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Automotive Breathanalyzer to Detect Alcohol Consumed Driver

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ABSTRACT

This project presents a smart Breath Analyzer System developed using an Arduino Uno, which detects the presence of alcohol in a person's breath and takes appropriate actions. The core component of the system is an alcohol sensor (MQ-3), which accurately senses alcohol content when the user breathes near it. Upon detecting alcohol above a predefined threshold, the system triggers a buzzer alarm, displays a warning message on an LCD screen, and sends real-time data through Wi-Fi (ESP8266 module) to a cloud server or mobile app for remote monitoring. Additionally, DC motors simulate vehicle ignition control, where the system prevents engine startup when alcohol is detected—ensuring enhanced safety. This feature can be integrated into vehicles to restrict drunk driving [5][6]. The combination of hardware and communication modules makes the system efficient, affordable, and suitable for both personal and commercial use. The breath analyzer aims to reduce road accidents caused by drunk driving and promote responsible behavior through a reliable and user-friendly embedded solution [32].

Keyword: *smart breath analyzer, Arduino Uno, alcohol detection, MQ-3 sensor, vehicle ignition control, drunk driving prevention*

1. INTRODUCTION

Alcohol consumption is one of the leading causes of road accidents and fatalities worldwide [5][6]. Despite strict laws and penalties, incidents of drunk driving continue to pose serious threats to public safety [7]. To combat this issue effectively, there is a growing need for reliable, low-cost, and real-time monitoring systems that can detect alcohol levels and prevent drivers under the influence from operating vehicles [8][10]. In this context, the development of a smart Breath Analyzer System using embedded electronics offers a practical and impactful solution.

This project utilizes an Arduino Uno microcontroller as the central processing unit, interfacing with an alcohol sensor (MQ-3) to detect the presence and concentration of alcohol in a person's breath [5][11]. When an individual breathes near the sensor, the system reads the analog signal corresponding to the alcohol level. If the concentration exceeds a predefined safe threshold, the Arduino initiates a series of safety responses. These include activating a buzzer to alert the user, displaying a warning message on an LCD screen, and disabling the DC motors to simulate vehicle ignition lock—thus preventing the vehicle from starting [28].

Moreover, the system is enhanced with a Wi-Fi module (ESP8266) that enables wireless communication. This feature can

be used to send data to a cloud database or notify concerned authorities or guardians in real-time through a mobile app or dashboard [11]. Such connectivity makes the system useful for vehicle fleets, public transportation, and personal vehicles, allowing remote monitoring and promoting accountability.

The main advantage of this breath analyzer system is its affordability, portability, and ease of integration into existing vehicle ignition systems. It can serve as a preventive tool in modern smart vehicles, enhancing road safety and reducing the risk of drunk-driving incidents [5][32]. The project also serves as a practical learning platform for students and hobbyists interested in embedded systems, sensors, and IoT (Internet of Things). Overall, the project demonstrates how simple yet effective technologies can be combined to address real-world problems. With growing awareness and the integration of such safety features in vehicles, the future holds promise for smarter and safer transportation systems. The proposed breath analyzer system not only encourages responsible driving but also contributes significantly to public health and safety by leveraging the power of microcontrollers and smart communication [32].

The primary objective of this project is to design and develop a smart Breath Analyzer System using Arduino Uno, capable of detecting alcohol levels in a person's breath through the MQ-3 alcohol sensor. The system aims to enhance road safety by triggering a buzzer alert, displaying real-time results on an LCD, and preventing vehicle operation via DC motor control when alcohol is detected. Additionally, the system integrates Wi-Fi for remote monitoring and data transmission. This project seeks to promote responsible driving behavior and provide a cost-effective, reliable solution to reduce drunk-driving-related accidents [5][7][10][32].

