are generated and sent to the Arduino for processing.
Processing Section: The Arduino UNO works like the brain of this system. It interprets data from sensors and accomplishes certain tasks when threshold values are reached. It detects whether alcohol is found or an accident has happened and therefore actuates the stages further.

Output Section: The processed input is used by Arduino to trigger the relay module for locking or unlocking the vehicle's engine, triggering the buzzer for sound alerts, and communicating with GSM and GPS modules for sending real-time messages with location details to registered emergency contacts.

### 4.3 Communication and Control Flow:

Serial communication between the Arduino and the interfaced modules is the basis of the flow of communication in the system. Location coordinates are provided at regular intervals by the GPS module to the Arduino through serial communication. In case of detection due to an accident or alcohol, the GSM sends out an SMS with the GPS coordinates to the predefined contacts. The relay acts as an actuator that operates on the vehicle's ignition system. The buzzer provides an immediate alert signal to the driver and people around for prompt awareness of any abnormal condition. This control flow synchronizes all modules in order to achieve seamless automated safety operation.

### 4.4 Hardware Architecture Description:

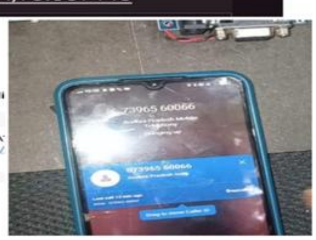
The hardware is structured on a compact embedded platform, powered with 12V DC, regulated into 5V to drive sensors and modules. Arduino UNO forms the central node to which input and output devices are connected through jumper wires and breadboards. The MQ-2 sensor is connected to the analog pin to sense alcohol, while the bump sensor connects to a digital input pin. The GSM and GPS modules are connected to serial communication pins, while the relay and buzzer are hooked up to digital output pins. Such structured wiring and modular assembly ensure flawless execution and troubleshooting of the system. The overall architecture ensures low power consumption, high reliability, and real-time performance.

## V.RESULT ANALYSIS

The Alcohol Detection and Accident Prevention System was tested under different real-world conditions to assess the efficiency, accuracy, and reliability of the system. The MQ-2 gas sensor detected alcohol vapors around the driver's seat correctly, thus creating an instant response in triggering the buzzer and locking the engine mechanism; this ensured that the vehicle would not start or would turn off midway in the case of alcohol consumption during driving. The bump sensor identified abrupt shocks or impacts, simulating accident conditions, and hence provided a prompt signal to initialize the GSM module to send an emergency alert message with GPS location coordinates of the vehicle to a pre-set number.

The results showed a very responsive and accurate outcome, with an almost negligible delay in sending alerts and correct positioning of GPS. It has also been established that it will be relatively cost-effective, power-efficient, and user-friendly for commercial and personal vehicle integrations. The project attained its goals of deterring drunk driving and reducing emergency response time, hence increasing road safety. On the whole, the analysis from the above proves that the proposed prototype serves efficiently as a real intelligent vehicle safety system in real time for the purpose of reducing accident-related fatalities and encouraging responsible driving.





## VI. SCOPE IMPROVEMENT

Although alcohol consumption is effectively detected, accidents are monitored, and emergency contacts are notified, there is a great scope for further improvement. Advanced AI-based data analysis in upcoming versions can forecast driver behavior and detect drowsiness or fatigue through camera modules. It can be integrated with cloud platforms to support real-time data storage, remote monitoring, and analytics both at traffic authorities and for family members. Integration of the system with voice alerts, automatic braking, and OBD-II on-board diagnostics of the vehicle may display the exact condition of the engine and driving pattern. The integration of IoT-based mobile applications in the system will enhance the ease of use, whereby notifications can be received on smartphones and vehicles tracked remotely. On improving hardware durability, reducing power consumption, and extending the system to electric and hybrid vehicles, the project can evolve into a comprehensive smart vehicle safety solution that will grow with the times into intelligent transportation systems.

## VII.CONCLUSION

This innovative Alcohol Detection and Accident Prevention with Automatic Engine Locking System aims to increase road safety by reducing accidents due to drunk driving and delayed responses during emergencies. This can be realized by Using sensors like an MQ-2 gas sensor to detect alcohol and a bump sensor in the case of an accident, The system provides real-time monitoring of the driver's condition and vehicle status. The Arduino UNO serves as the brain of the system, processing the signals from sensors and further triggering appropriate actions to prevent unsafe driving situations. on detecting alcohol, the system triggers the buzzer, locks the vehicle engine through the relay module, and sends an alert message along with the location of the vehicle using the GSM and GPS modules to the emergency contact. If there is an accident, the system does almost the same thing to ensure emergency services or a family member is contacted instantly. This automatic alert mechanism helps reduce response time, potentially saving lives in critical situations. overall, the project depicts how inexpensive and compact electronic components can be brought together to devise an effective solution in terms of safety. It not only avoids drunk driving but also ensures faster detection and alerting of accidents. Further upgrades can be done in the system to make it more intelligent, scalable, and suitable for actual vehicle deployment environments by incorporating cloud connectivity, integration with a mobile application, or AI-based data analytics.

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