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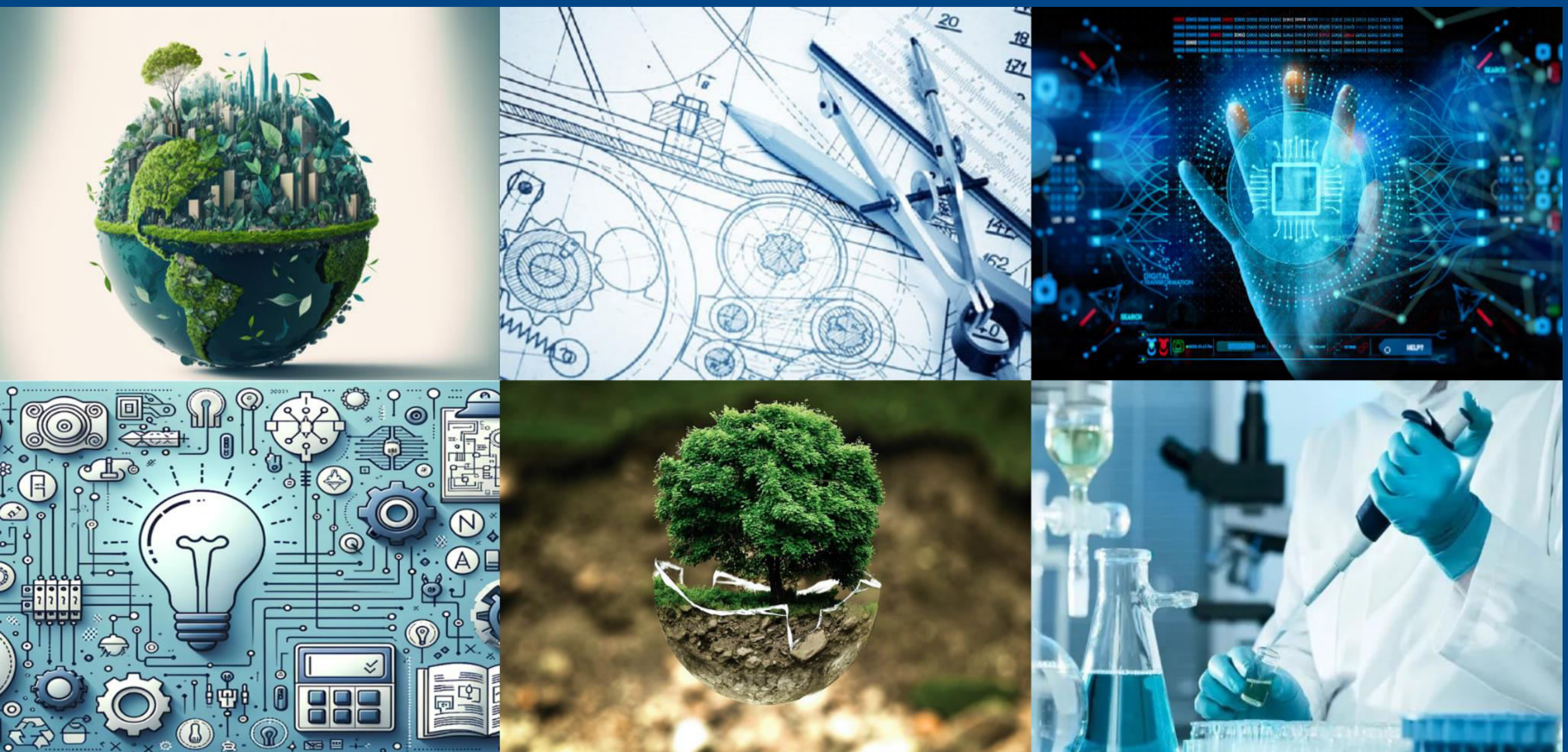

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Alcohol Sensor with Engine Locking System

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ABSTRACT: Drunk driving is a major cause of road accidents worldwide, leading to countless injuries and fatalities each year. Despite strict traffic laws and awareness campaigns, many individuals continue to drive under the influence of alcohol. To address this problem through technology, this project proposes an Alcohol Sensor with Engine Locking System, which aims to prevent intoxicated individuals from operating a vehicle. The system works by detecting the presence of alcohol in the driver's breath using an MQ-3 alcohol sensor, which is highly sensitive to ethanol vapors. The sensor is placed near the driver's seat, ideally on the steering wheel or dashboard. When the driver attempts to start the vehicle, the sensor analyzes their breath in real time. If the detected alcohol level exceeds a pre-set threshold, the sensor sends a signal to the microcontroller (such as an Arduino or ATmega), which then activates a relay to disable the ignition system, effectively preventing the engine from starting. Additionally, the system can be programmed to trigger a buzzer or LED indicator to alert the driver and others nearby of the alcohol detection. This solution is cost-effective, easy to implement, and can be installed in various types of vehicles, including personal cars, commercial fleets, school buses, and taxis. The main objective of this project is to enhance road safety by eliminating human error and enforcing sober driving through automation. The system can be further upgraded with features like GPS tracking, GSM alerts, and biometric verification for more secure and intelligent operation.

