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FABRICATION AND IMPLEMENTATION OF SMART VEHICLE BRAKING SYSTEM WITH ALCOHOL DETECTION

A. RADHAKRISHNA, S. SESHU. K. DINESH, D. VASU. DR.K. R YELLU KUMAR
1.Student, Dept. of Mechanical Engineering, P.V.K.K Institute of Technology, Road, Alamuru Anantapur, Andhra Pradesh
2.Assistant Professor, Dept. of Mechanical Engineering, P.V.K.K Institute of Technology, Road, Alamuru Anantapur, Andhra Pradesh

ABSTRACT

Road accidents caused by drunk driving are a major global concern and result in a large number of injuries and fatalities every year. To address this issue, the project **"Fabrication and Implementation of Smart Vehicle Braking System with Alcohol Detection"** focuses on improving vehicle safety by integrating an alcohol detection mechanism with an automatic braking system. The system uses an **MQ-3 Alcohol Sensor Module** to detect the presence of alcohol in the driver's breath. When the detected alcohol level exceeds a predefined threshold value, the system automatically prevents the vehicle from starting or activates the braking mechanism to stop the vehicle. An **Arduino Uno** microcontroller acts as the central processing unit that continuously monitors the sensor data and controls the braking system accordingly. The proposed smart braking system is designed to provide a quick response in unsafe driving conditions, thereby helping to prevent accidents and enhance road safety. Additional alert mechanisms such as a buzzer or display unit can also be incorporated to warn the driver. The fabrication process involves assembling the alcohol sensor, microcontroller, braking mechanism, and power supply into a functional prototype. This project demonstrates how intelligent vehicle safety systems can effectively reduce accidents caused by human negligence.

Keywords: Alcohol Detection System, Smart Vehicle Braking System, Drunk Driving Prevention, Embedded Systems, MQ-3 Alcohol Sensor Module, Arduino Uno, Automatic Braking, Road Safety, Microcontroller-Based System, Intelligent Vehicle Safety System.

1.INTRODUCTION

1.1 Background Study

Road accidents caused by drunk driving remain a serious global issue, leading to significant loss of life and property every year. Alcohol consumption affects a driver's ability to make quick decisions, reduces reaction time, and impairs coordination, making driving extremely dangerous. Even with strict laws and awareness programs, many drivers continue to operate vehicles under the influence of alcohol. This highlights the need for advanced technological solutions that can actively prevent such incidents rather than relying only on human responsibility.

Recent advancements in embedded systems and sensor technology have made it possible to develop intelligent safety systems for vehicles. Alcohol sensors such as the **MQ-3 Alcohol Sensor Module** can detect the presence and concentration of alcohol in a driver's breath and

provide real-time data. These sensors can be integrated with microcontrollers like the **Arduino Uno**, which process the information and make decisions based on predefined safety thresholds. Such systems offer a reliable way to continuously monitor the driver's condition and ensure safer driving environments.

The concept of a smart vehicle braking system enhances safety by reducing dependence on driver input during critical situations. When combined with alcohol detection, the system can prevent the vehicle from starting or automatically apply brakes if alcohol levels exceed safe limits.

This automatic response helps in avoiding accidents caused by impaired driving. Additionally, warning systems such as buzzers or display indicators can alert the driver and passengers, further increasing awareness and safety. Overall, integrating alcohol detection with an automatic braking system provides an effective solution to reduce accidents caused by drunk driving. This approach uses modern technology to address human negligence and improve road safety. The system is cost-effective, efficient, and can be implemented in real-world vehicles, making it a valuable contribution toward developing smarter and safer transportation systems. Furthermore, the development of such systems aligns with the growing trend toward intelligent and autonomous vehicle technologies. Modern vehicles are increasingly equipped with safety features designed to minimize risks and enhance driving efficiency. By incorporating alcohol detection with smart braking, this project introduces an important preventive measure that directly targets one of the most common causes of road accidents. In the future, such systems can be enhanced with technologies like IoT connectivity, GPS tracking, and real-time alert systems that notify authorities or family members, making transportation systems safer and more reliable.

1.2 Problem Statement

Road accidents caused by drunk driving continue to pose a serious threat to public safety worldwide. Despite strict traffic regulations and awareness campaigns, many drivers still operate vehicles under the influence of alcohol. Alcohol consumption significantly affects a driver's judgment, reaction time, and coordination, increasing the likelihood of accidents. Existing vehicle safety systems such as Anti-lock Braking Systems (ABS) and other driver assistance technologies mainly focus on improving vehicle control rather than addressing the root cause of impaired driving. There is a lack of integrated systems that can actively detect alcohol consumption and prevent a vehicle from being driven in unsafe conditions.

