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Technical Report

An intelligent system for Smart Cars using Deep Learning and IoT

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Abstract

Our project is an innovative initiative aimed at combating the escalating global issue of road accidents, particularly prevalent in India, where 150,000 lives were lost in 2019. The project focuses on the root causes, driver fatigue, and alcohol impairment, contributing to 50-60 percent of accidents. Motivated by the urgent need to curb the staggering 1.35 million annual deaths globally due to road accidents, integrates cutting-edge deep learning and IoT technologies into smart cars. This 360-degree safety system employs real-time driver monitoring through computer vision and an IoT alcohol sensor, preemptively detecting and warning against potential accidents. The project faces persistent challenges, including the pervasive nature of driver-related accidents, technical complexities in real-time monitoring, privacy concerns, integration with existing infrastructure, cost considerations, and regulatory compliance. Nevertheless, our project aspires to significantly enhance road safety, aligning with a broader commitment to saving lives and fostering a secure driving environment. To detect alcohol consumption, the system utilizes an IoT alcohol sensor that is integrated into the vehicle's cabin. The sensor continuously monitors the driver's breath for the presence of alcohol. If the sensor detects a high level of alcohol, it triggers an alert to the driver, warning them against driving under the influence. The problem addressed by the project is the alarming increase in road accidents, particularly in India, where 150,000 lives were lost in 2019. The primary issues to be tackled are driver-related accidents caused by factors such as fatigue and alcohol impairment, accounting for 50-60 percent of incidents. The project aims to mitigate these problems by developing DriveSafe360, an intelligent 360-degree safety system for smart cars, utilizing deep learning and IoT technologies. The overarching goal is to prevent accidents and save lives by actively monitoring and alerting drivers in real-time about potential dangers related to driver fatigue and alcohol consumption. The motivation behind the project stems from the alarming number of lives lost to road accidents, especially in India. With 150,000 fatalities in 2019 alone, there's a pressing need to tackle the root causes, notably driver fatigue and alcohol impairment, responsible for 50-60 percet of these incidents. The World Health Organization's data highlighting road accidents as a leading cause of death among young people further fuels our determination. Our project is motivated by a profound desire to harness deep learning and IoT technologies, providing a proactive solution to detect and prevent driver-related issues in real-time, ultimately saving lives and fostering safer roads.Addressing the persisting challenges in mitigating road accidents, particularly those related to driver behavior, is akin to navigating a complex landscape. The widespread occurrence of such accidents demands a nuanced approach that considers diverse driving conditions, cultural influences, and infrastructural variations. Real-time monitoring, a core aspect of the project, poses technical hurdles, requiring sophisticated sensors and algorithms to accurately detect driver fatigue and alcohol impairment while minimizing errors. Privacy concerns loom large, necessitating a delicate balance between safety measures and respecting individuals' privacy rights. Integration with existing vehicle infrastructure is a practical challenge, especially considering the diverse fleet of vehicles on the roads. The cost of implementing advanced technologies and ensuring their accessibility to a broad population raises economic considerations. Regulatory compliance is another critical facet, requiring careful navigation of legal frameworks and alignment with traffic regulations. Successfully addressing these multifaceted challenges calls for a comprehensive, interdisciplinary strategy that encompasses technological innovation, public awareness initiatives, collaboration with regulatory bodies, and ethical considerations.