2. RELATED WORK

Since the first practical device for breath alcohol analysis was introduced in 1930 [3][4], there has been a breakthrough in the conviction of drunken drivers. It has become an integral part of the traffic police and the emergency medicine department worldwide. Extensive research has been done to authenticate its use and make it a scientific evidential proof to prove drunker drivers in the court of law [2][7][24]. In India too it has been approved by Sec 185 of the Indian Motor Vehicle Act, 1988 [11]. But most of the conviction has been based on clinical examination findings. Recently Delhi High Court has ordered all the Emergency Department in the Govt. Hospitals to install Breathalyzer. Therefore it is important for the Doctors and the police officers to know its scientific functions and expected legal complications in the court of law to make it a reliable scientific evidence [24].

Breathalysers are commonly employed to diagnose drunk drivers but their ability to accurately measure levels of ethanol will depend on a number of variables, including the instrument's quality, environmental temperature, pattern of respiration, the consumption of food and drugs, pathological condition, metabolic state, and mouth alcohol [9][14][15][17][19][20][21][23][29][30][31][33]. This article will consider how these factors affect results and provides suggestions on how to improve the test's admissibility in evidence. This applied experimental research focuses on developing a drowsiness and alcohol detection system using Arduino Uno technology. This device is intended for integration into glasses to be used by drivers to enhance road safety by combining infrared sensors for detecting drowsiness based on the duration of the user’s blink, an MQ3 module for detecting alcohol in the breath, and an SMS system for emergency contact, all included in a single device [5][11]. Descriptive statistical methods evaluate the effectiveness of the drowsiness detection system in terms of accuracy and eye structure, and the alcohol detection system is evaluated in terms of consistency and sensitivity regarding the amount of alcohol present in the user’s breath [10][12].

For the drowsiness detection system, accuracy is assessed by its ability to detect eyelid closure for more than three seconds using an infrared sensor, with consistent recorded performance regardless of eye structure. Concerning the alcohol detection system, consistency is evaluated over 30 tests, with slightly varying success rates depending on alcohol consumption levels (10 mL, 20 mL, and 30 mL), demonstrating good accuracy across all trials. Statistical analyses, including t-tests and ANOVA, reveal no significant differences in efficacy based on eye structure or the amount of alcohol. The researchers recommend improving the sensitivity of the Drowsiness Detection System, addressing errors in the Alcohol Detection System by further calibrating the sensitivity of the module, integrating a NEO-6M GPS module for more detailed location information, and improving the design of the product by using lighter variants of the parts used.

3. MATERIALS AND METHODS

The proposed system is a smart Breath Analyzer designed to detect alcohol in a person's breath and respond accordingly to ensure road safety. The system is built around an Arduino Uno microcontroller, which serves as the main control unit. It is interfaced with an MQ-3 alcohol sensor that detects the presence and concentration of alcohol [5][8][10]. When a user exhales near the sensor, the sensor outputs an analog signal proportional to the alcohol content. The Arduino processes this data and compares it with a predefined threshold. If the alcohol level exceeds the safe limit, the system activates a buzzer to alert the user and displays a warning message on a 16x2 LCD screen. Simultaneously, the system disables the DC motors, simulating vehicle engine cutoff, preventing the user from starting or operating the vehicle [5][11]. The system also includes a Wi-Fi module (ESP8266) to send real-time alerts or log data remotely, which can be accessed by authorities or guardians [12]. This

system offers a compact, low-cost, and effective solution to prevent drunk driving and improve vehicle safety systems.

BENEFITS:

- **Enhanced Road Safety:** Prevents drunk driving by detecting alcohol and stopping vehicle operation automatically.
- **Real-Time Alerts:** Sends instant notifications via Wi-Fi for remote monitoring and safety tracking.
- **Low-Cost Solution:** Affordable components make it accessible for widespread implementation.
- **User-Friendly Design:** Simple interface with LCD display and buzzer for easy understanding and quick action.
- **Scalable Integration:** Easily adaptable to various vehicles and smart transportation systems.

