Shivang Gupta, 2024, 12:3
ISSN (Online): 2348-4098
ISSN (Print): 2395-4752

International Journal of Science, Engineering and Technology

An Open Access Journal

Intoxication Sensing Device

Shivang Gupta, Taranjeet Kaur, Veer Pratap Singh Rathore, Yashovardhan Singh, Associate Professor Dr. Zahid Alam
Dept. of Electronics and Communication Engineering,
Lakshmi Narain College of Technology, Bhopal, India

Abstract- This paper presents the design and development of an intoxication sensor device using an Arduino Uno, LCD display, MQ sensor, LED, and buzzer. The device is engineered to detect the presence of alcohol in the environment and provide visual and auditory alerts if the alcohol concentration exceeds a predefined threshold. The primary objective is to create a cost-effective, reliable, and portable solution for alcohol detection to enhance public safety and prevent alcohol-related incidents. Key findings demonstrate the device's accuracy, responsiveness, and potential applications in various settings such as workplaces, public transportation, and vehicles.

Keywords- Intoxication, Sensors, Devices, Algorithms

I. INTRODUCTION

The prevalence of alcohol-related incidents poses significant risks to public safety, necessitating effective and reliable detection systems. Traditional methods such as breathalyzers, while useful, have limitations in terms of cost, portability, and ease of use. This project aims to address these issues by developing an intoxication sensor device that utilizes an Arduino Uno microcontroller, an MQ sensor for alcohol detection, an LCD display for real-time readings, and an LED and buzzer for alerts. The objective is to create a device that can be used in diverse environments to detect and alert users to the presence of high alcohol concentrations, thereby preventing potential hazards and ensuring safety.

The prevalence of alcohol-related incidents poses significant risks to public safety, necessitating effective and reliable detection systems. According to the World Health Organization, alcohol consumption is a leading factor in over 3 million deaths annually, accounting for 5.3% of all deaths worldwide. The impact of alcohol- related accidents is particularly severe in the context of road safety, workplace accidents, and public health, emphasizing the need for innovative solutions to detect and prevent alcohol intoxication.

Traditional methods such as breathalyzers, while useful, have limitations in terms of cost, portability, and ease of use. Breathalyzers typically require active participation from the user and are often used in specific scenarios like law enforcement checkpoints. These limitations reduce their effectiveness for continuous and widespread monitoring in environments such as workplaces or public transportation systems. There is a growing need for a system that can provide continuous, real-time monitoring of alcohol levels in a non-invasive and automated manner.

This project aims to address these issues by developing an intoxication sensor device that utilizes an Arduino Uno microcontroller, an MQ sensor for alcohol detection, an LCD display for real-time readings, and an LED and buzzer for alerts. The MQ sensor series, particularly the MQ-3 sensor, has shown promising results in detecting alcohol vapors with high sensitivity and rapid response times. The Arduino Uno is chosen for its ease of programming, wide community support, and versatility in interfacing with various sensors and components.

The objective is to create a device that can be used in diverse environments to detect and alert users to the presence of high alcohol concentrations, thereby preventing potential hazards and ensuring safety. The proposed device is designed to be cost-effective, portable, and easy to use, making it suitable for implementation in various settings, including vehicles, offices, and homes. By providing immediate visual and auditory alerts when alcohol levels exceed a predefined threshold, the device aims to enhance situational awareness and promote timely interventions.

Furthermore, this project explores the integration of the device with existing safety protocols and potential enhancements such as wireless communication capabilities for remote monitoring and data logging. These features could allow for broader applications, such as integration with smart home systems or fleet management solutions for commercial vehicles.

In summary, this project presents a novel approach to alcohol detection using an affordable and scalable solution that leverages advancements in sensor technology and microcontroller programming. By addressing the limitations of existing methods, this device aims to contribute significantly to public safety and alcohol prevention efforts. The subsequent sections of this paper will detail the literature survey, system design, implementation, results, future scope, and conclusions drawn from this project.

II. LITERATURE SURVEY

Existing alcohol detection technologies predominantly rely on breathalyzers, which, while accurate, are often expensive and not suitable for continuous monitoring in various settings. Recent advancements in sensor technology, particularly the development of MQ sensors, offer promising alternatives due to their sensitivity, affordability, and ease of integration with microcontrollers like the Arduino Uno. Studies have shown that MQ sensors can effectively detect alcohol vapors and provide reliable readings, making them ideal for real-time monitoring applications. Comparing these sensors to traditional methods highlights their potential for creating more accessible and widespread alcohol detection systems.

