



# ALCOHOL IGNITION INTERLOCK

<sup>1</sup>Prof. Manisha Vaidya, <sup>2</sup>Pranali Dehelikar, <sup>3</sup>Tanisha Gokhale, <sup>4</sup>Sayli Vishwakarma, <sup>5</sup>Siddhi Thakre

<sup>1</sup>Asst Professor, <sup>2</sup>Student, <sup>3</sup>Student, <sup>4</sup>Student, <sup>5</sup>Student

<sup>1</sup>Computer Science & engineering,

<sup>1</sup>Priyadarshini J.L College of Engineering, Nagpur, India

**Abstract :** Alcohol detection systems that are integrated with vehicle engine immobilizers represent innovative technologies aimed at reducing incidents of drunk driving and improving road safety. These systems utilize a variety of techniques, including breathalyzer sensors, touch-based alcohol sensors, AI-enhanced facial recognition, and wearable devices, to assess whether a driver is under the influence of alcohol. If the detected alcohol concentration surpasses a set limit, the vehicle's engine is disabled, preventing it from being operated. This literature review analyzes the various alcohol detection methods, weighing their advantages and disadvantages. While these systems offer benefits such as preventing intoxicated individuals from driving, using non-invasive detection techniques, and facilitating real-time monitoring of alcohol levels, they also face specific challenges..

**IndexTerms -** MQ-3 Alcohol Sensor, Relay Module, Buzzer , LED, LCD Display, Resistor, Transistor, Battery, Arduino UNO.

## INTRODUCTION

The consumption of alcohol greatly affects a driver's ability to safely control a vehicle, leading to a significant number of traffic collisions and deaths globally. Driving under the influence remains a significant public safety concern, prompting the development of various strategies to tackle this issue. Among these strategies, alcohol detection systems that are combined with vehicle engine immobilization features have attracted attention as effective measures to curb drunk driving. These systems are designed to sense alcohol in the driver's breath, sweat, or through analysis of their behavior, and will immobilize the vehicle's engine if the alcohol level surpasses a certain limit. By preventing intoxicated individuals from starting or driving the vehicle, these systems intervene directly in potentially hazardous situations, thereby averting accidents and encouraging safer driving practices. They store a dataset and classify any new information into a category that closely resembles the incoming data. Conventional approaches such as awareness campaigns, legal restrictions, and random breathalyzer checkpoints have been utilized, but they typically depend on enforcement after a driver has already taken to the road. This lag in detection heightens the risk of accidents occurring before any measures can be enacted. Moreover, alcohol consumption can hinder reaction times, cognitive reasoning, and motor skills, making the implementation of proactive solutions even more essential.

Integrating smart alcohol detection technology into vehicles can greatly lower the chances of drunk driving incidents by enabling real-time monitoring and automatic vehicle management. Drunk driving ranks among the top causes of traffic accidents worldwide, leading to numerous injuries and deaths every year. The World Health Organization (WHO) reports that alcohol-related accidents result in thousands of fatalities annually, underscoring the critical need for effective prevention strategies. While traditional approaches like awareness campaigns, legal regulations, and random breathalyzer tests have been employed, they often depend on enforcement after a driver has already taken to the road..

## NEED OF THE STUDY

The primary objective of this project is the detection of drunk driving. Nowadays, a significant number of accidents occur due to drivers consuming alcohol or the individuals operating the vehicle. As a result, drunk driving stands as a key contributor to accidents across virtually all nations worldwide. It is widely recognized that alcohol consumption hinders driving abilities and elevates the risk of accidents. Research indicates that driving while under the influence of alcohol dramatically increases the likelihood of being involved in an accident that leads to injury or fatality. According to estimates from the European Commission, at least 10,000 individuals in the European Union lose their lives each year in road accidents attributed to alcohol. Alcohol-related driving accidents represent about 31% of all fatalities on the roads in the United States. In China, research by Li et al. found that around 34.1% of traffic accidents were linked to alcohol.

