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Automatic Engine Stopping System for Alcoholic Driver using NodeMCU

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***Abstract*—"The Alcohol Detection and Automatic Engine Locking System Using NodeMCU"is an innovative and highly effective solution designed to address the growing concerns of drunk driving by incorporating smart technology. With the primary goal of enhancing road safety, the system integrates a cutting- edge MQ-3 alcohol sensor with a Node MCU microcontroller, which together work to accurately detect alcohol levels in the breath of the driver. This real-time detection capability ensures that any signs of intoxication are immediately recognized. When the sensor detects alcohol concentrations exceeding a predefined safety threshold, the system triggers an automatic response by activating an engine locking mechanism that prevents the vehicle from starting, thereby reducing the risk of accidents caused by impaired driving. In addition to its immediate on-site safety benefits, the system leverages the Wi-Fi functionality of the NodeMCU to provide remote monitoring and control capabilities. This allows for the seamless transmission of data to mobile devices or cloud-based platforms, where real-time alert scan be sent to vehicle owners, fleet managers, or law enforcement, keeping all relevant parties informed about the driver's condition. This feature not only adds an extra layer of safety but also enables data logging for future reference,helping authorities or vehicle operators track alcohol-related incidents and take appropriate actions. Moreover, the flexibility and scalability of the system make it suitable for installation in a wide variety of vehicle types, from personal cars to commercial fleet vehicles. Its easy integration with existing vehicle systems and cost-effective design further enhance its applicability and practicality. With these advanced features, the Alcohol Detection and Automatic Engine Locking System offers a modern, efficient, and highly reliable solution to combat drunk driving, ensuring safer roads for everyone.**

***Index Terms*—NodeMCU, Alcohol Detection ,Locking System**

I. Introduction

The Drunk driving is a pervasive issue that poses a significant threat to road safety, contributing to a high percentage of traffic accidents and fatalities worldwide. Despite stringent regulations and awareness campaigns, incidents of driving under the influence (DUI) remain prevalent, highlighting the need for an effective preventive mechanism. This project, titled Alcohol Detection and Automatic Engine Locking System Using Node MCU offers an innovative solution to gatethis challenge by integrating technology into vehicles to prevent intoxicated individuals from driving. The system is designed around the NodeMCU, a powerful, low-cost microcontroller with built-in Wi-Fi capabilities, making it ideal for smart IoTapplications.AnMQ-3alcoholsensorplaysacritical role in detecting alcohol levels in the driver's breath. If the alcohol concentration exceeds a predefined safety threshold, the system takes immediate action. The Node MCU's Wi-Fi capabilities open the possibility of IoT extensions, such as sending alerts to a mobile app or a central monitoring system for enhanced safety measures. This project is designed to be compact, cost-effective, and easily integral into existing vehicles. It not only provides an immediate solution for private vehicle safety but can also be adapted for use in public trans- portation and commercial vehicles. By combining advanced sensor technology, automation, and IoT readiness, this system offers a robust solution or reduces drunken driving incidents and enhances overall road safety. The project represents a significant step toward leveraging technology to solve real- world problems and save lives.

II. Literature Survey

[1]This paper delves into the integration of NodeMCU-based systems to address safety challenges in automobiles, specifically alcohol detection and pothole detection. The authors propose an intelligent framework that leverages IoT and embedded technologies to enhance vehicle safety. By automating the detection of unsafe driving conditions and providing preventive alerts, this study highlights a cost-effective and scalable approach for improving road safety. The research underscores the potential of technological innovation in significantly reducing accidents and promoting security in rural and urban settings. [2]This research focuses on preventing drunk driving by integrating embedded sensors and network connectivity into vehicles. The system automatically detects alcohol consumption through sensors and locks the vehicle engine to prevent operation. By offering a real-time and auto- mated approach, the study eliminates the reliance on manual