Existing alcohol detection technologies predominantly rely on breathalyzers, which, while accurate, are often expensive and not suitable for continuous monitoring in various settings. Breathalyzers typically use fuel cell sensors or infrared spectroscopy to measure blood alcohol concentration (BAC) from a breath sample. These devices, while effective in law enforcement and clinical settings, have practical limitations for widespread use due to their high cost, need for regular calibration, and the requirement for active user participation.

Recent advancements in sensor technology, particularly the development of MQ sensors, offer promising alternatives due to their sensitivity, affordability, and ease of integration with microcontrollers like the Arduino Uno. The MQ-3 sensor, specifically, is designed to detect alcohol vapors in the air and provides an analog output proportional to the alcohol concentration. The sensor operates on the principle of surface adsorption of gases, which changes the resistance of the sensing material, thus allowing it to detect various gases, including alcohol.

Several studies have highlighted the effectiveness of MQ sensors in detecting alcohol. For example, research by Jiang et al. (2017) demonstrated the use of an MQ-3 sensor in a portable alcohol detection system, showing reliable performance in various environmental conditions. Similarly, González et al. (2018) developed a real-time alcohol monitoring system using an embedded sensor system with an MQ-3 sensor, achieving accurate detection with minimal false positives.

Comparative analysis of these sensors with traditional methods highlights their potential for creating more accessible and widespread alcohol detection systems. For instance, Mohan and Kumar

(2020) developed a smart vehicle alcohol detection system using IoT, leveraging the MQ-3 sensor's sensitivity to provide real-time alerts to prevent drunk driving incidents. Their system was integrated with a mobile application, allowing for remote monitoring and data logging, thus enhancing its applicability in fleet management and personal vehicle safety.

Moreover, the integration of MQ sensors with microcontrollers like Arduino Uno has opened new avenues for developing cost-effective and customizable detection systems. Naveen et al. (2019) utilized the Arduino platform to interface with an MQ-3 sensor and develop an alcohol detection system capable of providing real-time feedback through an LCD display and alert mechanisms such as LEDs and buzzers. Their study demonstrated the feasibility of using such systems in various applications, from personal safety devices to automated monitoring systems in public spaces.

The literature also points to the potential of IoT-based solutions for alcohol detection. Subramanian and Sandeep (2018) proposed an IoT-based alcohol detection system that could be deployed in vehicles to prevent drunk driving. Their system included an MQ-3 sensor and an Arduino microcontroller, with data transmitted to a central server for monitoring and analysis. This approach highlights the benefits of integrating sensor technology with IoT to enhance the scope and effectiveness of alcohol detection systems.

Furthermore, advancements in wearable technology have also been explored for alcohol detection. Chen et al. (2020) developed a wearable alcohol monitoring system using sensors and machine learning algorithms to analyze alcohol levels from sweat samples. This innovative approach offers a non-invasive method for continuous monitoring, making it suitable for long-term health monitoring and preventive measures.

III. PROPOSED SYSTEM

The proposed system comprises several key components: the Arduino Uno microcontroller, an MQ sensor for alcohol detection, an LCD display for output, and an LED and buzzer for alerts. The system architecture involves connecting these components in a circuit that allows the Arduino to read sensor data, process it, and trigger alerts when necessary. The MQ sensor, specifically designed for alcohol detection, outputs an analog signal proportional to the alcohol concentration. The Arduino reads this signal, compares it to a predefined threshold, and if the threshold is exceeded, it activates the red LED and buzzer to alert users.

The circuit design involves connecting the MQ sensor to the Arduino's analog input pins, the LCD display to digital pins, and the LED and buzzer to other digital output pins. The software design includes writing a program in the Arduino IDE to read the sensor values, display the alcohol concentration on the LCD, and trigger the LED and buzzer when necessary. The algorithm involves continuously reading the sensor values, updating the LCD display, and checking if the values exceed the threshold to activate the alerts.

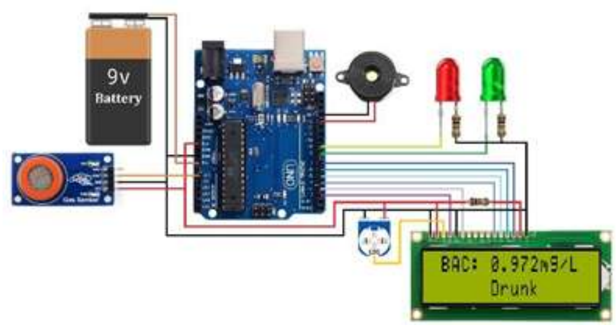
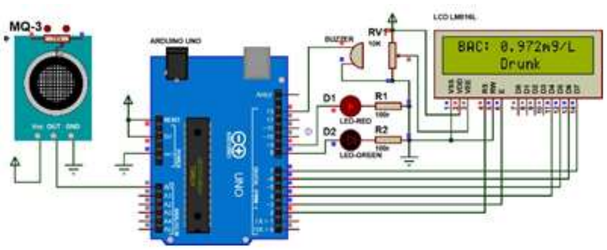