### 3.1 Population and Sample

A population, in terms of alcohol ignition interlock devices, includes all people who could use or be affected by these devices, such as individuals convicted of DUI, commercial drivers, or ordinary vehicle owners in regions where interlock regulations are implemented. A sample, on the other hand, represents a smaller, more specific group chosen from this population for examination or analysis, such as 500 DUI offenders in a certain state who were mandated to install interlock devices and whose driving behavior was monitored for a year.

### 3.2 Data and Sources of Data

The information pertaining to alcohol ignition interlock devices comprises installation statistics, rates of DUI recidivism, the effectiveness of devices in decreasing alcohol-related incidents, user adherence indicated by failed and passed breath tests, legal regulations mandating interlock usage, and societal views on its acceptance. This data is collected from multiple sources including governmental documents from entities such as the National Highway Traffic Safety Administration (NHTSA), law enforcement agencies that oversee DUI arrest and compliance statistics, scholarly studies, reports from manufacturers regarding device sales and usage, survey findings that indicate public opinion, and analyses by insurance companies on accident trends prior to and following the implementation of interlocks.

### 3.3 Theoretical framework

The theoretical basis for alcohol ignition interlock devices is grounded in theories of behavioral deterrence and technological intervention. Deterrence Theory posits that the likelihood of individuals engaging in dangerous behaviors, such as driving under the influence, decreases when they face strict penalties, such as having an interlock installed. The Technology Acceptance Model (TAM) focuses on how users view and embrace interlock devices, taking into account their user-friendliness and perceived efficacy in averting DUI incidents. Furthermore, the Public Safety and Risk Reduction Theory advocates for the use of interlock systems as a proactive approach to minimize alcohol-related accidents. By combining these theoretical perspectives, researchers can evaluate how effective interlock devices are in altering driver behavior, decreasing repeat offenses, and improving road safety.

## RESEARCH METHODOLOGY

The methodology for researching alcohol ignition interlock devices employs both quantitative and qualitative strategies. A quantitative strategy involves analyzing statistical data on DUI recidivism rates, accident reduction, and compliance rates through surveys, government records, and law enforcement documentation. The qualitative strategy includes conducting interviews with offenders, law enforcement personnel, and policymakers to gain insight into perceptions and obstacles related to interlock devices. Data collection techniques encompass surveys, case studies, and secondary data obtained from official reports. The sampling methods might utilize either random or purposive sampling of DUI offenders and other relevant stakeholders. Data analysis is carried out using statistical tools to evaluate effectiveness, while thematic analysis is utilized for qualitative findings, ensuring a thorough comprehension of the influence of interlock devices on road safety.

### 3.1 System Block Diagram

- **Breathalyzer** : A fuel cell sensor is utilized for conducting alcohol verification tests. The outcomes of the test are sent to a microcontroller via a wired connection for further processing. The collected data is transmitted to the microcontroller via a wired serial interface (e.g., UART, SPI, or I2C) for real-time processing.
- **Indicator**: A number of LEDs are utilized to show if a test result is positive or negative. They serve to reflect the overall condition of certain components within the system. The signal activates the corresponding indicator. Green LED indicates that alcohol is not detected (BAC below threshold). Red LED Signals that alcohol is detected (BAC above threshold), warning the driver. The LEDs serve not only as test indicators but also as status indicators for system components (e.g., sensor failure, low battery, or circuit issues).
- **Microcontroller**: The microcontroller manages the whole system. The controller executes the central program to validate the test outcomes from the breath analyzer. By processing the input results, it performs specific predefined actions.
- **Engine control unit** : This is the car's control unit, responsible for managing the operation of key components, especially in deciding whether the ignition should be activated or deactivated. This unit is linked to the microcontroller via a wired connection. According to the test outcomes, the microcontroller transmits the appropriate signals to either activate or deactivate the ignition.
- **Alarm unit** : The system consists of an LED light and a buzzer. It is linked to a microcontroller via a wired connection for signal communication. Upon receiving an "on" signal, the buzzer emits a beep to alert the driver to halt the vehicle, and the LED light will illuminate if alcohol is detected. Alcohol detected continuous buzzer sound with red LED illumination. Test required Short beep with blinking LED, prompting the driver to take the test. System error: Intermittent beeping to indicate a fault in the system.