Intervention. The system also integrates network capabilities for continuous monitoring, ensuring a proactive solution to enhance road safety. The authors emphasize the importance of automation and connectivity in addressing critical safety challenges effectively.[3]This study introduces cutting-edge Raspberry Pi-based system that integrates alcohol sensors to monitor and prevent drunk driving. The system automatically locks the vehicle engine when it detects alcohol consumption, thus preventing potential accidents. It also features real-time alerts and GPS-based location tracking, enabling immediate response and assistance. By focusing on scalability and affordability, the research showcases a practical solution that enhances both driver and public safety. The study highlights how IoT and embedded systems can transform vehicle safety standards. [4]This paper proposes a system that uses the PIC16F877A microcontroller to detect alcohol levels and lock vehicle ignition automatically. The research emphasizes the simplicity and reliability of microcontroller-based systems for preventing drunken driving. The authors present a low-cost and efficient design that ensures safety while being adaptable to various vehicle types. The system's focus on affordability and ease of implementation makes it a viable solution for wide spread adoption.[5]This research integrates IoT technologies with alcohol detection systems to provide a comprehensive solution for vehicle safety. The system detects alcohol levels in the driver's breath and locks the vehicle engine if necessary.Additionally,it employs cloud-based monitoring to provide real-time updates to authorized personnel. The study emphasizes the system's scalability and adaptability, making it suitable for fleet management and individual users alike. The authors highlight how IoT-driven automation can revolutionize safety measures in transportation. [6]This paper explores the use of IoT in designing a modular alcohol detection and engine control system. The proposed system incorporates real- time monitoring and adaptability to different vehicle types. By leveraging cloud connectivity, the solution ensures that alcohol detection data is accessible to authorized users, providing enhanced safety and accountability. The research demonstrates a user-friendly and efficient approach to preventing drunk driving incidents. [7]This study introduces a smart vehicle alcohol detection system that integrates IoT for real-time monitoring and prevention. The system provides immediate feedback to the driver and prevents vehicle operation upon detecting alcohol. The authors emphasize the importance of IoT in enabling proactive safety measures and improving system scalability. The research highlights the potential of connected technologies in reducing drunk driving-related incidents effectively. [8]This paper leverages IoT and deep learning to develop a system for detecting and preventing vehicle accidents. The proposed system employs sensors and machine learning models to identify potential risks and take preventive actions in real-time. The system also provides real- time alerts to emergency services, ensuring timely assistance. The research highlights the transformative role of IoT and artificial intelligence in creating safer road environments.

III. ANALYSIS

The Alcohol Detection and Automatic Engine Locking System Using NodeMCU represents a significant advancement in vehicle safety systems, addressing the short comings of traditional approaches with an innovative, efficient,and modern solution. One of the core features is real-time alcohol detection, which utilizes anMQ-3alcohol sensor to continuously monitor the alcohol levels in the driver's breath. This ensures precise and timely identification of intoxication, enabling immediate actions to prevent a potentially dangerous situation. Unlike manual breath analyzers, this system eliminates the need for human intervention, delivering consistent and reliable monitoring. Building on this, the system incorporates automated engine locking, which is activated when the detected alcohol concentration exceeds a predefined threshold. A relay module is employed to disconnect the vehicle's engine, effectively preventing it from starting or operating. This automated mechanism ensures that intoxicated individuals cannot drive, offering a proactive and dependable method for stopping drunk driving.Additionally,the system features audible alerts, with a buzzer that is triggered whenever alcohol is detected. This not only provides immediate feedback to the driver but also serves as a warning to nearby individuals, thereby enhancing overall levels. This visual feedback keeps the driver informed about their condition, encouraging compliance and self-awareness. The integration of IoT capabilities through the NodeMCU module adds another layer of sophistication. With wireless connectivity, the system can send alerts to a central monitoring platform or mobile devices, enabling remote monitoring and control. This IoT integration paves the way for scalable deployment and real-time supervision, making the system suitable for individual and fleet applications. The proposed system also ensures stability and reliability through a 7805-voltage regulator, which delivers a consistent 5V power supply to all components. This feature prevents malfunctions caused by power fluctuations, ensuring seamless operation even under challenging conditions. Moreover, the system boasts a compact and cost-effective design, integrating all components into an efficient structure. This makes the system easy to install and highly affordable, ensuring its suitability for a wide range of vehicles, from personal cars to commercial fleets. By automating alcohol detection, providing real-time monitoring, and incorporating engine control, the Alcohol Detection and Automatic Engine Locking System Using NodeMCU stand out as a comprehensive and modern solution to the critical issue of drunk driving. Its innovative features not only enhance road safety but also ensure ease of use, affordability,and adaptability, making it a practical choice for widespread adoption.

