DEVELOPMENT OF RTADS - REAL-TIME ALCOHOL DETECTION SYSTEM FOR ENHANCING ROAD SAFETY IN VEHICLES

Muhammed Biyas S[1], Megha Aji[2], Meenakshy Krishna SP[3], Amal M[4], Kanchi K Sen[5]
Professor, Department of Computer Science & Engineering,
Younus College of Engineering and Technology, Pallimukk, Kollam, Kerala, India

Abstract—This paper presents a real-time alcohol detection system aimed at preventing alcohol-impaired driving, a major cause of road accidents worldwide. Utilizing MQ-3 and MQ-135 sensors for detecting alcohol levels and a DHT22 sensor for environmental monitoring, the system ensures accurate and reliable operation. A Raspberry Pi 5 serves as the core processing unit, with an ADS1115 analog-to-digital converter enhancing precision. Upon detecting alcohol above a predefined threshold, the system issues a warning to the driver and notifies authorities via email, enabling proactive intervention. Designed for scalability and cost-effectiveness, this solution offers a practical approach to enhancing road safety and reducing drunk-driving incidents.

Index Terms—Raspberry Pi 5, MQ3, MQ135, ADS1115, DHT22, Buzzer

I. INTRODUCTION

Drunk driving remains a major contributor to road accidents worldwide, leading to severe injuries, fatalities, and property damage. Despite strict regulations and public awareness campaigns, alcohol-impaired driving persists as a critical challenge. To address this issue, technology-driven solutions capable of real-time monitoring and intervention are essential.

This paper presents the Development of a Real-Time Alcohol Detection System for Enhancing Road Safety in Vehicles, an embedded system designed to detect alcohol consumption in drivers and trigger preventive measures. The system is built using a Raspberry Pi 5 as the processing unit, combined with MQ-3 and MQ-135 sensors for alcohol detection. The ADS1115 module ensures precise analog-to-digital conversion, while the DHT22 sensor monitors environmental conditions. If alcohol is detected, the system issues warnings and transmits alerts to authorities via a connected interface, enabling timely intervention. By integrating sensor technology with real-time data processing and communication, this system offers a proactive approach to mitigating alcohol-related road accidents. The paper discusses the system's design, implementation, and effectiveness in enhancing road safety.

II.LITERATURE REVIEW

Several approaches have been proposed related to this issue in many papers.Of these, some specific papers have been analyzed in the following paragraphs. M Anthony el al[1] proposed a model using arduino uno and alcohol detection sensor(MQ-3).As a safety measure,when the level of alcohol crosses a permissible limit,the vehiccle ignition system(DC motor)will be turned off and the concerned authority will be alerted using the GSM module.Deepak Garg el al[2] proposed a system using arduino technology,enhances the road safety by automatically assessing a driver's blood alcohol concetration(BAC). Gurpreet Singh Chhabra el al[3] proposed a model by using Internet of Things(IoT) technology.The paper explores the innovative concept of a smart helmet that incorporates alcohol detection and location tracking systems.G Pradeep Kumar el al[4] proposed an IoT based alcohol detection system,uses sensors and microprocessors to monitor the driver's BAC and cuts of the cars ignition if it suspects that the driver has been drinking while driving.RCH Chang el al[5] intoduced an innovative approach using a two-stage deep neural network(DNN)to detect deunk driving, providing a more accurate and proactive solution.

III. SYSTEM COMPONENTS

A. Block Diagram

The system consists of an Raspberry Pi 5,MQ3 alcohol sensor,MQ135 gas sensor,ADS1115 ADC, DHT22 sensor, power supply, buzzer/speaker,SD card/pendrive, connecting wires and breadboard. The sensor detects alcohol, and the Raspberry Pi 5 pro-cesses the signal to trigger appropriate actions.