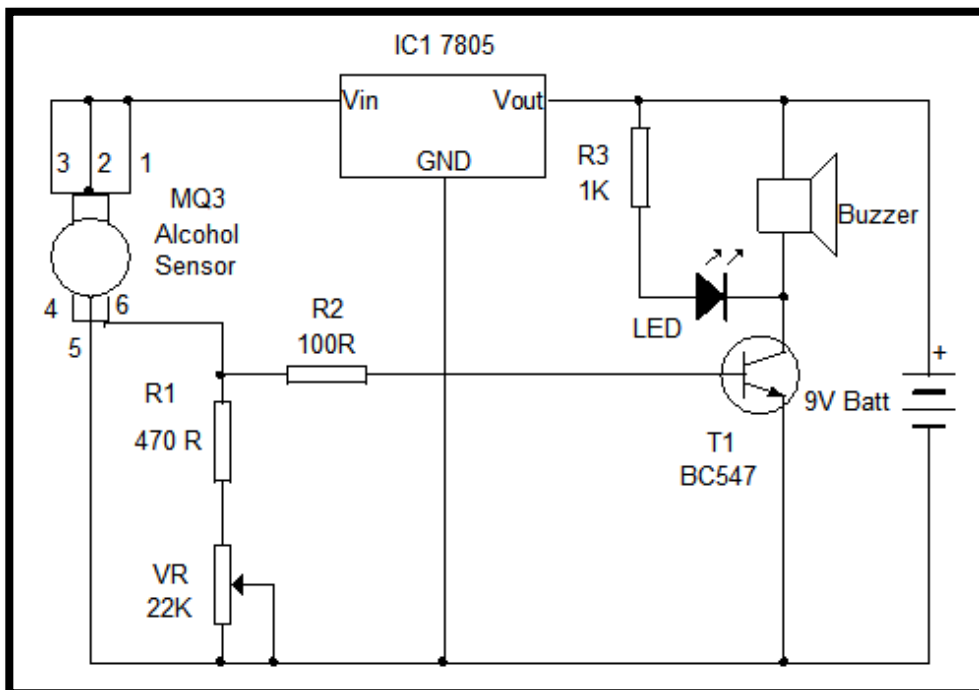


Fig: System Block Diagram

### 3.2 Working

#### Alcohol Detection

An ignition interlock device is a breath testing instrument installed in a vehicle to deter drunk driving. Prior to starting the car, the driver is required to exhale into the device, which assesses their breath for levels of alcohol. The device calculates the Blood Alcohol Concentration (BAC) according to the breath sample it analyzes. If the BAC is above a predetermined threshold (usually 0.02% or less), the device will signal this by illuminating a red light and emitting a buzzer, thereby preventing the vehicle from being started. If the BAC falls below the specified limit, the device will shine a green light, permitting the driver to safely operate the vehicle. This system is frequently utilized for individuals with past DUI violations to encourage responsible driving behavior.

#### Alcohol Detection-Based LED Indicator

In Module 2, once the driver exhales into the Alcohol Ignition Interlock device, the LED light displays the outcome of the breath test. If the Blood Alcohol Concentration (BAC) is above the allowable limit, the device triggers a buzzer as a warning signal, informing the driver that they have surpassed the legal limit and cannot start the vehicle. At the same time, the interlock communicates with the vehicle's ignition system, blocking the engine from starting. On the other hand, if the BAC is within the permissible range, the vehicle can be started normally, enabling the driver to operate the car safely. This system aims to discourage impaired driving and improve road safety.

#### Alcohol Detection-Based Buzzer Alert

The process of object detection in an alcohol ignition interlock device utilizing infrared (IR) sensors encompasses several steps: The IR sensor is mounted in the vehicle to identify objects located in front of the car. It emits infrared light and analyzes the returned reflections to determine the presence of obstacles, such as pedestrians or other cars. When the IR sensor identifies an object, it transmits this data to the vehicle's control system for analysis. If an object is recognized, the system activates an alert. This alert is shown on an LCD screen inside the vehicle, offering a visual warning message to the driver. This functionality enhances safety by making sure that the driver is informed about any obstacles in their path, which helps to decrease the likelihood of accidents, particularly when the vehicle is in motion.