IV. SYSTEM REQUIREMENTS

The Alcohol Detection and Automatic Engine Locking System Using NodeMCU relies on a carefully selected

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bination of software and hardware to deliver an efficient and innovative solution for road safety.The software requirements are centered around tools and libraries that streamline the programming and functionality of the system. The Arduino IDE (Integrated Development Environment) is the primary platform used for programming the Node MCU microcontroller and uploading the necessary code.With its built-incode editor and library manager, the Arduino IDE facilitates the seamless development of C/C++ programs and the integration of essential dependencies. The system employs various specialized libraries to enable efficient interaction with hardware components. The Adafruit Unified Sensor Library supports the integration of the MQ-3 alcohol sensor, simplifying data retrieval and ensuring real-time alcohol detection. The Liquid Crystal- I2C Library provides an interface for the LCD screen, enabling the display of real-time alcohol concentration levels and other critical alerts or system statuses. For IoT-based functionality, the ESP8266WiFi Library empowers the NodeMCU with wireless connectivity, supporting real-time data logging and the ability to send alerts to connected devices. Additionally, the Universal TelegramBot Library facilitates communication with a configured Telegram bot, enabling the system to send real-time messages to users, enhancing its modern and efficient messaging capabilities. The Telegram App plays a crucial role in the system's IoT integration. This cloud-based messaging platform offers secure communication, file sharing, and bot integration, making it highly suitable for personal, professional, and IoT applications. Tools like Bot Father, which helps create and manage bots, allow users to generate unique tokens for API integration, customize bot commands, and configure pro- files.Meanwhile,IDBot is used to retrieve unique user, group, or channel IDs, ensuring precise and seamless bot operations. These features enable automation and real-time notifications, enhancing the system's overall functionality.From a functional perspective, the system introduce several critical features to ensure comprehensive and reliable operation. Alcohol Detection is achieved using the MQ-3 sensor, which continuously monitors alcohol concentration in real-time. When the detected levels exceed the set threshold, the system triggers engine control mechanisms, such as activating a relay to disable the DC motor, thereby preventing the

Vehicle from operating. To enhance user feedback, the system provides both visual and audible alerts. Messages like "Alcohol Detected - Engine Locked" are displayed on the LCD screen, while a buzzer delivers immediate audible feedback to ensure awareness. The system's IoT integration allows for remote monitoring and alerting through Wi-Fi connectivity. Alerts generated upon alcohol detection are sent to cloud servers or mobile devices, enabling real-time supervision and logging events in a database for review. Power management is another essential aspect, achieved through a 7805 voltage regulator that ensures a stable power supply to all components. This feature supports both USB and battery power options, ensuring reliability under diverse operating conditions. Scalability is also a key consideration in the system design. Its modular architecture supports future upgrades, such as the addition of more sensors or advanced features. The compatibility with cloud platforms enables expanded functionality, allowing the system to adapt to evolving technological demands. The hardware components used in the proposed system include the NodeMCU ESP8266, which serves as the core microcontroller for IoT integration, andtheMQ-3alcoholsensor,responsible for detecting alcohol levels. A relay module is employed for engine control, while

a buzzer provides audible alerts. The system is powered by a7805voltage regulator to ensure a consistent supply of 5V to all components. Additional components, such as a DC motor to simulate engine functionality,aTelegram bot for real- time alerts, and various power supply components, complete the setup. By integrating these software tools, libraries, and hardware components, the system delivers a compact, cost-effective, and scalable solution to address the critical issue of drunkdriving.Its robust functionality,IoTcapabilities, and user-friendly design make it a transformative addition to modern vehicle safety systems.