1 Introduction

Road accidents continue to be a critical global concern, casting a long shadow over public safety and health. Nowhere is this more evident than in India, where the Ministry of Road Transport and Highways reported a staggering 150,000 lives lost in 2019 alone. Beyond the statistics, the human toll is immeasurable, with families shattered and communities affected. The World Health Organization's sobering revelation that road traffic accidents are the leading cause of death among young people aged 15-29, claiming 1.35 million lives annually worldwide, underscores the urgency of addressing this issue. Driver behaviour, notably fatigue and alcohol impairment, emerges as a major contributor, responsible for approximately 50-60 percent of road accidents both in India and globally. The need for effective measures to curb these preventable tragedies is undeniable. The motivation behind this research stems from the imperative to mitigate the devastating impact of road accidents, especially those caused by avoidable factors like driver fatigue and alcohol impairment. Consider a scenario where a tired truck driver, navigating through the night to meet delivery deadlines, succumbs to fatigue. The consequences are not just confined to the driver; they extend to potential collisions affecting fellow motorists. Alternatively, envision a situation where a driver, underestimating their alcohol intake, takes to the roads, endangering not only their life but also the lives of others. These scenarios underscore the critical need for proactive, technologically advanced solutions to prevent accidents and save lives.Several challenges persist in addressing the road accident epidemic. The widespread occurrence of accidents, influenced by diverse driving conditions and cultural factors, poses a significant hurdle. Real-time monitoring of driver behavior, a key component of accident prevention, encounters technical complexities, including the need for accurate and reliable sensors. Privacy concerns arise as monitoring technology advances, necessitating a delicate balance between safety measures and individual privacy rights. Integrating new technologies with existing vehicle infrastructure, ensuring affordability, and navigating complex regulatory frameworks further compound the challenges.Current solutions to address road accidents often focus on reactive measures such as improved emergency response systems and stricter traffic regulations. While these measures are vital, they do not tackle the root causes, particularly driver behavior. Some existing technologies include driver assistance systems, but their effectiveness in real-time monitoring for fatigue and alcohol impairment is limited. A comprehensive and proactive approach is needed to complement existing measures and address the core issues contributing to accidents. Our solution approach involves the development of An intelligent 360-degree safety system for smart cars. This system leverages cutting-edge technologies, including deep learning and IoT, to monitor drivers in real-time. Using computer vision and an IoT alcohol sensor, our project detects signs of driver fatigue and alcohol consumption, providing timely warnings to prevent accidents. The proactive nature of this approach distinguishes it from traditional solutions, aiming not only to respond to accidents but to prevent them from occurring in the first place.The research objectives of this work are multifaceted, aiming to address the complex challenges associated with road accidents. Firstly, the project aims to design and implement a real-time driver monitoring system utilising computer vision, with a focus on accurately detecting signs of driver fatigue. Secondly, the research involves the integration of an Internet of Things (IoT) alcohol sensor into the vehicle cabin to enable continuous monitoring of alcohol levels in the driver's breath. Thirdly, the goal is to develop a sophisticated alert system capable of providing timely warnings to drivers exhibiting indications of fatigue or alcohol impairment, thereby enabling proactive intervention. Finally, the research endeavours to assess the feasibility and effectiveness of our project is as an comprehensive solution for preventing road accidents, contributing to the broader objective of enhancing road safety through innovative technological interventions. The contributions of this work include the development of our project as an innovative solution to proactively address the root causes of road accidents. The integration of deep learning and IoT technologies for real-time monitoring sets this system apart, offering a comprehensive approach to enhancing road safety. By preventing accidents caused by driver fatigue and alcohol impairment, our project aims to make a significant impact on reducing road fatalities and improving overall safety on the roads.

2 Literature Survey

The paper introduces an innovative approach to enhance road safety within the Internet of Vehicles (IoV) framework by proposing a Vehicle Speed Limiting System.[1] It explores the integration of smart technologies to dynamically limit vehicle speed based on real-time road conditions and traffic scenarios, contributing to a proactive system for accident prevention. While the proposed Vehicle Speed Limiting System presents a promising solution, it may face challenges in achieving widespread adoption due to potential resistance from drivers or concerns regarding personal autonomy. Additionally, the effectiveness of the system could be contingent on the availability and reliability of real-time data sources.