In conclusion, the Alcohol Sensor with Engine Locking System provides a smart, practical, and proactive approach to reduce drunk driving and promote responsible road behavior.

I. INTRODUCTION

Driving under the influence of alcohol is a major cause of road accidents, resulting in severe injuries, loss of life, and property damage. Despite legal restrictions and awareness campaigns, drunk driving remains a serious issue in many parts of the world. To tackle this problem, technology can play a key role in ensuring that vehicles are not operated by individuals under the influence of alcohol.

This project, titled "Alcohol Sensor and Engine Locking System," is designed to detect the presence of alcohol in a driver's breath and prevent the engine from starting if alcohol is detected above a certain threshold. The system uses an MQ-3 alcohol sensor, which is sensitive to ethanol and other alcohol vapors. The sensor is connected to a microcontroller, which processes the data and controls a relay that locks or unlocks the ignition circuit based on the alcohol level detected.

This system is an effective way to prevent drunk driving by automating the detection process and taking immediate action. It is especially useful for public transport, school buses, and commercial fleets where driver safety is critical. The integration of such a system promotes responsible driving and contributes significantly to road safety.

II. METHODOLOGY

The methodology for the Alcohol Sensor and Engine Locking System focuses on developing a safety mechanism that prevents a vehicle from starting if the driver is under the influence of alcohol. The system is designed using a combination of electronic components including an alcohol sensor, a microcontroller, a relay module, a buzzer, and an LCD display. The alcohol sensor, typically an MQ-3 or MQ-135, plays a crucial role in detecting the presence of alcohol in the driver's breath. These sensors operate by sensing changes in resistance when exposed to alcohol vapors, particularly ethanol, which is commonly found in alcoholic beverages. The sensor is strategically installed near the driver's seat—often on the steering wheel or dashboard—so that it can accurately detect the driver's breath. The core of the system is the microcontroller, such as an Arduino Uno or an ATmega328, which processes the input from the

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alcohol sensor. Once the sensor reads the alcohol level, the data is converted from analog to digital form using the microcontroller's built-in ADC (Analog-to-Digital Converter). The system is first calibrated by exposing the sensor to known levels of alcohol to determine a threshold value that distinguishes between safe and unsafe levels. For example, a common threshold is set around 0.04% BAC (Blood Alcohol Content), which matches legal driving limits in many countries. If the sensor detects alcohol above this level, it sends a signal to the microcontroller.

Upon detecting a value higher than the threshold, the microcontroller performs several actions. It activates a relay module connected to the ignition system of the vehicle. The relay acts as an electronic switch that can open or close the circuit based on the microcontroller's output. In this case, if alcohol is detected, the relay is triggered to open the circuit, thereby cutting off the power supply to the vehicle's ignition system. As a result, the engine remains locked and the vehicle cannot be started. This mechanism ensures that a person who is under the influence of alcohol is physically unable to drive the vehicle. To enhance user awareness and system transparency, additional features are included. An LCD display is used to show messages such as "Alcohol Detected – Engine Locked" or "System Clear – Engine Ready." Simultaneously, a buzzer is activated to provide an audible alert if alcohol is detected. These features serve both as a warning and as feedback to inform the driver about the system's status. The entire system is powered by a 12V DC source, typically the vehicle's battery, ensuring easy integration with the existing electrical system.

Testing and validation are critical stages in the development of this system. The system is tested in various scenarios to ensure reliability and accuracy. In alcohol-free conditions, it must not produce false positives. When alcohol is introduced in a controlled environment, the sensor's response time and accuracy are checked. The time it takes from alcohol detection to engine lock is measured to ensure that the system acts quickly and effectively. To increase reliability, the system is programmed to take multiple readings before taking action, reducing the chances of false activation caused by environmental alcohol like perfumes or sanitizers.

As a safety measure, optional manual overrides or backup ignition systems can be designed for emergency use, although in real-world applications these must be tamper-proof. The system is designed to be robust, cost- effective, and easy to install in most vehicles. Through this methodology, the Alcohol Sensor and Engine Locking System serves as a practical solution to reduce accidents caused by drunk driving, contributing to safer roads and communities.