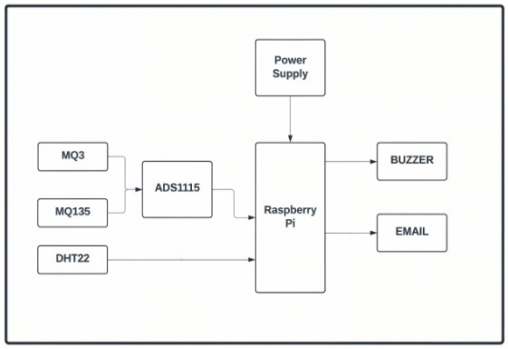

Figure1:Block Diagram

B. System Architecture

The system includes an alcohol detection shield using the MQ3 sensor, an ADS1115 analog-to-digital converter, an MQ135 sensor monitors the air quality inside the vehicle,a DHT22 temperature and humidity sensor and a buzzer for alerts**.**

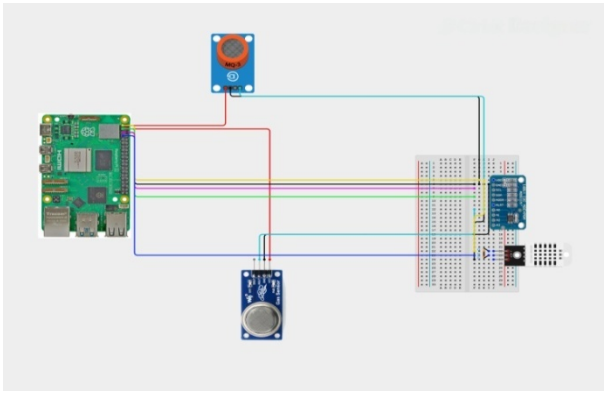

Figure2: Architecture

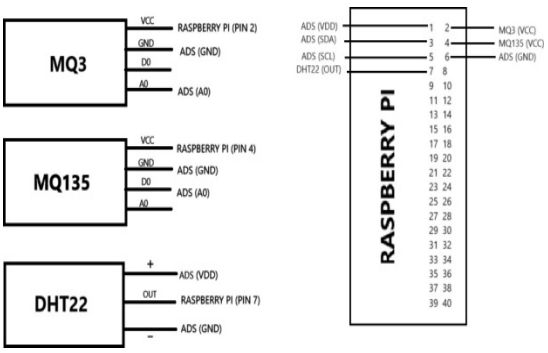

Figure3: CONNECTION LAYOUT

C. Raspberry Pi 5

The Raspberry Pi 5, released in 2023, features a 2.0 GHz quad-core ARM Cortex-A76 CPU and a VideoCore VII GPU, offering significant performance improvements over previous models. It comes with 8GB of LPDDR4 RAM, USB 3.0 ports, Gigabit Ethernet, and dual HDMI 2.1 outputs supporting 4K displays.It is the main processing unit responsible for running the code, interfacing with sensors and managing communiction modules.

Figure 4: RASPBERRY PI

D. Alcohol Sensor (MQ3)

The MQ3 sensor detects alcohol with high sensitivity. It operates based on changes in resistivity in the presence of alcohol vapors.The sensor helps to detect whether the driver has consumed alcohol. Whenever
alcohol is present in air, the sensor conductivity increases,generating the required output.The range of this sensor is upto two meters and it can be used for detecting alcohol with varying concentration levels.

Figure 5: MQ3

E. Alcohol Sensor (MQ135)

The MQ-135 is an air quality sensor used to detect a wide range of gases, including *alcohol, ammonia, benzene, smoke, and carbon dioxide (CO). It monitors the air quality inside the vehicle to ensure the environment is suitable for accurate sensor readings and detects harmful gases.

Figure 6: MQ135

F. TEMPERATURE AND HUMIDITY SENSOR (DHT22)

The DHT22 sensor is used in an alcohol detection system to monitor temperature and humidity, which can affect the accuracy of alcohol sensors. By providing real-time environmental data, it helps compensate for changes in conditions and ensures more reliable alcohol readings. This improves the overall performance and accuracy of the detection system in a vehicle.

Figure7: DHT22

G. ANALOG TO DIGITAL CONVERTER (ADS1115)

ADS1115 sensor provide high-precision analog-to-digital conversion. The MQ-3 and MQ-135 sensors produce analog signals in response to detected gases, such as alcohol, which the Raspberry Pi cannot directly read. The ADS1115 converts these analog signals into digital data that the Raspberry Pi can process, allowing accurate measurement and monitoring of alcohol levels.

Figure 8: ADS1115

H. Buzzer

A piezoelectric buzzer provide immediate feedback to the driver through sound signals if alcohol is detected either below or above the threshold level.