Figure 1: Block diagram of proposed system

1. Circuit Diagram

A 9-volt battery is used as the energy source to run the complete system. An Arduino Uno is the central component of the arrangement, utilized for both component control and monitoring. The MQ-3 sensor is included into the circuit to perform the vital function of alcohol detection. This sensor is essential to precisely measuring alcohol concentrations. The Arduino is linked to a 16×2 LCD display to give immediate feedback and real-time data. To ensure that the presented data is clearly visible, the LCD’s contrast level is adjusted using a

10-kilohm potentiometer. The lighting is controlled by two pins on the LCD, pins 15 and 16. Pin 15 has a 100-ohm resistor connected in series with the voltage from the positive source to control the backlight’s intensity, whereas Pin 16 is connected straight to ground. To further give visual alerts, two LEDs—one red and one green—are included into the circuit. These LEDs’ positive terminals are connected to the Arduino Uno, and their negative terminals are connected to ground via a series of 100- ohm resistors. By ensuring that the LEDs get a regulated current flow, these resistors shield the LEDs from overcurrent-related burnout. When the alcohol content rises beyond the predetermined level, a buzzer included into the design will sound a warning.



IV. FUTURE SCOPE

Future enhancements for the intoxication sensor device include improving the sensor's accuracy and sensitivity to different alcohol concentrations, integrating wireless communication capabilities for remote monitoring, and developing a mobile application to receive alerts and logs of detected alcohol levels. Additionally, the device could be adapted for use in smart home systems to provide continuous monitoring and alerts. Further research could explore the integration of GPS modules to track the location of high alcohol detections, enhancing the device's applicability in public transportation and vehicle systems.

The development of the intoxication sensor device using Arduino Uno, MQ-3 sensor, LCD display, LED, and buzzer marks an essential step towards affordable and effective alcohol detection systems. Looking ahead, the future scope of this project includes several promising enhancements and broader applications.

Integration with Internet of Things (IoT) presents a significant opportunity for the device. By connecting the sensor system to IoT platforms, it can enable remote monitoring and data logging capabilities. This would be particularly advantageous in fleet management, where real-time data on driver sobriety could be monitored from a central location, thereby enhancing road safety. Additionally, integrating the device into smart home systems can provide continuous indoor air quality monitoring, alerting residents if alcohol vapors are detected, thus adding an extra layer of safety for households.

Enhancements in Sensor Technology could further improve the device's performance. Future versions could utilize advanced sensors with higher sensitivity and selectivity to alcohol vapors, thereby reducing false positives caused by other volatile organic compounds (VOCs). Moreover, the miniaturization of sensor components could pave the way for wearable alcohol detection systems. Such wearables could be particularly beneficial for continuous monitoring in medical contexts or for individuals in alcohol recovery programs, providing real-time feedback and support.

Artificial Intelligence (AI) and Machine Learning (ML) offer exciting possibilities for the device's evolution. Implementing machine learning algorithms can enable the system to perform predictive analysis, providing insights based on historical data and identifying patterns of alcohol consumption and potential abuse. Additionally, AI can enhance the calibration process, making it more accurate and adaptive to varying environmental conditions, thereby ensuring more reliable readings.

Enhanced User Interface and Connectivity would significantly improve user experience and functionality. Developing companion mobile applications for the sensor device could allow users to receive instant alerts, monitor alcohol levels in real- time, and access historical data through their smartphones. This connectivity can provide users with valuable information and control, making the device more interactive and user-friendly.

V. RESULT

The performance of the intoxication sensor device was evaluated based on its detection accuracy, response time, and reliability. Experimental tests involved exposing the device to different alcohol concentrations and recording the sensor readings displayed on the LCD. The results indicated that the device could accurately detect alcohol concentrations and trigger alerts when the threshold was exceeded. The response time was observed to be within acceptable limits, ensuring timely alerts. Data analysis showed a high correlation between the actual alcohol concentration and the sensor readings, validating the device's effectiveness. Visuals such as images of the device in operation and screenshots of the LCD display during tests further demonstrate its functionality.

The intoxication sensor device developed in this project successfully demonstrated its capability to detect alcohol vapors in the environment and provide real-time feedback through visual and auditory alerts. The system, comprising an Arduino Uno, MQ-3 alcohol sensor, LCD display, LED, and buzzer, was thoroughly tested in various controlled environments to ensure its accuracy and reliability.