The paper proposes an Automatic Engine Locking System, named Safe Drive, as a preventive measure against drunken driving. It introduces[2] a technology-driven approach to ensure public safety by automatically locking the vehicle's engine when alcohol is detected in the driver's breath. This contribution aligns with the broader goal of reducing alcohol-related accidents and promoting responsible driving. While the Safe Drive system presents an innovative solution, potential limitations may include challenges in achieving a high level of accuracy in alcohol detection. Factors such as environmental conditions or the type of alcoholic beverage consumed could influence the system's reliability. Additionally, user acceptance and willingness to adopt such systems might be a limiting factor.

The paper presents an Alcohol Sensing Alert with Engine Locking system, offering a proactive solution to prevent alcohol-impaired driving. The system integrates alcohol sensing technology to detect alcohol levels in the driver's breath, triggering an alert and automatically locking the engine if necessary. The paper contributes to the field by proposing an efficient and timely intervention mechanism to mitigate the risks [3] associated with drunk driving. While the Alcohol Sensing Alert with Engine Locking system is a valuable contribution, potential limitations may include challenges in achieving real-time and highly accurate alcohol detection. Environmental factors, calibration issues, and variations in alcohol concentration levels might influence the system's effectiveness. Additionally, user compliance and system adaptability to different vehicle types could be areas of concern.

The paper introduces an IoT-based system employing ultrasonic sensors to collect data and alert drivers, focusing on over-speed detection and accident avoidance. Utilizing components like Ultrasonic Sensor, Arduino UNO, Potentiometer, CAN Controller, DC Motor, GSM, LCD, and a buzzer, the system aims to enhance road safety. The integration of IoT technology allows real-time monitoring and alerts, providing a proactive approach to prevent accidents caused by overspeeding.[4]sensor interference, especially with the MQ-3 sensor measuring alcohol concentration, may lead to inaccurate readings influenced by external factors like humidity and temperature.

The paper addresses the critical issue of driver drowsiness, presenting a system that leverages visual features for detection and mitigation. The contributions include designing and implementing algorithms to extract relevant visual features from the driver's behavior or environment. Machine learning and computer vision models are developed to analyze and interpret these features, integrated into a cohesive system capable of real-time or near-real-time drowsiness detection. [5] Drowsiness detection can be computationally demanding, particularly in resource-constrained environments like embedded systems in vehicles. False positives may incorrectly identify a driver as drowsy, while false negatives may fail to detect drowsiness when present, raising concerns about system accuracy.

3 Literature Survey

Paper	Title/Year	Problem addressed	Contributions	Limitations	Open-Problems
Title: IoV Road Safety: Vehicle Speed Limiting System Authors: Abdelsalam Mohamed, Bonny Talal	IEEE Year: 2019	The proposed system in this research paper uses a transmitter unit fixed on speed signs and a receiver unit installed in the car. The transmitter unit sends a message signal containing the speed limit of the road to the receiver unit, which then compares the car's current speed to the speed limit and adjusts the car's speed if necessary.	Firstly, while the transmitter receiver units enable speed limit enforcement, there is no mention of how the accuracy and reliability of the transmitted speed limit information are ensured, which could potentially lead to incorrect speed adjustments.	Connection Reliability: The system depends on RF wireless connection between the receiver units in cars and the transmitter units on traffic signs. Signal interference, range restrictions, and possible communication breakdowns in densely populated or metropolitan regions might all have an impact on how successful the system is.	The system that is being suggested in this research has a great deal of potential to be used in emerging technologies. Autonomous vehicles and IoV (Internet of Vehicles) are two recent technologies or concepts that are beginning to acquire traction. This method presents a fantastic chance to aid in the adoption of these technologies. The suggested system can function extremely well with autonomous vehicles since it might aid in managing road traffic and preventing accidents by regulating the speed limit of these vehicles.