As a result, vehicles can still be operated by intoxicated drivers, leading to avoidable accidents, injuries, and fatalities. Therefore, there is a need to design and develop an intelligent safety system that can detect alcohol consumption and take immediate preventive action. The proposed smart vehicle braking system with alcohol detection monitors the driver's condition and automatically intervenes when unsafe alcohol levels are detected. The system prevents the vehicle from starting or activates the braking mechanism to stop the vehicle, thereby reducing the risk of accidents and promoting responsible driving behaviour.

1.3 Objectives

General Objectives

- To detect the presence of alcohol in the driver's breath using sensors.
- To prevent vehicle operation or apply automatic braking when alcohol exceeds safe limits.
- To enhance road safety by reducing accidents caused by drunk driving.

Specific Objectives

- To design and develop a smart vehicle braking system integrated with an alcohol detection unit.
- To detect and measure alcohol levels in the driver's breath using a suitable sensor interfaced with a microcontroller.
- To program the system to compare detected alcohol levels with a predefined threshold and make decisions accordingly.
- To automatically disable vehicle ignition or apply braking when alcohol levels exceed safe limits.
- To provide alert indications such as buzzer, LED, or display and evaluate system performance for accuracy and reliability.

1.4 Advantages

- Helps prevent accidents caused by drunk driving by detecting alcohol levels in real time.
- Automatically disables the vehicle ignition or activates braking when unsafe alcohol levels are detected.
- Reduces dependence on driver judgment, especially in critical situations.
- Provides quick and accurate response using sensor-based and microcontroller-based automation.
- Cost-effective and easy to implement using readily available electronic components.

1.5 Disadvantages

- The system depends on electronic components, which may fail due to wear, damage, or power issues.
- Alcohol sensors may sometimes produce false readings due to environmental factors such as smoke, perfumes, or cleaning chemicals.
- Initial installation costs may be higher for vehicles not originally equipped with smart braking systems.
- The system may not detect alcohol if the driver avoids properly using the sensor.
- Regular maintenance and calibration are required for consistent sensor performance.
- Over-reliance on automation may reduce driver vigilance in some situations.
- Integration with older vehicles without modern electronic interfaces can be complex.

1.6 Smart Vehicle Braking System with Alcohol Detection

The **Smart Vehicle Braking System with Alcohol Detection** is an intelligent safety system designed to prevent accidents caused by drunk driving. The system uses an alcohol sensor to detect alcohol vapours in the driver's breath and sends the detected values to a microcontroller. The microcontroller processes the sensor data and compares it with a predefined safety threshold. If the detected alcohol level is within safe limits, the vehicle operates normally. However, if the alcohol concentration exceeds the allowed limit, the system automatically disables the engine or activates the braking mechanism to stop the vehicle. In addition to controlling vehicle operation, the system also provides warning alerts through buzzers or display units to notify the driver about the detected alcohol level. By combining alcohol detection with automatic braking, the system enhances vehicle safety and significantly reduces the risk of accidents caused by impaired driving.

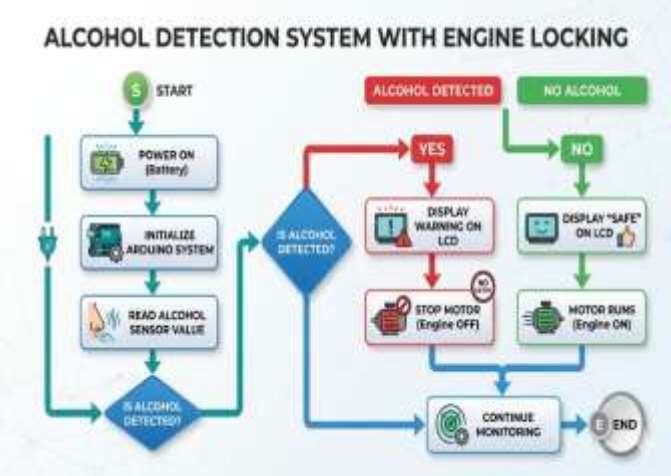


Fig 1.1 Smart Vehicle Braking System with Alcohol Detection

communication modules to send alerts about the vehicle's status.