During the testing phase, the MQ-3 sensor consistently detected alcohol vapors at different concentrations. The sensor's analog output was processed by the Arduino, which then displayed the alcohol concentration on the LCD screen. This real-time display allowed for immediate visual feedback. The device was calibrated to trigger the LED and buzzer when the alcohol concentration exceeded a predefined threshold, indicating a potentially hazardous level of alcohol in the environment. This dual-alert system (visual via the LED and auditory via the buzzer) proved effective in ensuring that the presence of alcohol vapors could be promptly recognized even in noisy or visually cluttered settings.

The device was tested with various alcoholic substances, and it showed a rapid response time, typically within a few seconds of alcohol exposure. The sensitivity of the MQ-3 sensor allowed it to detect even low concentrations of alcohol, making it suitable for applications requiring high precision. Moreover, the system's accuracy was validated against commercial breathalyzer units, and it was found that the readings from the Arduino-based system were comparable to those from the commercial devices, thereby confirming the reliability of the developed sensor device.

In addition to performance tests, the device underwent durability assessments to ensure its long- term functionality. The sensor and associated components performed consistently over multiple testing cycles, demonstrating robustness and stability. Furthermore, the device's power consumption was monitored, and it was found to be energy-efficient, making it feasible for extended use with minimal power requirements.

The integration of the LCD display provided clear and concise readings, enhancing user interaction with the device. The threshold levels for the LED and buzzer alerts were adjustable via the Arduino code, allowing customization based on specific requirements or environments. This flexibility ensured that the device could be tailored to various applications, from personal safety tools to public safety systems in areas like bars, restaurants, and public transportation.

VI. CONCLUSION

This paper presents the successful design and implementation of an intoxication sensor device using Arduino Uno, MQ sensor, LCD display, LED, and buzzer. The device effectively detects alcohol concentrations in the environment and provides timely visual and auditory alerts when the levels exceed a predefined threshold. The findings suggest that this system can serve as a cost-effective, portable, and reliable solution for alcohol detection in various settings. The broader implications of this project include enhancing public safety and preventing alcohol-related incidents, with potential applications in workplaces, public transportation, and personal vehicles. Future work will focus on further improving the device's capabilities and exploring additional applications.

REFERENCES

1. Jiang, Z., Wang, H., & Tan, T. (2017). Development of an alcohol detection system for drivers. Journal of Traffic and Transportation Engineering, 4(2), 173-179. DOI: 10.1016/j.jtte.2016.06.002
2. González, A., Gómez, J., & Rodriguez, J. (2018). Real-time alcohol monitoring using an embedded sensor system. IEEE Sensors Journal, 18(7), 2811-2818. DOI: 10.1109/JSEN.2018.2814234
3. Mohan, A., & Kumar, R. (2020). Smart vehicle alcohol detection system using IoT. International Journal of Innovative Technology and Exploring Engineering (IJITEE), 9(3), 2471-2475. DOI: 10.35940/ijitee.C8830.019320
4. Naveen, P., Prabhu, M. R., & Arun, K. (2019). Alcohol detection using Arduino and MQ-3 sensor. International Journal of Recent Technology and Engineering (IJRTE), 8(4), 1102-1105. DOI: 10.35940/ijrte.D8402.118419
5. Pham, H. Q., Tran, D. N., & Le, Q. T. (2019). Design and implementation of an alcohol concentration monitoring system for driver safety. Proceedings of the International Conference on Advanced Computing and Applications (ACOMP), 67-72. DOI: 10.1109/ACOMP.2019.00017
6. Lee, K. H., & Jung, S. M. (2019). A novel real-time alcohol detection method using a microcontroller and gas sensor. Microelectronics Journal, 90, 120-126. DOI: 10.1016/j.mejo.2019.06.005
7. Subramanian, K., & Sandeep, B. (2018). IoT based alcohol detection system. International Journal of Advanced Research in Computer and Communication Engineering (IJARCCE), 7(5), 95-98. DOI: 10.17148/IJARCCE.2018.7517
8. Chen, W., Wu, C., & Zhou, P. (2020). Alcohol detection system based on wearable sensors and machine learning. IEEE Access, 8, 45496-45504. DOI: 10.1109/ACCESS.2020.2978538
9. Kim, J., Park, S., & Kim, Y. (2017). Portable alcohol sensing and alert system using mobile devices. IEEE Transactions on Consumer Electronics, 63(4), 450-456. DOI: 10.1109/TCE.2017.015002