#### Alcohol Detection with Automatic Vehicle Locking

In an alcohol ignition interlock device with an LCD display, the system conveys essential information to the driver about alcohol detection and the presence of objects. When the driver exhales into the device, it analyzes the Blood Alcohol Concentration (BAC). If the alcohol level exceeds the allowed limit, the LCD display presents a message like "Alcohol Detected." This warns the driver that they are not fit to operate the vehicle. The device also features an infrared (IR) sensor to identify objects in front of the car. If an object, such as a pedestrian or another vehicle, is within a specific range, the LCD display will indicate "Object Detected." This acts as a warning for the driver to remain cautious and aware of their environment. If both situations arise at the same time (alcohol detected and an object in front), the LCD can show both messages, ensuring the driver is completely informed of the circumstances.

### 3.3 Design prototype

During the planning phase of the project, various designs were evaluated. Several essential factors were taken into account when choosing the most appropriate design, including cost, power consumption, user-friendliness, and system accuracy. The following section presents a detailed table of the preferred components selected for both hardware fabrication and prototype design.

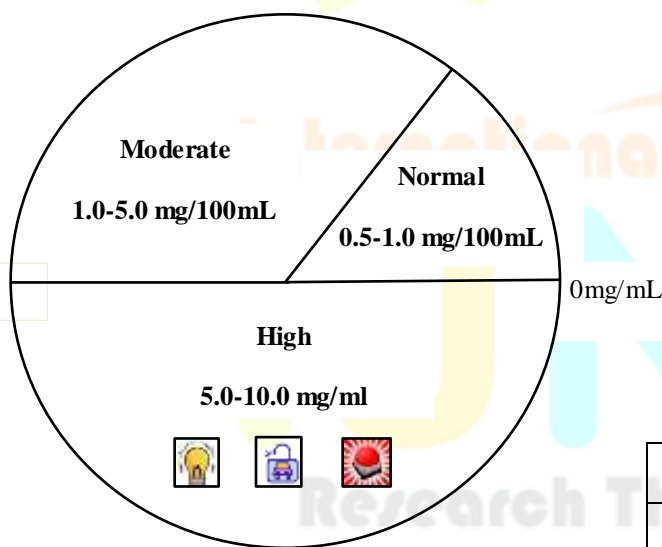
Components	Image	Purpose
MQ3 alcohol sensor		The MQ-3 alcohol sensor is a commonly utilized gas sensor that is specifically created to detect alcohol vapors present in the air..
Arduino Uno		The Arduino Uno serves as the central processor of the system by analyzing sensor information and managing the engine locking mechanism.
Relay Module		Manages the ignition system by disconnecting the power to the engine when alcohol is detected beyond the specified limit..
Buzzer and LED		The buzzer and LED signal an audible and visual alert to the driver and passengers when alcohol is detected.
Jumper Wires (connecting wires)		Jumper wires are utilized to connect different devices.
LCD Display		An LCD screen is utilized to show text messages on the display.
Resistor		A resistor serves to temporarily hold a small quantity of data..
Transistor		A transistor operates as a switch or an amplifier within electronic circuits.
Battery		A battery is utilized to store and provide electrical energy for portable devices.




### 3.4 Embedded software

The selected programming language for the creation of the embedded software is C++. The source code includes the main logic necessary for the system to function correctly, using signals received from sensors and processing them based on the sensor readings. Consequently, the relevant signals are transmitted to the appropriate units to perform actions based on the results of the computations. The source code operates in accordance with the system flow outlined in the system workflow subsection. The embedded program is designed to execute tasks automatically, meaning it starts running as soon as the system is powered on.

