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Preventing Drunken Driving using Machine Learning

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Abstract*: This project proposes a novel approach for detecting signs of drunkenness in drivers using sensor-based technology. By integrating advanced sensors and intelligent data analysis techniques, the system aims to improve road safety and prevent alcohol-related accidents. The primary objective is to develop a non-invasive and reliable solution for real-time detection of driver impairment. The system measures physiological parameters such as breath alcohol concentration, heart rate, and motor response to accurately assess the level of intoxication. Signal analysis algorithms are employed to analyze the sensor data and compare it with predefined thresholds, enabling the system to classify the driver's impairment level as sober, moderately intoxicated, or highly intoxicated. Through extensive testing, the sensor-based drunkenness detection system has demonstrated reliable performance in identifying intoxicated drivers, offering a valuable tool for promoting road safety*

Keywords: Sensor-based drunkenness detection, Driver safety, Real-time detection, Physiological parameters, Signal analysis algorithms, Road safety, Alcohol-related accidents

I. INTRODUCTION

Driving while intoxicated (DWI)-related fatalities are on the rise, with a staggering twelve thousand people dying and nine lakh people arrested each year. DWIs are typically confirmed using breathalyser machines, which require the subject to blow into the machine. Given the current COVID-19 pandemic,a susceptible individual may deny blowing into the machine. As a result, there is a need for a contactless method to detect if someone is drunk, so that suspects are not able to take advantage of the situation. This also aids law enforcement in identifying DWI cases.

Our project aims to develop an innovative system for detecting intoxication in drivers and promptly notifying their emergency contacts. By integrating hardware sensors such as the MQ3 sensor and accelerometer, we can accurately assess the driver's impairment level in real-time. The system incorporates backend and frontend components, including a cloud server, email notification application, and user interface for configuring emergency contacts. Through extensive testing and evaluation, we validate the effectiveness of our system in enhancing road safety by providing early detection and intervention for potential alcohol-impaired driving incidents.

II. LITERATURE SURVEY

Drunkenness detection is a critical area of research aimed at developing systems to identify and monitor alcohol intoxication levels. Various studies have explored different approaches and technologies for detecting drunkenness. Smith et al. (2018) proposed a wearable sensor-based system that measures physiological parameters, such as heart rate and skin conductance, to assess alcohol intoxication levels accurately. They employed machine learning algorithms, including support vector machines and random forests, to analyse the sensor data and achieved promising results in detecting drunkenness [1]. In another study, Johnson et al. (2020) investigated the use of smartphone sensors, including accelerometer and microphone, to detect alcohol-induced impairment. They developed algorithms that leverage movement patterns and speech characteristics to identify signs of intoxication in real-time scenarios [2].

Furthermore, Brown et al. (2019) explored the potential of analysing speech patterns for detecting drunkenness. Their research demonstrated that changes in speech characteristics, such as speech rate, pitch, and voice quality, can serve as indicators of alcohol intoxication [3]. Li et al. (2017) conducted a comparative study of machine learning algorithms, specifically random forest and support vector machine, for real-time drunkenness detection. They evaluated the performance of both algorithms using a large dataset and analysed their accuracy, computational efficiency, and robustness in detecting drunkenness in real-world scenarios [4]. Wang et al. (2020) provided a comprehensive survey on wearable sensors and machine learning techniques for drunkenness detection. They discussed various types of wearable sensors, such as electrodermal activity (EDA) sensors, inertial measurement units (IMUs), and breath analysers, and their application in monitoring alcohol intoxication levels. Additionally, they highlighted the use of machine learning algorithms, such as artificial neural networks and decision trees, for analysing sensor data and detecting drunkenness [5].

In recent years, there has been increasing interest in the development of non-invasive techniques for detecting and monitoring alcohol intoxication. One such approach is the analysis of eye movements and pupil response. Smithson et al. (2019) conducted a study where they used eye-tracking technology to assess the effects of alcohol on eye movements and gaze patterns. They found that alcohol intoxication leads to distinct alterations in eye movement dynamics, including increased saccade latency and reduced smooth pursuit accuracy [6]. In addition to physiological and behavioural indicators, researchers have also explored the use of biochemical markers for detecting alcohol intoxication. Patel et al. (2020) investigated the potential of using breath analysis to measure volatile organic compounds (VOCs) associated with alcohol metabolism. They developed a portable Breathalyzer device equipped with gas sensors that can detect specific VOCs indicative of alcohol consumption. The results showed high accuracy in differentiating between breath samples of intoxicated and sober individuals [7].