V. System Architecture

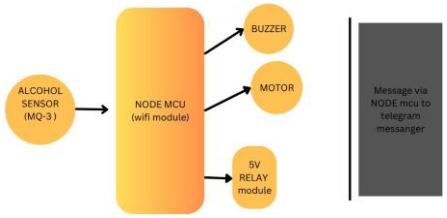

Fig.1.SystemArchitecture

The proposed **Alcohol Detection and Automatic Engine Locking System** integrates various hardware components to ensure accurate, reliable, and efficient operation. The system is designed to automatically detect alcohol levels in real time and prevent vehicle operation when necessary. The architecture of the system is depicted in the block diagram below, illustrating the interaction between components and their roles in ensuring road safety.

A. Overview of System Architecture

The architecture centers around the **NodeMCU ESP8266**, which acts as the central controller of the system. It interfaces withthe**MQ-3 alcoholsensor** to detect alcohol in the driver's breath. Based on the alcohol concentration, the system uses output devices such as **LEDs**, a **buzzer**, and an **engine-locking mechanism** to communicate the vehicle's operational status. The **Wi-Fi module** enables wireless communication with the **Telegram bot**, allowing real-time notifications and remote monitoring. The system is powered by a stable **power supply** to ensure continuous operation, with **connecting wires** facilitating communication between components.

B. Component Interaction and DataFlow

The **NodeMCU ESP8266** serves as the primary processing unit, handling data from sensors and activating output devices accordingly. The system operates in the following sequence:

1) **Alcohol Detection:** The **MQ-3 alcohol sensor**

continuously monitors the alcohol levels in the driver's breath. The sensor outputs an analog signal that is processed by the Node MCU.If the alcohol concentration exceeds a predefined threshold; the NodeMCU triggers the following actions:

- **Visual Feedback:** The **red LED** is illuminated to indicate that the vehicle cannot be operated. The **green LED** lights up if no alcohol is detected, confirming that the vehicle is safe to drive.
- **Audible Alert:** The **buzzer** is activated to pro-vide an immediate warning to the driver and those nearby.
- **Engine Locking:** The **engine-locking mechanism** is triggered to prevent the vehicle from starting if alcohol is detected.

2) **Real-time Communication:** The **Wi-Fi module** within the NodeMCU connects the system to the internet, allowing it to send real-time alerts to a**Telegram bot**. The bot provides instant notifications about the system's status, such as "ALCOHOL DETECTED" or "ALCOHOL NOT DETECTED," to a predefined chat. This feature ensures remote monitoring and enhances user convenience.

C. System Integration

All components work together in aseamless manner:

- The **NodeMCU ESP8266** acts as the system's central hub, processing sensor inputs and controlling the output devices.
- The **MQ-3 sensor** is interfaced with the NodeMCU, providing alcohol concentration data to determine whether the vehicle should be locked.
- The **Wi-Fi module** enables the system's IoT functionality, facilitating communication between the vehicle system and the Telegram bot for remote monitoring.
- The **power supply** ensures reliable operation of all components,witha**7805voltageregulator** providing a stable 5V output.
- **Connecting wires** are employed to establish reliable communication between the NodeMCU, sensors, actuators, and other components.

D. Logical Flow and Decision-making

The system performs the following logical steps in real-time:

1) **Input Data:** The MQ-3 sensor continuously monitors the alcohol concentration in the driver's breath.
2) **Data Processing:** The NodeMCU processes the sensor's analog signal. If the signal exceeds these threshold, the system triggers an alert.
3) **Output Activation:** Based on the processed data, the NodeMCU activates the corresponding outputs:
   - If alcohol is detected: the **red LED** and **buzzer** are triggered, and the engine is locked.
   - If alcohol is not detected: the **green LED** is activated, and the vehicle remains operational.
4) **Real-time Notification:** The **Wi-Fi module** sends a message to the **Telegram bot**, notifying the user about the alcohol detection status.