Paper	Title/Year	Problem addressed	Contributions	Limitations	Open-Problems
Title: Safe Drive: An Automatic Engine Locking System to Prevent Drunken Driving Authors: Sharanabasappa Sayed Farooq Soundarya, V.N Rao, Vikram S Chandraprabha	Publisher: IEEE Year: 2018	The proposed system uses an IoT based MQ-3 gas sensor to detect alcohol, an Arduino Uno R3 microcontroller board, a Raspberry Pi 3, and DC motors to simulate car engines.	The survey does not provide sufficient information about the accuracy and reliability of the MQ-3 gas sensor in detecting alcohol levels, which is crucial for ensuring the effectiveness of the system.	Limited Sensor Accuracy: The MQ-3 sensor's ability to detect alcohol may not be accurate enough to distinguish between low concentrations of alcohol and other substances, which might result in false positives.Environmental Variability: The system's performance may change depending on the temperature, humidity, and air quality of the surroundings, which may impact the accuracy of alcohol detection.	The system that is being suggested in this research has a great deal of potential to be used in emerging technologies. Autonomous vehicles and IoV (Internet of Vehicles) are two recent technologies or concepts that are beginning to acquire traction.Similar to IoV, cars are linked to a network so they may interact with one another and the road's infrastructure.

Paper	Title/Year	Problem addressed	Contributions	Limitations	Open-Problems
Title: Alcohol Sensing Alert with Engine Locking. Authors: Kanishka Jose, Sangeeth M , Raj Arya S Sarath M , Vidya Surendran	Publisher: JETIR. Year: 2021	This research paper proposes a system that uses an alcohol sensor, Arduino Uno microcontroller, LCD, buzzer, relay, and LED to detectthe presence of alcohol in a driver's breath and alert the driver, and an engine locking mechanism.	The paper needs to mention how the system handles false positives, which could be a significant drawback if it locks the engine when it is not supposed to.	Sensor Accuracy and Reliability: The accuracy and reliability of the alcohol detection system heavily rely on the sensitivity and specificity of the MQ-3 sensor. Variations in sensor calibration, environmental factors, and sensor degradation over time could affect the system's performance.	The applications of this project are easily visible. The Alcohol detection with engine locking system can be implemented in any 4- 4-wheeler.Alcohol detection with an engine locking system can help prevent accidents due to drunk driving.

Paper	Title/Year	Problem addressed	Contributions	Limitations	Open-Problems
Title: IoT-based Vehicle Over- Speed Detection and Accident Avoidance System Authors: T., Hari Chandan Nagaraju, Shamanth Varma, Bharath M., Kiran Kumar S., Manasa V., Mukund K	Publisher: IEEE. Year: 2021	The proposed system is an IoT-based system that uses ultrasonic sensors to collect data and alert the driver. The system includes an Ultrasonic Sensor, Arduino UNO, Potentiometer, CAN Controller, DC Motor, GSM, LCD, and a buzzer	This approach is relies on the ultrasonic sensor to detect objects or vehicles in front of the car. These sensors can be affected by weather conditions such as fog or rain, reducing their accuracy.	Sensor Interference: The MQ-3 sensor's readings might be affected by external factors such as humidity, temperature, and other gases in the environment, leading to inaccurate alcohol concentration measurements. Privacy Concerns: Monitoring drivers' alcohol levels raises privacy concerns, and some individuals might be reluctant to use a system that constantly tracks them.	Our future aim is to focus on the entrepreneurial process and add additional features to the speed monitoring system and to introduce it with a stronger business plan in future. Vehicle Collision and Auto Accident Detection and the SOS Service: Accident detection systems can be used in connection with vehicle speed monitoring systems to identify accidents on highways.