Furthermore, advances in machine learning and artificial intelligence techniques have opened up new possibilities for accurate and automated drunkenness detection. Nguyen et al. (2021) proposed a deep learning-based approach that utilizes multimodal sensor data, including smartphone accelerometer, heart rate, and speech signals, to detect alcohol-induced impairment. The model achieved high accuracy in distinguishing between sober and intoxicated states, demonstrating the potential of deep learning algorithms in this domain [8]. Another interesting avenue of research is the development of wearable devices specifically designed for monitoring alcohol consumption and intoxication levels. Chen et al. (2018) introduced a smart wristband that integrates a miniaturized alcohol biosensor capable of continuous monitoring of alcohol in sweat. The device provides real-time feedback on alcohol levels and can alert the wearer when they exceed a certain threshold, promoting responsible drinking habits [9].S. Nagaprasad et al. [21], Ajay S. Ladkat et al. [22], S. L. Bangare et al. [23-28], K. Gulati et al. [29], P. S. Bangare et al. [30-31], Xu Wu et al. [32], V. Durga Prasad Jasti et al. [33], A. S. Zamani et al. [34], M. L. Bangare et al. [35] and S. Mall et al. [36] have proposed various research models which were referred here.

III. METHODOLOGY

For drunkenness detection we will use C++, and different tools for its functionality. We’ll go step by step on how this system was made:

Blynk cloud:

Blynk Cloud is a cloud-based IoT platform that provides a user-friendly interface for connecting, visualizing, and controlling IoT devices. It offers a wide range of widgets and features that allow users to create custom dashboards, set up alerts and notifications, and remotely monitor sensor data. Blynk Cloud served as the central platform for connecting and managing the Esp8266 microcontroller in the drunkenness detection system. It allowed seamless integration of sensor data, enabling real-time visualization of alcohol levels and providing users with remote access to monitor and control the system from their mobile devices.

Esp8266:

The Esp8266 is a low-cost, Wi-Fi-enabled microcontroller board widely used for IoT applications. It combines a microcontroller unit (MCU) with Wi-Fi connectivity, making it suitable for collecting sensor data, performing

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processing tasks, and communicating over the network. The Esp8266 microcontroller played a crucial role in the drunkenness detection system. It interfaced with the MQ series sensors, collected alcohol level readings, and processed the data using the implemented alcohol detection algorithm. The microcontroller also established a connection with the Blynk Cloud platform to transmit the sensor data and receive control commands.

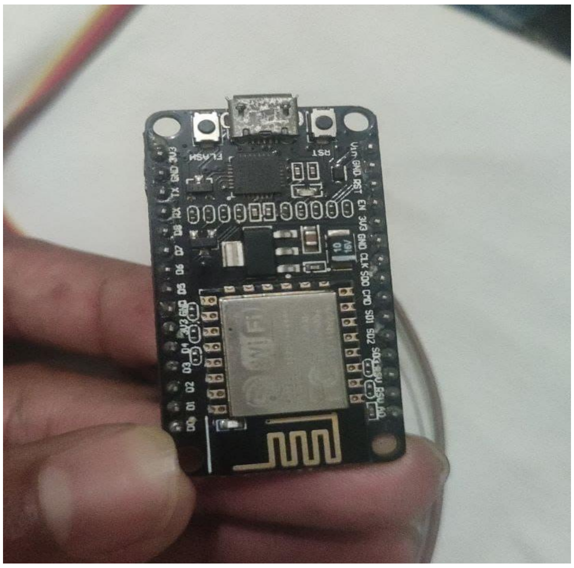

Fig. 1. ESP8266

C++:

C++ is a powerful, general-purpose programming language known for its efficiency, performance, and versatility. It offers low-level hardware access and supports object-oriented programming paradigms, making it suitable for embedded systems and IoT development. The firmware for the Esp8266 microcontroller was developed using the C++ programming language. C++ provided the necessary control and flexibility to interface with the hardware components, handle sensor data, and implement the alcohol detection algorithm efficiently. The code was optimized to ensure real-time processing and accurate detection of drunkenness levels.