Figure9: BUZZER

IV. SYSTEMFLOWCHART

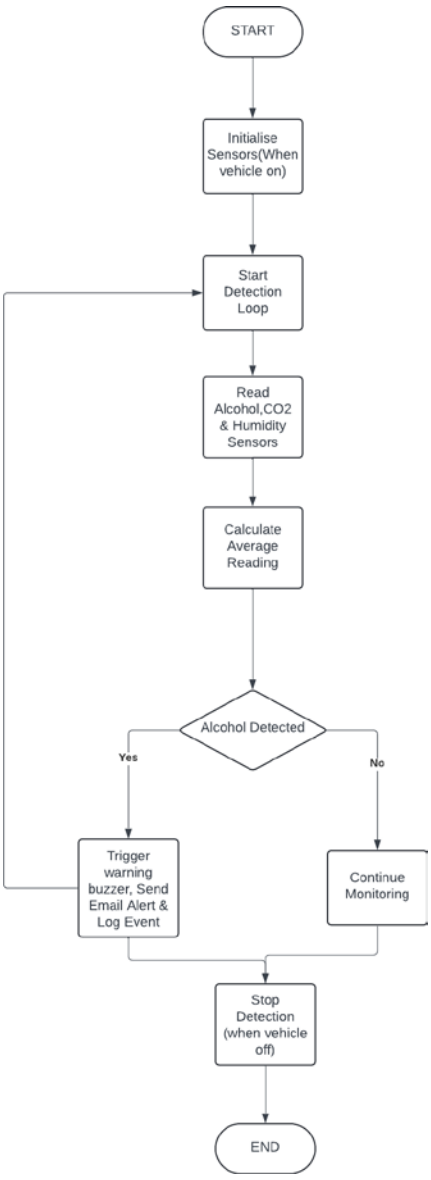

Figure10:FLOW CHART

V. ADVANTAGES

• Prevents Accidents – Alerts drivers to alcohol presence, helping to avoid impaired driving accidents.

VI. APPLICATIONS

• Personal Vehicles – Ensures that the vehicle is not operated while alcohol is detected inside the cabin.
• Fleet Management – Monitors driver safety and ensures that commercial drivers are not impaired before operating the vehicle.
• Public Transport – Ensures bus or taxi drivers are sober and fit to drive, preventing accidents.
• Law Enforcement and Traffic Monitoring – Assists police in detecting and preventing drunk driving incidents in real-time.
• Workplace Safety in Industries – Monitors alcohol levels in workers operating heavy machinery to prevent accidents.
• Smart Automobiles and IoT-Based Vehicles – Integrates with connected car systems for real time alerts and centralized monitoring.

VII. RESULTS AND DISCUSSION

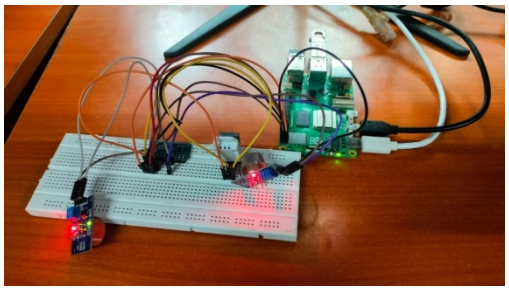

Figure 11: SYSTEM CONFIGURATION

The system is operational, as indicated by the illuminated LED lights on the sensors and Raspberry Pi.
The connected components are actively transmitting data. The glowing red LED confirms that the alcohol sensor is functioning.

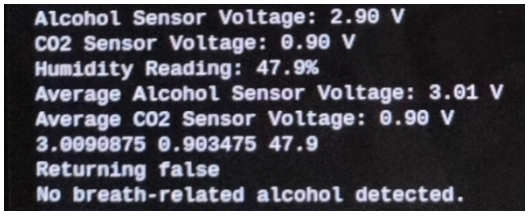

Figure 12: INTERFACE OF ALCOHOL NOT DE- TECTED

The sensor system analyzed the data from the alcohol and CO2 sensors along with humidity levels. After processing the average sensor readings, it determined that there was no detectable breath-related alcohol. As a result, the system returned a negative result, indicating that no alcohol was detected.