Paper	Title/Year	Problem addressed	Contributions	Limitations	Open-Problems
Driver Drowsiness Detection System Based on Visual Features. Authors: Fouzia Roopalakshmi, R. Rathod, J.A. Shetty, A.S. Supriya, K.	Publisher: IEEE. Year: 2018	The problem addressed the issue of driver drowsiness, aiming to develop a system that utilizes visual features to detect and mitigate the potential dangers associated with a drowsy driver.	Designing and implementing algorithms for extracting relevant visual features from the driver's behavior or environment. Developing machine learning or computer vision models to analyze and interpret the extracted features.Integrating the developed algorithms into a cohesive system capable of real-time or near-real-time drowsiness detection.	Processing visual features in real-time for timely drowsiness detection can be computationally demanding, especially in resource-constrained environments such as embedded systems in vehicles. The system may exhibit false positives (incorrectly identifying a driver as drowsy) or false negatives (failing to detect drowsiness when it is present), impacting the overall reliability of the system	investigating how to integrate multiple modalities (e.g., visual, physiological, and environmental) for a more comprehensive and robust drowsiness detection system.Developing methods for the system to adapt and maintain accuracy over an extended period, considering factors such as changes in individual behavior patterns and environmental conditions.Addressing real-time processing challenges by optimizing algorithms for efficiency and minimizing computational load, especially for implementation in resource-constrained environments.

4 Proposed Methodology

This diagram represents our whole project

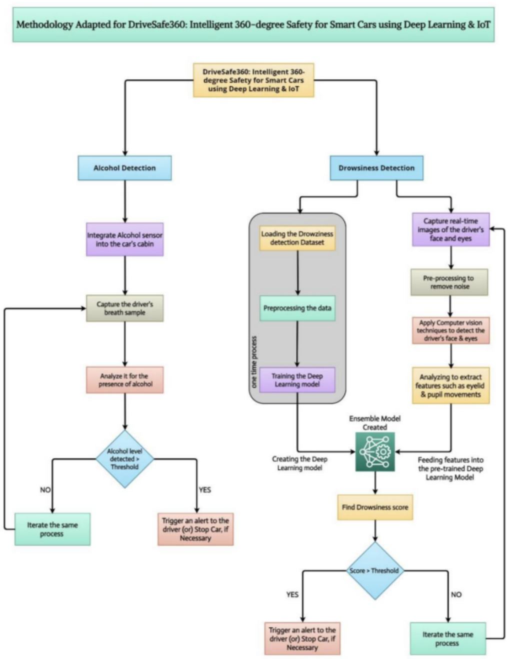

Figure 1: *Proposed Modules*

4.1 Alcohol Detection Module :

In this project, we propose an architecture that uses an **MQ-3 sensor** connected to an **Arduino UNO-3** to detect the level of alcohol in a person's breath. The system triggers a **piezo buzzer** and an **LED** if a high level of alcohol is detected. It also displays a message on an LCD screen, giving the driver an option to enable the emergency mode if necessary. The system 12 architecture consists of five main components: input, pre-processing, decision-making, output, and emergency mode. Input: The input component comprises an MQ-3 sensor that measures the level of alcohol in a person's breath. The sensor is connected to an analog pin of an Arduino UNO-3. Pre-processing: The pre-processing component performs data cleaning to remove any noise from the analog signal. It then applies a calibration process to obtain an accurate reading of the alcohol level. Decision Making: The decision-making component compares the alcohol level against a predefined threshold. If the alcohol level is below the threshold, the system does nothing. If the alcohol level is above the threshold, the system triggers a piezo buzzer and an LED to alert the driver. It also displays a message on an LCD screen, giving the driver an option to enable the emergency mode if necessary. Output: The output component consists of three parts:

piezo buzzer, LED, and LCD screen. The piezo buzzer and LED are triggered when the alcohol level is above the threshold. The LCD screen displays a message informing the driver about the alcohol level and giving them the option to enable emergency mode. Emergency Mode: The emergency mode component consists of a pushbutton that enables emergency mode if pressed. When the pushbutton is pressed, the LCD screen displays a message asking the driver to confirm whether they want to enable emergency mode or not. If the driver confirms, the system sends a signal to the car's central control system to stop the Alcohol Detection Process since it's an Emergency Case.