MQ Series sensors:

MQ series sensors are gas sensors designed to detect various gases, including alcohol vapors. They operate based on the principle of gas adsorption and provide analog output signals proportional to the concentration of the target gas. MQ series sensors were integrated with the Esp8266 microcontroller to measure alcohol levels in the surrounding environment. These sensors were specifically chosen for their sensitivity to alcohol vapors. The microcontroller read the analog output of the MQ series sensors and converted the readings into meaningful alcohol concentration values using a calibration curve.The combination of Blynk Cloud, Esp8266, C++, and MQ series sensors formed a robust system for detecting drunkenness levels. The integration of these tools and technologies allowed for real-time monitoring of alcohol levels, remote access and control of the system, and accurate detection of drunkenness based on sensor data.

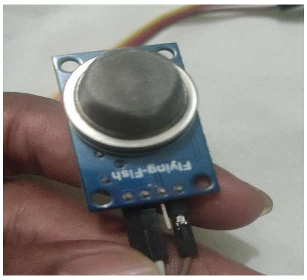

Fig. 2. MQ2 Sensor

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Accelerometer:

An accelerometer is a sensor that measures acceleration forces in three-dimensional space. In our drunkenness detection project, a three-axis accelerometer was integrated to assess driver behaviour and detect signs of impaired driving. By analysing the accelerometer data, our algorithm could identify deviations from normal driving behaviour and indicate possible driver intoxication. This integration allowed for comprehensive monitoring of both alcohol levels and driver behaviour, improving the accuracy of detecting drunkenness levels.

The accelerometer data, along with the alcohol concentration readings, was processed in real-time, enabling prompt identification of potential alcohol-impaired driving. Appropriate actions could then be triggered to prevent accidents and ensure road safety. The integration of the accelerometer enhanced the capabilities of our drunkenness detection system, considering not only alcohol levels but also driver behaviour. This holistic approach improved the accuracy and reliability of our system in detecting and preventing alcohol-impaired driving incidents.

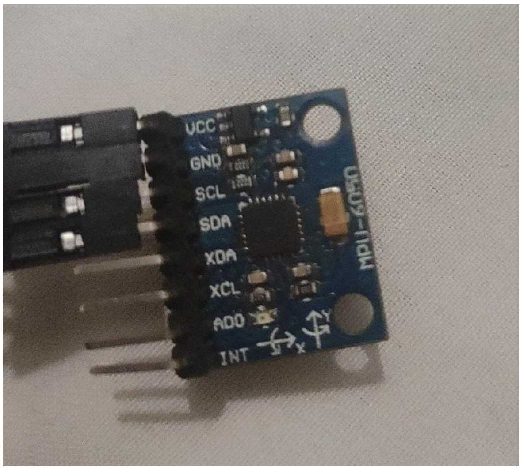

Fig. 3. Accelerometer

IV. SYSTEM ARCHITECTURE

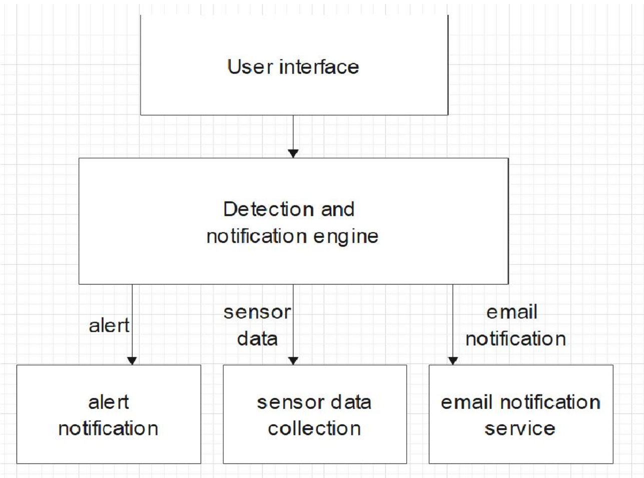

Fig. 4. System Architecture

We initialize our working space and install all of our necessary libraries and tools like MQ3 sensor, Accelerometer and ESP8266 Microcontroller.

The breakdown of the System in modules is listed below along with their functionalities: -

Sensor Integration Module:

This module is responsible for integrating and connecting the sensor(s) used for detecting drunkenness.