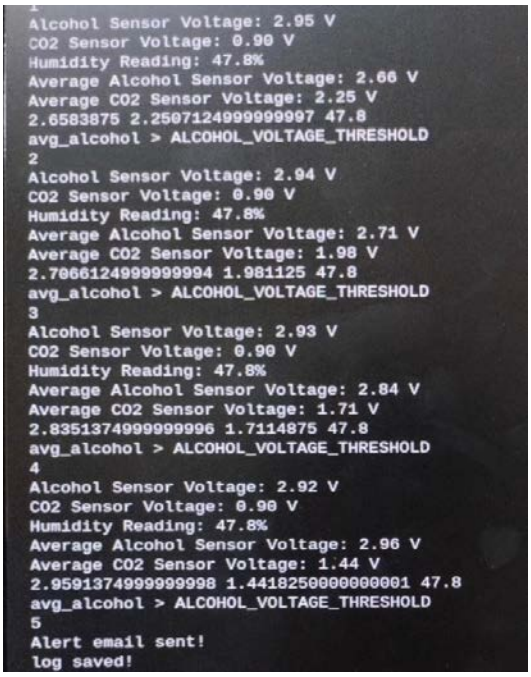

Figure 13: INTERFACE OF ALCOHOLDETECTED

The system detects alcohol by continuously measuring voltage from the MQ-3 sensor, which varies based on alcohol concentration. It calculates the average alcohol sensor voltage over multiple readings and compares it to a predefined threshold. If the average exceeds this threshold, the system confirms alcohol presence, triggers an alert email, and logs the data.
Additional environmental data, such as CO2 levels and humidity, are also recorded for analysis.

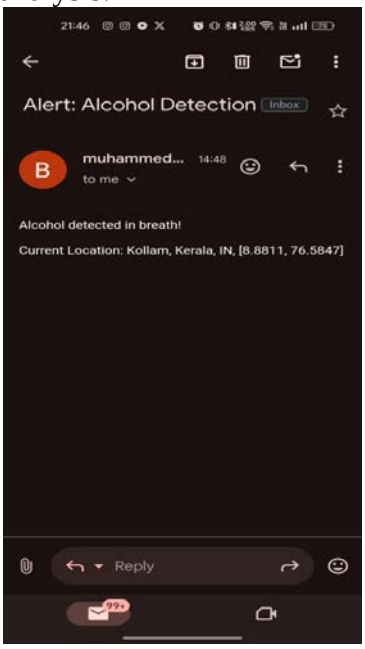

Figure14:ALERT MAIL

When the system detects alcohol above a predefined level,it sends an alert message to the concerned authority or family members via email.

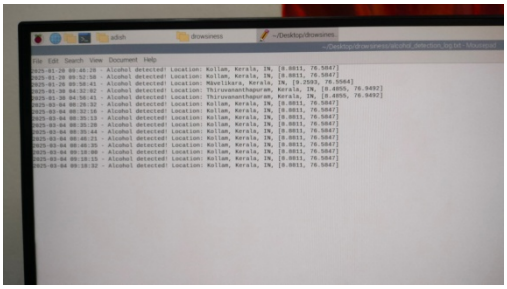

Figure 15: SAVE DETAILS INTO A LOG FILE

When the system detects the presence of alcohol, specific details has been stored into a log file.

VIII. CONCLUSION

The real-time alcohol detection system using Raspberry Pi 5, MQ-3, MQ-135, ADS1115, and DHT22 effectively addresses drunk driving by providing automated monitoring and alerting. It accurately detects alcohol levels, averages multiple sensor readings for reliability, and triggers alerts when the threshold is exceeded. Email notifications ensure that authorities are informed in real time, enabling timely intervention to prevent accidents. The system uses cost-effective and widely available components, making it practical for real-world applications. ADS1115 improves accuracy, while DHT22 provides environmental data to fine-tune performance under different conditions.

IX. FUTURE ENHANCEMENT

Future enhancements for this real-time alcohol detection system can focus on im proving accuracy, portability, and integration with advanced technologies. The system could also leverage AI-based data processing, using machine learning algorithms to distinguish alcohol from other gases and reduce false positives. Additionally, integrating a mobile application with real-time notifications via SMS or push alerts would enhance user convenience. For greater portability, the system could be optimized for battery power, with solar charging support for remote locations. Another crucial enhancement is vehicle integration, where the system could be linked to the ignition mechanism to prevent intoxicated driving, ensuring road safety. Furthermore, multisensor fusion with biometric authentication, heart rate monitoring, or camera-based verification could provide a more comprehensive intoxication assessment.

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