Figure 2: *Arduino Uno R3, MQ-3 alcohol sensor, Piezo buzzer,LED's*

Figure 3: *Lcd Screen 16x2, Push button, 180 Resistors*

4.2 Alcohol Detection Module

Establish Circuit Connections : Connect the Arduino UNO to the circuit by ensuring all the necessary connections are made correctly.Connect the LCD screen, LEDs, Buzzer, Push Button, and MQ3 alcohol sensor to the Arduino UNO using jumper wires.
Connect Power Supply :
Provide power to the circuit by connecting the appropriate power supply. Ensure the power supply is stable and capable of powering all the components.
Continuous Alcohol Monitoring : Set up the circuit to continuously monitor the presence of alcohol using the MQ3 alcohol sensor. The sensor should be configured to detect any alcohol vapours in the environment.
Trigger Red LED and Piezo Buzzer :

If the MQ3 sensor detects alcohol presence, it immediately triggers the Red LED and the Buzzer to indicate the presence of alcohol. The Red LED and Buzzer should remain active until there is no presence of Alcohol detected.
Display Message on LCD Screen :
After the 20-second alarm, display a message on the LCD screen asking whether to activate the emergency mode. The LCD screen should prompt the user with an appropriate message and await their response. **Countdown Timer :** Start a countdown timer on the LCD screen, initially set to 20 seconds. The timer should decrease by one second at a time until it reaches 0 seconds. Emergency Mode Activation: If the alcohol-impaired driver finds themselves in an emergency, they can activate the emergency mode. To activate the emergency mode, the driver should press the push button within the 20-second timeframe. If the push button is pressed, the emergency mode will be activated, Deactivating the Red LED and Buzzer, and activating another Blue LED (Indicating Emergency Mode).
Engine Lock : If the push button is not pressed within the 20-second timeframe, then display a message on the LCD screen stating that the engine is locked. The engine lock message serves as a safety measure to prevent the impaired driver from driving the vehicle. If the User of the vehicle wants to avoid this engine lock situation, then there should be no alcohol presence near the dashboard (where MQ-3 Sensor will be placed), which means that the alcohol-impaired person should move out from the driver seat as soon as possible before this Engine Lock situation takes place.
By following this step-by-step procedure, you can establish the necessary circuit connections, monitor alcohol presence, trigger appropriate alerts, display messages on the LCD screen, activate the emergency mode, and implement an engine lock if required. This system helps ensure safety by alerting and preventing alcohol-impaired individuals from driving and provides an option for emergency situation.

5 Experimental Results

5.1 Experimental Setup

Arduino IDE Tinkercad Computer or Laptop which consists of working Operation System. (We used the Windows OS)
Arduino Uno R3: The Arduino Uno R3 is being used as the main microcontroller board in this project. It provides a platform for controlling and interfacing with various components of the system. Arduino Uno is chosen for its simplicity, versatility, and ease of use. It enables the execution of the necessary code and facilitates communication between different parts of the circuit.
MQ-3 alcohol sensor: The MQ-3 alcohol sensor is a key component of the project as it is responsible for detecting the presence of alcohol vapors in the environment.
This sensor uses a semiconductor to measure the concentration of alcohol in the surrounding air. It plays a critical role in determining whether the driver is under the

influence of alcohol, allowing for timely alerts and appropriate actions to be taken.

Piezo buzzer: The piezo buzzer is used to generate audible alerts or alarms in the system. In this project, the buzzer is triggered when alcohol vapors are detected by the MQ-3 sensor. It provides an audible indication to both the driver and those nearby that alcohol is present, signaling the need for caution or action.

LED's: LEDs (Light Emitting Diodes) are employed as visual indicators in the project. They serve as warning lights to visually alert individuals about the presence of alcohol. The LEDs are typically activated in conjunction with the piezo buzzer to provide a combined visual and audible warning.

Lcd Screen 16x2: The LCD screen (Liquid Crystal Display) is used to provide visual feedback and display relevant information to the user. It can show messages, prompts, and countdown timers. In this project, the LCD screen is utilized to display messages regarding the presence of alcohol, emergency mode activation, and engine lock status.