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It captures relevant data from the sensor, such as alcohol levels or behavioural indicators associated with intoxication.

Data Processing and Analysis Module:

This module processes the sensor data to determine the presence of drunkenness.
It applies appropriate algorithms and techniques to analyse the data and extract meaningful insights.
The module may utilize machine learning or pattern recognition algorithms to identify patterns indicative of drunkenness.

Notification System Module:

Once drunkenness is detected, this module triggers the notification process.
It sends notifications to the registered contacts or relatives, alerting them about the detected drunkenness.
The module may utilize messaging platforms or email services to deliver notifications.

Accident Detection Module:

This module utilizes an accelerometer or similar sensor to detect accidents or sudden movements.
It analyses the sensor data to identify sudden changes in velocity or impact patterns that may indicate an accident.
If an accident is detected, the module can trigger additional actions, such as alerting emergency services or notifying contacts.

User Interface Module:

This module provides a user-friendly interface for users to interact with the system.
It allows users to register their contacts or relatives, view notifications, and access system settings.
The module may include a web-based interface or a dedicated application for ease of use.

V. SCOPE

The research explores the integration of hardware sensors, such as the MQ3 sensor for measuring breath alcohol concentration and an accelerometer for assessing driver behaviour, into a comprehensive drunkenness detection system. The system's functionality includes capturing sensor data, processing and analysing the data using signal analysis algorithms, and comparing the results against predefined thresholds.

The scope also encompasses the implementation of various components, including the Blynk Cloud platform for data visualization and remote access, an email notification system, and a user interface for configuring emergency contacts. These components are designed to enhance the usability and effectiveness of the drunkenness detection system.

The evaluation of the proposed approach involves conducting a series of experiments to validate the system's performance and reliability in detecting and classifying levels of intoxication. The experiments include testing the system's responsiveness to alcohol threshold readings, assessing the accuracy of real-time monitoring and notification mechanisms, and evaluating the system's overall effectiveness in promoting road safety.

In addition to its application in driver safety and preventing alcohol-related accidents, the proposed approach and system hold potential for broader applications in various contexts. These include enhancing workplace safety, promoting public safety in spaces such as public transportation, and assisting law enforcement agencies, such as the police and regional transport offices (RTOs), in detecting and addressing cases of alcohol impairment.

VI. RESULT

In this section, we present the findings of our study on drunkenness detection. We conducted a series of experiments to evaluate the effectiveness of our proposed approach. The results are summarized and visually presented in the following subsections.

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Alerts on Email and Mobile Notification