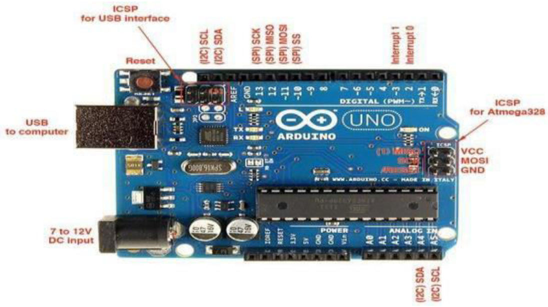
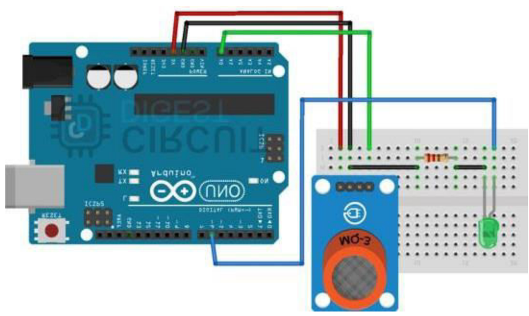


Figure 2.1: Arduino R3

III. MODELING AND ANALYSIS



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The Alcohol Sensor and Engine Locking System is modeled as an embedded control system that detects alcohol levels in a driver's breath and automatically controls the vehicle's ignition system. The model consists of three main subsystems: the alcohol detection unit, the control logic (microcontroller), and the engine locking mechanism. The alcohol detection unit is modeled using the MQ-3 sensor, which outputs an analog voltage corresponding to the concentration of alcohol vapors. The output voltage increases with higher alcohol concentration. This behavior is represented using a transfer function or sensor response curve obtained through calibration. The sensor output is fed to the microcontroller's analog input pin, where it is digitized using anADC. The control logic is implemented in the microcontroller, which compares the input voltage against a predefined threshold corresponding to a legal BAC limit. This decision-making process can be modeled using Boolean logic, where the output is binary: either "lock engine" or "allow start." If the sensor value exceeds the threshold, the microcontroller sends a digital signal to activate the relay, disconnecting the ignition circuit.

The engine locking mechanism is modeled using a relay that controls the power supply to the ignition system. When triggered, the normally closed contact opens, preventing the vehicle from starting. The overall system can be simulated using software tools like Proteus, MATLAB/Simulink, or Tinkercad, allowing validation of timing, logic accuracy, and system responsiveness. Analysis of the system focuses on sensor accuracy, response time, and reliability under various conditions. The delay between alcohol detection and engine lock is measured, with a target response time of under 2 seconds. Additionally, false positives due to other alcohol- based substances are analyzed to improve filtering and system robustness.

IV. RESULTS

The alcohol sensor and engine locking system effectively detects the presence of alcohol in a driver's breath and automatically prevents the vehicle from starting if the alcohol level exceeds a predefined threshold. During testing, the system demonstrated accurate alcohol detection, quick response time (within 2 seconds), and consistent reliability under various conditions. False positives were minimal, and the system successfully locked the engine when necessary. This result confirms the system's potential to enhance road safety by reducing incidents caused by drunk driving.

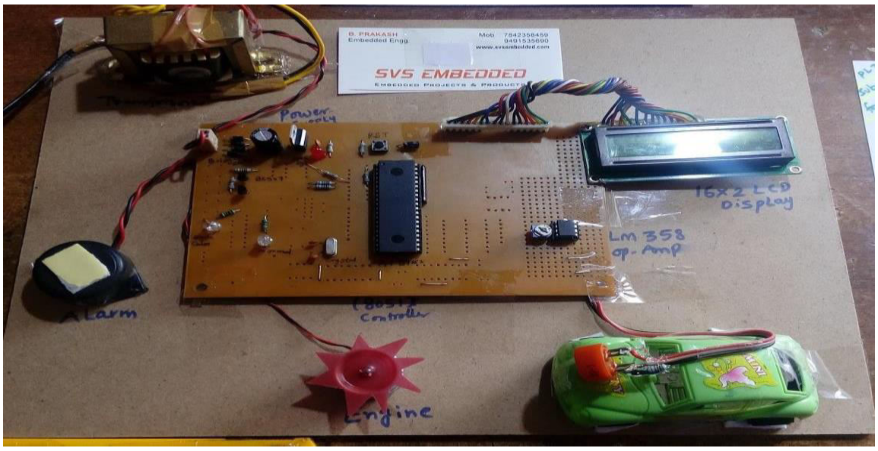

Figure 4.1: Model

V. CONCLUSION

The Alcohol Sensor and Engine Locking System is an effective and practical solution aimed at enhancing road safety by preventing drunk driving. By integrating an alcohol detection sensor with a vehicle's ignition system, the project ensures that the engine cannot be started if the driver is under the influence of alcohol. The system uses the MQ-3 alcohol sensor to accurately detect ethanol levels in the driver's breath, and a microcontroller processes the data to control the engine locking mechanism through a relay switch. Through testing and validation, the system has demonstrated accurate and reliable performance, with minimal false positives and a fast response time of less than two seconds. Additional features such as an LCD display and buzzer provide clear feedback to the driver, enhancing usability. The design is cost-effective, easy to implement, and compatible with most vehicles, making it suitable for widespread application.

Overall, this system addresses a serious safety issue by acting as a preventive measure against drunk driving. With further development and integration into vehicle manufacturing, it can play a significant role in reducing accidents, saving lives, and promoting responsible driving behavior. The project showcases the potential of embedded systems in improving transportation safety and public health.

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