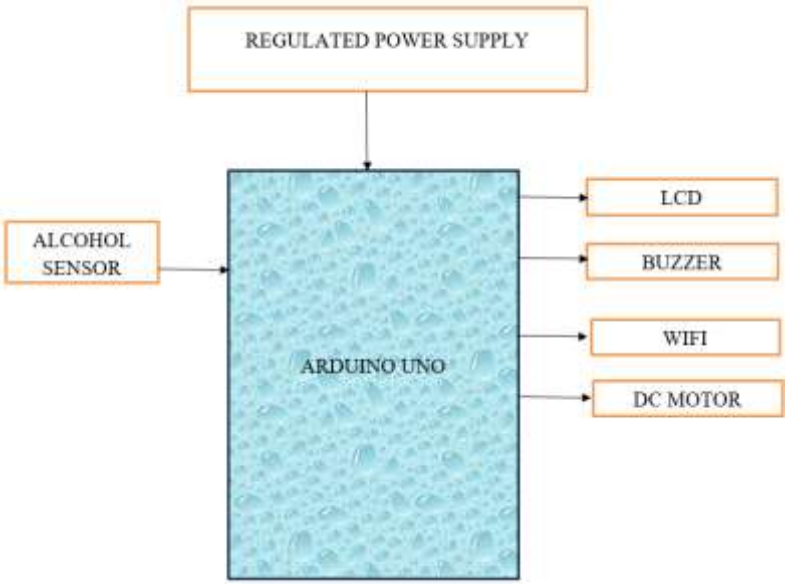

Fig.1 Block diagram

The block diagram illustrates the architecture of a smart Breath Analyzer System using an Arduino Uno as the central controller. A regulated power supply provides stable voltage to the Arduino Uno and all connected components. The alcohol sensor (MQ-3) detects the presence of alcohol in a person's breath and sends the signal to the Arduino [5][8][10]. Upon detection of alcohol above the threshold, the Arduino activates a buzzer for alert, displays a warning on the LCD screen, and sends data via a Wi-Fi module (ESP8266) for remote monitoring [11][12]. Simultaneously, it controls a DC motor that simulates the vehicle ignition system, preventing engine start when alcohol is detected [5]. This integrated setup ensures real-time detection, alerting, and safety control to help prevent drunk driving.

Working process:

ARDUINO UNO:

The most common version of Arduino is the Arduino Uno. This board is what most people are talking about when they refer to an Arduino. The Uno is one of the more popular boards in the Arduino family and a great choice for beginners. There are different revisions of Arduino Uno, below detail is the most recent revision (Rev3 or R3). The Arduino Uno is a microcontroller board based on the ATmega328. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started.

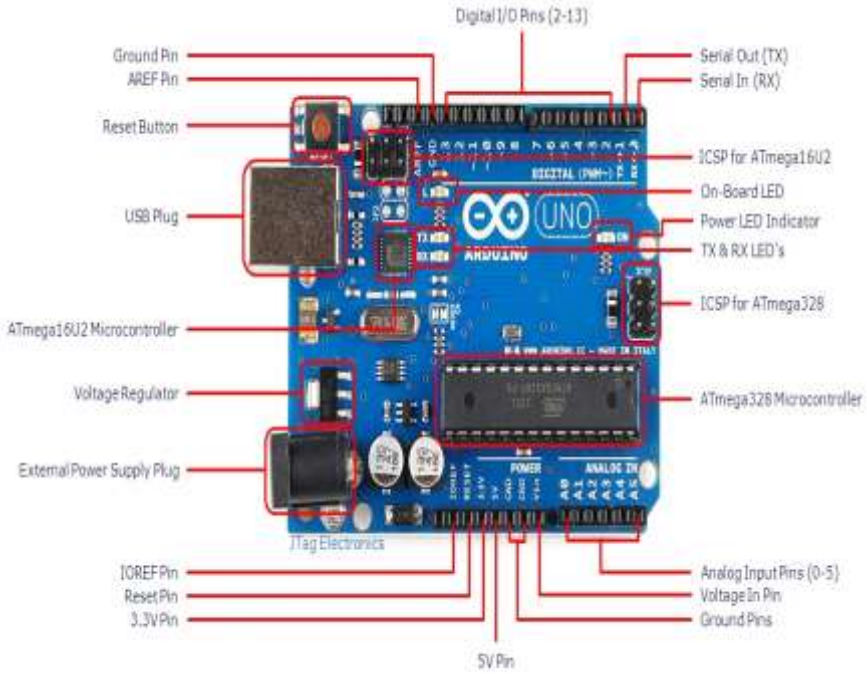

Fig.2 ArduinoUno R3 Board

ALCOHOL SENSOR

Designing an alcohol sensor involves several key components and considerations. Here's a brief outline that you can expand into a 300-word description: An alcohol sensor, typically used in breathalyzers and industrial safety equipment, detects the presence of alcohol vapor in the air. These sensors are crucial in ensuring safety in various environments, from detecting drunk driving to maintaining workplace sobriety standards.