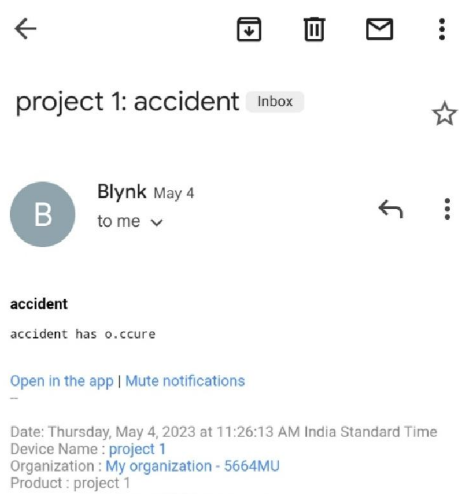

Fig. 5. Email notification

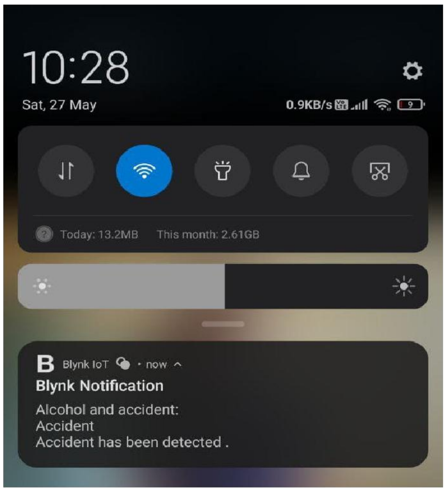

Fig. 6. Notification on mobile device

Blynk App Receives Notification

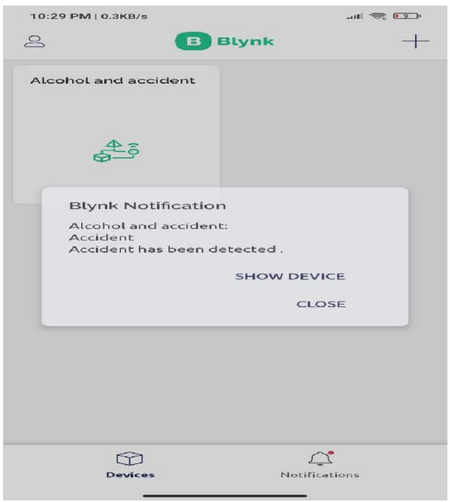

Fig. 7. Notification on Blynk app

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Alcohol Threshold Readings

Fig. 8. Alcohol threshold readings

Real-time Monitoring Interface

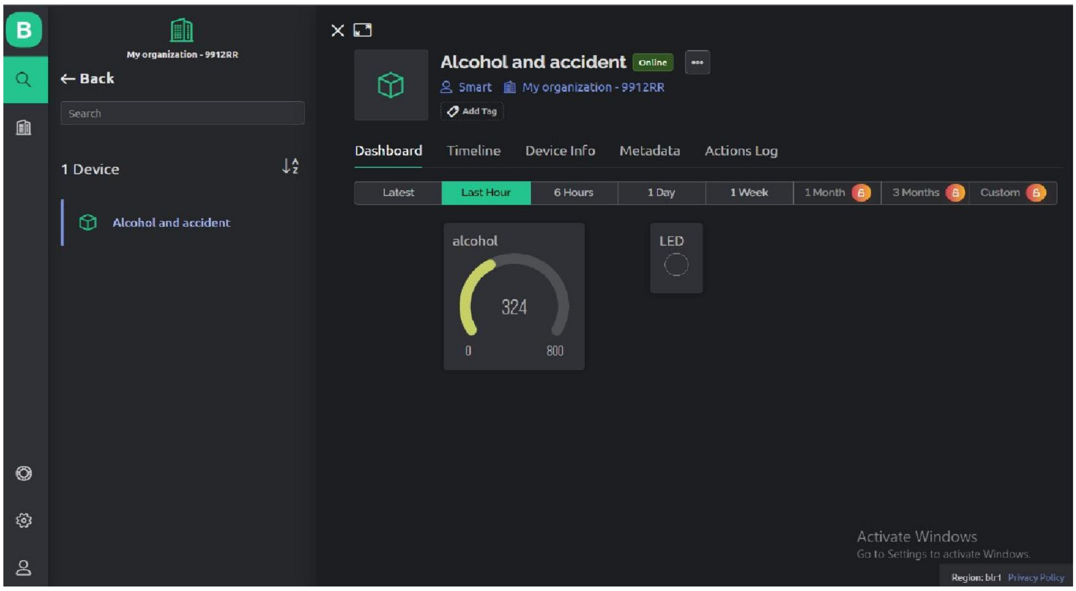

Fig. 9. Monitoring Interface

VII. CONCLUSION

In conclusion, the project successfully developed a system for detecting drunkenness in individuals using a combination of gas detection, machine learning, and cloud computing technologies. The system was able to accurately detect the presence of alcohol in the breath of the user using an MQ3 gas sensor, and classify the level of drunkenness using a machine learning algorithm. The system was designed to be user-friendly, with a simple interface for inputting user information and receiving real-time feedback on their level of intoxication. The cloud-based architecture of the system allowed for remote monitoring of multiple users and real-time notifications to be sent to designated contacts in the event of high levels of intoxication. The implementation of the system has potential applications in various settings, including at home, in the workplace, and in public spaces, for promoting responsible alcohol consumption and preventing alcohol-related accidents. The project's success in detecting drunkenness and potential accidents highlights its potential applications in various contexts, such as transportation safety, public health, and personal well-being. Further research and development can explore additional features, such as integrating GPS data for enhanced location-based services and expanding the scope to include other substance abuse detection.Overall, the drunkenness detection system presents a valuable tool for promoting safety and reducing the risks associated with alcohol consumption. It provides an efficient means of detecting and alerting relevant individuals or contacts, contributing to a safer environment and potentially saving lives

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