3. Smart Vehicle Management System for Accident Prevention Using Alcohol Detection (2020)

Mizan et al. proposed a smart vehicle monitoring system that detects alcohol consumption and prevents vehicle ignition. The system integrates sensors with a microcontroller to continuously monitor driver behavior. When alcohol is detected, the engine is disabled and warning alerts are generated, improving overall driver safety.

2.LITERATURE SURVEY

1. Alcohol Sensor for Safe Driving (2020)

Smita V. Khogare and Dr. Meena Chavan proposed an alcohol detection system designed to prevent drunk driving by using alcohol sensors integrated with vehicle control systems. The system detects alcohol in the driver's breath and disables the ignition when the detected level exceeds a preset limit. Their study showed that alcohol sensors can be effectively used in automobiles to enhance road safety and reduce accident risks caused by intoxicated drivers.

2. Automatic Engine Locking System through Alcohol Detection (2020)

Shukla et al. developed a vehicle safety system that uses an alcohol sensor connected to a microcontroller to detect alcohol levels in the driver's breath. When alcohol concentration exceeds the threshold, the system automatically locks the engine and prevents the vehicle from operating. The research also incorporated

4. Alcohol Detection Based Car Engine Lock System (2024)

Haritha et al. designed a low-cost vehicle safety system using an alcohol sensor and microcontroller. The system monitors alcohol concentration and prevents the vehicle from starting if unsafe levels are detected. The study highlighted the effectiveness of sensor-based automation in preventing drunk driving and improving transportation safety.

5. Design and Implementation of In-Vehicle Alcohol Detection and Speed Control System (2022)

Okengwu and Taiwo proposed a system that detects alcohol consumption and automatically reduces vehicle speed or disables the engine when alcohol levels exceed safe limits. Their system demonstrated how sensor-based monitoring combined with vehicle control mechanisms can reduce road accidents caused by impaired driving.

6. In-Vehicle Alcohol Detection Using Low-Cost Sensors and Genetic Algorithms (2021)

Celaya-Padilla et al. developed a non-invasive alcohol detection method using multiple low-cost sensors placed inside a vehicle. Machine learning techniques were applied to analyze sensor data and classify alcohol presence with high accuracy. Experimental results showed a detection accuracy with an ROC value of 0.98, proving the effectiveness of intelligent detection techniques.

7. A Two-Step Electronic Nose System for Rapid Drunk Driving Detection (2023)

Wang et al. introduced an electronic nose-based system capable of rapidly detecting alcohol in shared vehicles.

The system uses multiple gas sensors to analyze ethanol concentration and identify drunk driving conditions. This approach improves detection reliability and minimizes interference from other gases in the vehicle environment.

8. Design of Automated Identification of Alcoholic Drivers (2021)

Researchers proposed an automated system that detects intoxicated drivers using alcohol sensors and integrates additional technologies such as GPS and communication modules. When alcohol is detected, the system sends alerts with location details, helping authorities or emergency contacts respond quickly.

9. IoT-Based Multilevel Drunken Driving Detection System (2020)

Viswanatha et al. designed an IoT-enabled system using sensors and wireless communication modules. The system detects alcohol levels and transmits alerts to a mobile application while disabling vehicle ignition. It also monitors driver health conditions and improves safety through real-time monitoring.

10. IoT-Enabled Driver Safety Alert System with Alcohol Detection (2025)

Recent research introduced an IoT-based driver monitoring system that integrates alcohol sensors and fatigue detection mechanisms. The system generates alerts, gradually reduces vehicle speed, and eventually stops the vehicle when unsafe conditions persist, improving accident prevention strategies.

3.METHODOLOGY

The **Fabrication and Implementation of Smart Vehicle Braking System with Alcohol Detection** is designed to enhance vehicle safety by preventing accidents caused by drunk driving. The system integrates an alcohol detection sensor with an automated braking mechanism to continuously monitor the driver's condition and take immediate action when unsafe conditions are detected.

The system uses the **MQ-3 Alcohol Sensor Module** to detect alcohol vapours present in the driver's breath. The sensor continuously senses the surrounding air and converts the detected alcohol concentration into an electrical signal. This signal is transmitted to the **Arduino Uno** microcontroller for processing.