Fig.3 Alcohol Sensor

LCD

LCD (Liquid Crystal Display) screen is an electronic display module and find a wide range of applications. A 16x2 LCD display is very basic module and is very commonly used in various devices and circuits. These modules are preferred over seven segments and other multi segment LEDs. The reasons being: LCDs are economical; easily programmable; have no limitation of displaying special & even custom characters (unlike in seven segments), animationsand so on.

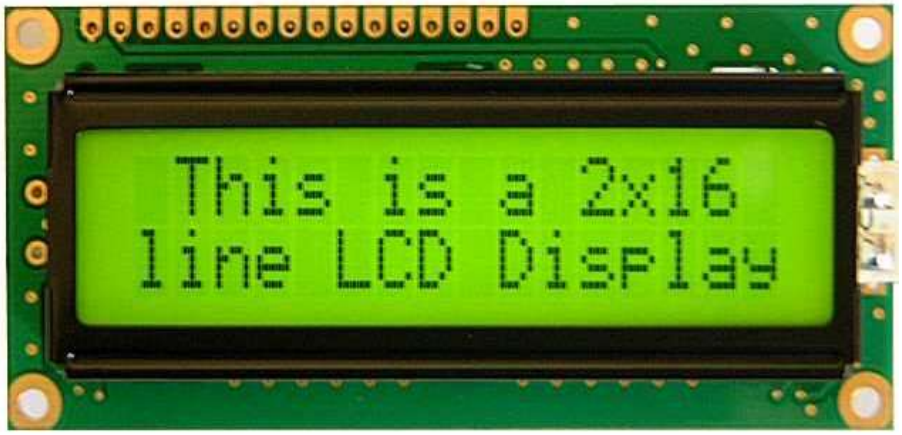

Fig.4 16x2 LCD display

BUZZER

A buzzer or beeper is an audio signaling device, which may be mechanical, electromechanical, or electronic. Typical uses of buzzers and beepers include alarms, timers and confirmation of user input such as a mouse click or keystroke.

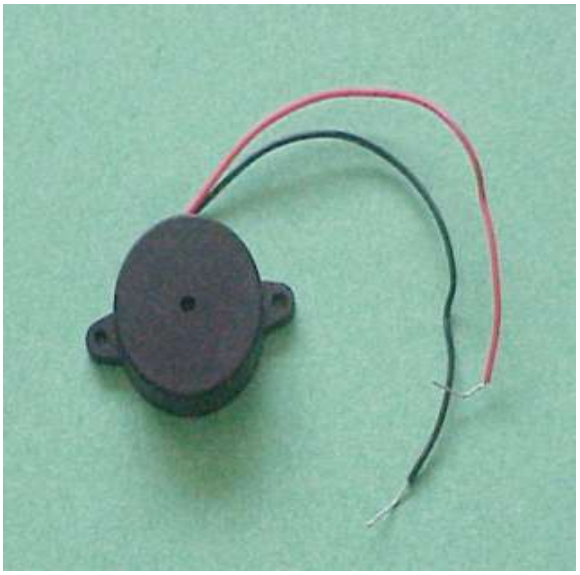

Fig. 5 Buzzer

WIFI:

The ESP8266 is a low-cost Wi-Fi chip with full TCP/IP stack and MCU (microcontroller unit) capability produced by Shanghai-based Chinese manufacturer, Espressif Systems.