- **Start :** The code runs as soon as the script starts executing. Upon startup, the script first calls the setup function, which configures the board mode and defines certain pin states and ports. An Arduino Uno is managed through the USB port. Most of the operations and checks are performed within the btn function.
- **Test:** The function verifies that the user has completed the test. A comparison of the sensor readings before and after the test is conducted. It then proceeds to assess whether the test results are positive or negative. If the results are positive, the buzzer will emit a beep and the LED light will illuminate. The constants for the “buzzer pin” and “LED pin” specify which pins on the microcontroller are connected to the buzzer and the LED, respectively. The loop() function illustrates how to utilize the ‘beep buzzer()’ and ‘glow led()’ functions. It triggers the buzzer to sound for 1 second and lights up the LED for 0.5 seconds.
- **Ignition :** The ‘allow ignition’ and ‘stop ignition’ functions are responsible for starting the vehicle's ignition. The ‘allow ignition’ function is invoked when the alcohol concentration is below the set threshold, allowing the vehicle to be started safely. It sets the relay pin to high, which usually completes the relay circuit, enabling power to reach the ignition system and thus starting the engine. Conversely, when the alcohol level surpasses the threshold, the ‘stop ignition’ function is activated when the sensor determines that the driver is intoxicated. It sets the relay pin to low, which breaks the relay circuit and disconnects power to the ignition system, preventing the engine from starting.
- **Object Detection :** The IR sensor is utilized to detect the object. In this case, we employ the 'object detection' function to ascertain whether the IR sensor has detected an object. The 'detect object' function examines the digital output from the IR sensor. A high output indicates that an object has been detected, and the function returns 'true'. Conversely, if the output is low, it returns 'false'.
- **LCD Display :** The IR sensor is utilized to identify the presence of an object. We employ the 'object detection' function to assess whether the IR sensor has detected an object. The 'detect object' function captures the digital output from the IR sensor. A high output indicates that an object has been detected, leading the function to return 'true.' If not, it returns 'false.'

## IV. RESULTS AND DISCUSSION



Alcohol level	Normal	Moderate	High
LED Light 	Off	Off	On
Buzzer 	Off	Off	On
Vehicle lock 	Off	Off	On

### REFERENCES

[1] Gupta, A., Kumar, R., & Singh, M. (2023). AI- Powered Alcohol Detection using Facial Analysis. *Journal of Transportation Safety & Security*, 15(2), 145-162.

[2] Thompson, D. C., & McCarthy, D. J. (2023). Evaluation of New Technologies for Alcohol Detection and Their Impact on Traffic Safety. *Traffic Injury Prevention*, 24(2), 142-150.

[3] Li, Y., Wu, C., & Wu, Z. (2023). Smart Wearable Alcohol Detection Systems: Current Trends and Future Directions. *Sensors*, 23(1), 45.

[4] Bhat, C. R., & Sardesai, R. (2022). Effectiveness of Ignition Interlocks in Reducing Drunk Driving: A Review. *Transportation Research Part A: Policy and Practice*, 163, 115-130.

[5] Kim, J., Park, S., & Lee, H. (2022). Wearable Alcohol Monitoring Devices for Vehicles. *International Journal of Vehicle Safety*, 14(1), 23-38.

- [6] Lee, D., Choi, Y., & Ryu, H. (2022). Integration of Multi-Modal Alcohol Detection Systems. *Transportation Research Part F: Traffic Psychology and Behavior*, 83, 115-128.
- [7] Ranjan, P., & Kumar, V. (2022). A Review of IoT-Based Alcohol Detection Systems and Their Application in Road Safety. *Internet of Things*, 18.
- [8] Sharma, P., & Mehta, S. (2021). Development of a Breathalyzer Ignition Interlock System. *Accident Analysis & Prevention*, 156, 106135.
- [9] O'Brien, J., & Kearney, M. (2021). The Role of Technology in Combating Drunk Driving: A Comprehensive Overview. *Journal of Traffic Medicine*, 24(4), 221-235.
- [10] Wang, L., & Zhao, H. (2021). Advancements in Breath Alcohol Detection Technologies and Their Applications in Vehicles. *Journal of Safety Research*, 75, 123-132.
- [11] Patel, A., & Desai, R. (2020). Design of a Touch-Based Alcohol Detection System. *Journal of Safety Research*, 74, 157-165.
- [12] Harrison, W. A., & Tilley, A. J. (2020). Alcohol Detection Technologies and Their Implications for Road Safety: A Systematic Review. *Safety Science*, 128, 104753.