The microcontroller acts as the main control unit of the system. It reads the input values from the alcohol sensor and compares them with a predefined threshold level programmed in the system. If the detected alcohol level is

below the safety limit, the vehicle operates normally. However, if the alcohol concentration exceeds the predefined threshold, the microcontroller activates the safety mechanism. The safety mechanism includes stopping the vehicle motor, slowing down the system, or applying the braking mechanism to prevent accidents. In addition, warning signals such as buzzers, LEDs, or display messages are triggered to alert the driver and passengers about the unsafe condition.

The fabrication process involves assembling the necessary hardware components such as the alcohol sensor, microcontroller, ultrasonic sensor, motor driver, braking system, and power supply on a chassis. Proper calibration and testing are carried out to ensure accurate alcohol detection and reliable system performance.

This methodology provides a **simple, efficient, and cost-effective solution** to improve road safety by automatically preventing vehicle operation under unsafe driving conditions.

3.1 Design Constraints

1. Sensor Accuracy and Sensitivity

The alcohol sensor must accurately detect alcohol levels in the driver's breath. It should be sensitive enough to distinguish between safe and unsafe alcohol concentrations while minimizing false readings caused by environmental factors such as smoke, perfumes, or chemicals.

2. Response Time

The system must respond quickly when alcohol levels exceed the threshold value. Any delay in activating the braking system or disabling the engine could lead to unsafe driving conditions.

3. Power Consumption

The design should consume minimal electrical power to prevent excessive battery drain. Efficient power management ensures continuous operation of the system.

4. Compact Size and Integration

All electronic components should be compact and easily integrated into the vehicle without affecting its design or functionality.

5. Cost Constraints

The system should be designed using affordable components so that it can be implemented in real vehicles without significantly increasing the overall cost.

6. Environmental Interference

External factors such as humidity, air pollution, smoke, or other gases may affect sensor readings. Therefore, the system must be designed to minimize environmental interference.

7. Safety and Fail-Safe Mechanism

The system should include fail-safe features to ensure that hardware or software failures do not create dangerous conditions such as sudden or unintended braking.

8. User Comfort and Convenience

The system must operate automatically without causing inconvenience to the driver. It should be simple, reliable, and easy to use.

9. Maintenance and Durability

All components used in the system should be durable and require minimal maintenance to ensure long-term reliability and consistent performance.

3.2 Components Used

The following components are used in the fabrication of the smart vehicle braking system:

- Ultrasonic Sensor
- Alcohol Detection Sensor (MQ-3)
- Gear Motors
- Microcontroller (Arduino)
- Buzzer
- Battery
- Chassis
- Plywood Base
- Wheels
- ON/OFF Switch
- Battery Charger
- Screws and Nuts
- Metal Frame
- Display Unit

3.2.1 Ultrasonic Sensor

The **HC-SR04 Ultrasonic Sensor** is a distance-measuring device that uses high-frequency sound waves to detect nearby objects. It operates by transmitting ultrasonic pulses and measuring the time taken for the reflected sound waves (echo) to return to the sensor. When the ultrasonic waves encounter an object, they are reflected back towards the sensor receiver. The receiver captures these reflected signals and converts them into electrical signals. By calculating the time taken for the sound waves to travel to the object and return, the system determines the distance between the sensor and the object.

In this project, the ultrasonic sensor is used for **obstacle detection**. If an obstacle is detected within a predefined distance, the system activates the braking mechanism to prevent collisions. This enhances the safety of the vehicle and supports the alcohol detection system by providing an additional accident prevention mechanism.

Ultra sonic sensor Fig:3:1

Figure3.9: Micro Controller Arduino

On/Off Switch

The ON/OFF switch is a basic electrical component used to control the power supply of the system. It allows the user to manually turn the circuit ON or OFF as needed. When the switch is in the ON position, it completes the circuit and supplies power to all components such as the microcontroller, sensors, and motor. When it is turned OFF, the circuit is broken, stopping the flow of current and

shutting down the system. In this project, the ON/OFF switch is important for safe operation and energy saving. It helps prevent unnecessary power consumption and allows easy control of the system during testing and maintenance.

Figure 3.10 On/Off Switch

Metal Frame

The metal frame is a strong structural component used to support and hold all parts of the system securely. It provides a rigid base for mounting components such as motors, sensors, battery, and control units. Metal frames are usually made of materials like aluminum or steel, which offer high strength, durability, and resistance to wear and tear. In this project, the metal frame ensures stability and proper alignment of all components during operation.