Fig. 6 WIFI

DC MOTOR:

DC motors are configured in many types and sizes, including brush less, servo, and gear motor types. A motor consists of a rotor and a permanent magnetic field stator. The magnetic field is maintained using either permanent magnets or electromagnetic windings. DC motors are most commonly used in variable speed and torque.

Fig. 7 DC motor

REGULATED POWER SUPPLY:

All digital circuits require regulated power supply. In this article we are going to learn how to get a regulated positive supply from the mains supply. In this project, the Regulated Power Supply plays a crucial role by providing a stable and consistent voltage to all the electronic components, ensuring reliable operation of the system. It supplies the required voltage to the Arduino Uno and other connected modules such as the alcohol sensor (MQ-3), LCD display, buzzer, Wi-Fi module, and DC motor. Since fluctuations or surges in power can lead to malfunction or damage to sensitive components, the regulated power supply maintains a constant output, typically 5V or 12V depending on the circuit design. This helps in achieving accurate sensor readings and uninterrupted system performance, making the breath analyzer system dependable and safe for real-world applications.

4. RESULTS

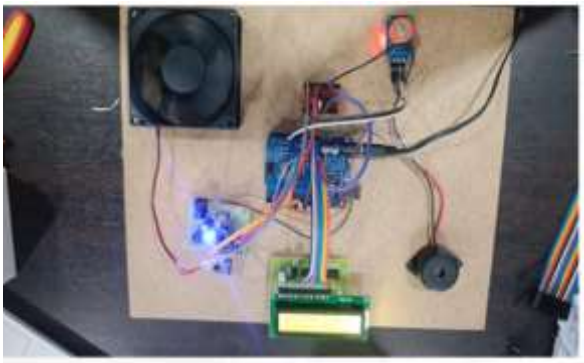

Fig.8 Board

Fig.9 Breath analyser system

Fig.10 Alcohol status

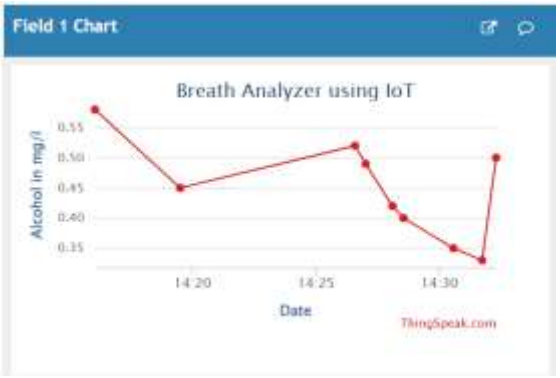

Fig.11 Chart

Fig. 12 alert message

5. CONCLUSION

The proposed Breath Analyzer System using Arduino Uno, MQ-3 alcohol sensor, LCD, buzzer, Wi-Fi, and DC motors offers a practical and efficient solution to help prevent drunk driving [5][10][11]. By accurately detecting alcohol content in a person's breath and responding through alerts and motor control, the system ensures enhanced safety by restricting vehicle ignition in unsafe conditions [8][14][19]. Its ability to send real-time data through Wi-Fi adds value for remote monitoring and accountability [12][21]. The system is cost-effective, easy to build, and highly adaptable for use in personal vehicles, commercial fleets, and educational prototypes [5][28]. This project demonstrates the integration of embedded systems and IoT to solve real-world problems [11][32]. With further enhancements, such systems can be standardized in vehicles, contributing significantly to reducing road accidents and promoting responsible behavior [1][7][24]. Overall, the breath analyzer not only supports public safety but also highlights the role of technology in creating a safer driving environment.

6. FUTURE SCOPE

The Breath Analyzer system can be further enhanced by integrating GPS tracking to locate the vehicle when alcohol is detected, enabling quick response from authorities [21][22]. Mobile app integration can allow guardians or fleet managers to receive real-time alerts and logs [12][27]. The system can be upgraded with facial recognition to ensure identity verification of the driver. Additionally, using advanced sensors can improve accuracy and reduce false readings [10][15][17]. Solar-powered modules can make the system more energy-efficient. With these enhancements, the system can be widely adopted in public transport, private vehicles, and industrial fleets, promoting safer roads globally

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