Push button: The push button is a user input component used for manual activation of the emergency mode. It allows the driver, in case of an emergency situation, to indicate the need for immediate assistance or special action. By pressing the push button within a specified timeframe, the driver can activate the emergency mode.

Few 180 Resistors: The 180 resistors are used as current-limiting resistors in conjunction with the LEDs. They protect the LEDs from excessive current flow, preventing damage to the LEDs and ensuring proper operation. The resistors help regulate the flow of electricity, allowing the LEDs to emit light at the desired brightness level.

Using this Hardware Prototype, we performed testing by moving Alcohol near and away from the MQ-3

5.2 Experiment 1

Here we implemented an alcohol detection model using ThinkerCAD. The alcohol detection model utilises a circuit setup with continuous monitoring capabilities. Upon detecting alcohol, it triggers a red LED and Piezo Buzzer for immediate alerts. Messages are displayed on an LCD screen, providing real-time information to the user. The system includes a countdown timer and an emergency mode, with the option to activate an engine lock for added safety. This model aims to prevent alcohol-impaired driving by combining detection and alert mechanisms while offering features for emergencies.

5.3 Experiment 2

To set up the circuit connections, begin by connecting the power supply. This comprehensive system enables continuous monitoring of alcohol levels. When alcohol is detected, it triggers the red LED and Piezo Buzzer for immediate alerts. Simultaneously, messages are displayed on the LCD screen to inform the user. The system also includes a countdown timer and an emergency mode that can be activated as needed. In cases of emergency, an engine lock can be implemented, adding an extra layer of safety. This step-by-step procedure ensures a well-integrated system that

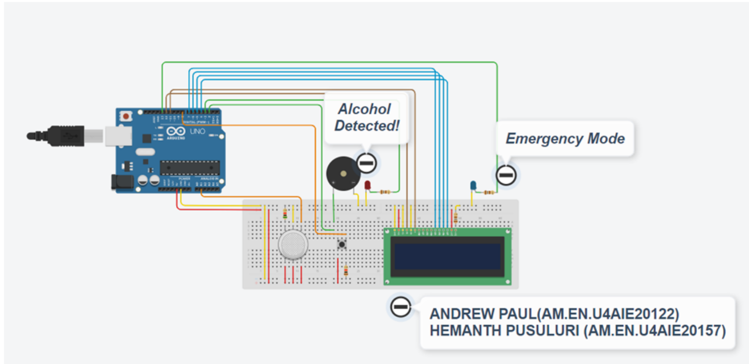

Figure 4: *Sequence Diagram*

not only alerts individuals about alcohol presence but also takes preventive measures, particularly in the context of impaired driving, enhancing overall safety.

Figure 5: *Result Analysis*

6 Conclusions

In conclusion, the development and integration of alcohol-detecting sensors in vehicles represent a crucial step towards enhancing road safety and mitigating the risks associated with alcohol-impaired driving. The reviewed literature highlights the significant contributions of various systems, such as those employing automatic engine locking and real-time alerts based on alcohol levels. While these innovations demonstrate promising preventive measures, it is essential to acknowledge the existing limitations, including challenges in achieving absolute accuracy and user compliance. In this project, we successfully developed a software and hardware prototype for alcohol detection. Through extensive testing and evaluation, we have achieved promising results and demonstrated the effectiveness of our system. Firstly, we conducted testing on our hardware prototype of the Alcohol Detection Module by manipulating the proximity of alcohol to the MQ-3 sensor approximately 150 times. The prototype provided accurate results in 146 instances, demonstrating a success rate of 97.33percent. Although there were a few instances of significant delays, the overall performance of the system was highly reliable. Future research in this domain should focus on refining the sensing technologies for improved reliability, addressing calibration issues, and ensuring adaptability across diverse vehicle models. Additionally, the exploration of user-friendly interfaces and strategies to enhance user acceptance will play a pivotal role in the successful implementation and widespread adoption of alcohol-detecting sensor systems, ultimately contributing to safer roads and reduced incidents of alcohol-related accidents.

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