It helps withstand vibrations and mechanical stress, especially when the vehicle is in motion. Additionally, the metal frame protects internal components from damage and improves the overall durability and lifespan of the system.

Figure 3.11: Metal Frame

3.1 Battery Charger

A battery charger is an electrical device used to recharge a battery by supplying controlled electrical energy. It converts AC power from a power source into DC power suitable for charging batteries. The charger ensures that the battery receives the correct voltage and current, preventing overcharging or damage. In this project,

the battery charger is used to recharge the 12V battery that powers the system components such as the microcontroller, sensors, and motors. It plays an important role in maintaining continuous operation and extending battery life. A good charger improves efficiency, safety, and reliability of the overall system.

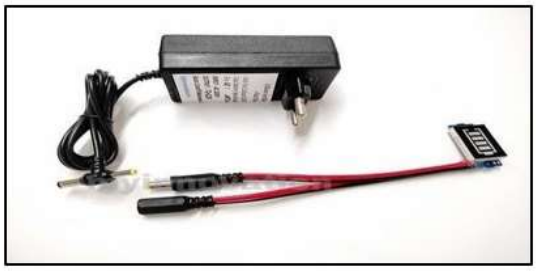


Figure 3.12: Battery Charger

Screws & Nuts

The screws and nuts are essential mechanical fasteners used to join and secure different components of the system. They play a crucial role in holding parts like the chassis, metal frame, motors, sensors, and other hardware firmly in place. Screws are typically inserted through holes and tightened with nuts to create a strong and stable connection. in this project, screws and nuts ensure proper alignment and stability of all components, preventing loosening due to vibrations during operation. They also allow easy assembly and disassembly, which is helpful during testing, maintenance, or modifications. Made from materials like steel or stainless steel, they provide strength, durability, and resistance to corrosion.

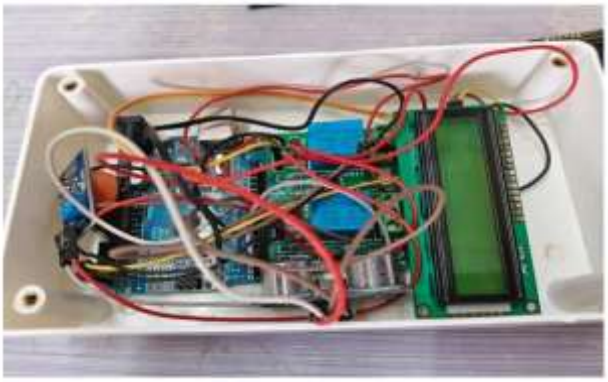
Figure 3.13: Screws& Nuts

Display

A display in a smart vehicle with alcohol detection system provides real-time information to the driver. It shows alcohol levels, system status, and warning messages. If alcohol is detected beyond limits, the display alerts &driver Indicates enhancing awareness, safety, and user interaction with the system.

Fig 3.14 : Display

APPENDIX



RESULT

The Smart Vehicle Braking System with Alcohol Detection was successfully designed and implemented. The system effectively detects alcohol levels in the driver's breath using the MQ-3 sensor and accurately processes the data through the microcontroller. When the alcohol level exceeds the predefined limit, the system responds immediately by activating safety measures such as stopping the motor, applying brakes, and triggering a

buzzer alert.

The ultrasonic sensor also successfully detects obstacles and assists in preventing collisions by enabling automatic braking when objects are too close. The integration of all components worked efficiently, ensuring smooth operation and quick response. The Vehicle Will Be Stops At 100 Cm. When The Alcohol Level Exceeds At 2 ml Alcohol Vapour, The Sensor Sends A Signal To The Micro Controller Which Activates The Buzzer.

Fig : SMART VEHICLE BRAKING SYSTEM WITH ALCOHOL DETECTION

CONCLUSION

The Fabrication And Implementation Of Smart Vehicle Braking System with Alcohol Detection provides a reliable and intelligent approach to improving road safety by addressing the serious issue of drunk driving. By combining an MQ3 alcohol sensor with a microcontroller-based control unit, the system continuously monitors the driver's breath and ensures timely intervention whenever unsafe alcohol levels are detected. The automatic actions, such as Speed reduction, or braking, help prevent accidents and protect both the driver and others on the road.This project highlights the importance of integrating modern embedded systems and sensor technologies into automobiles. It reduces dependency on human judgment, which can often be impaired, and introduces a layer of automated safety. The inclusion of alert systems like buzzers and indicators further enhances awareness and response.

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