E. PowerManagement

A stable power supply is crucial for the system's reliable performance.ThesystemispoweredeitherthroughUSBor an external battery, ensuring continuous operation. The **7805 voltage regulator** provides a steady 5V output to all components, protecting them from voltage fluctuations and ensuring uninterrupted service.

VI. METHODOLOGY

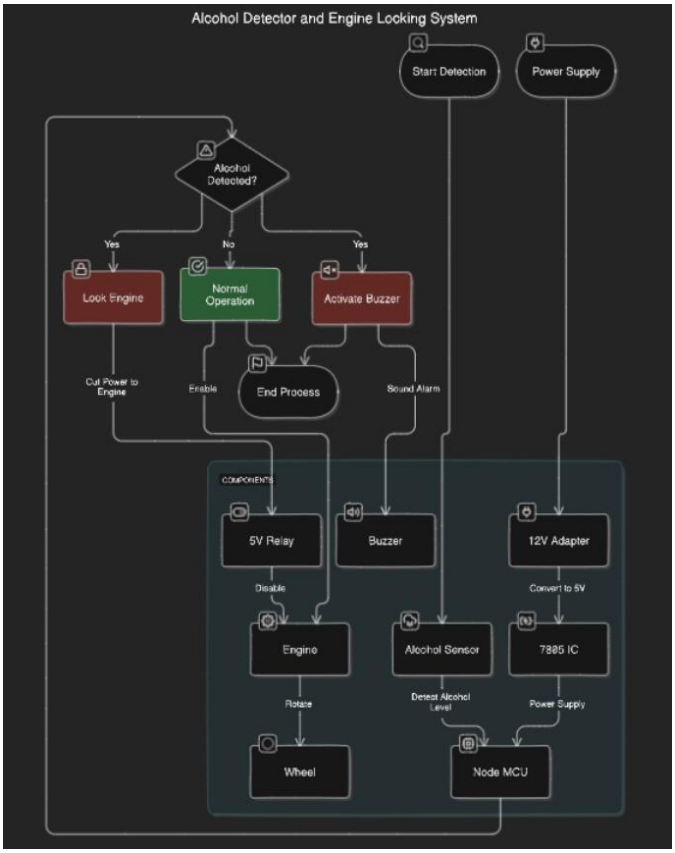

Fig.2.FlowChart

The development of the **Alcohol Detection and Automatic Engine Locking System Using NodeMCU** involves multiple stages, from code development and hardware integration to system calibration and real-time operation. Each step ensures a fully functional, reliable, and efficient solution to prevent drunk driving.

A. Code Development

The system's development begins with programming the **NodeMCU** microcontroller to manage its core functions. The firmwareiswrittentointerfacewiththeMQ-3alcoholsensor,

relay module, and buzzer. Using the Universal Telegram Bot Library, the NodeMCU enables real-time messaging through Telegram. The code is designed to:

- ReadalcoholconcentrationdatafromtheMQ-3sensor.
- Activate the relay and buzzer when alcohol levels exceed a predefined threshold.
- Send alerts such as "ALCOHOL DETECTED" or "ALCOHOL NOT DETECTED" to a configured Telegram bot.

To enhance performance and reliability, AI tools and debugging techniques are employed to optimize the code.

B. Hardware Setup

The hardware assembly focuses on connecting all components effectively. The MQ-3 alcohol sensor is wired to the NodeMCU's analog input pin, while there lay module is linked to a DC motor representing the vehicle engine. Additionally, the buzzer and LEDs are attached to provide audible and visual feedback. The entire setup is validated against the block diagram to ensure correct wiring and integration. Each component is individually tested for functionality before being incorporated into the system to guarantee proper operation and compatibility.

C. Power Management

A stable power supply is vital for system reliability. The NodeMCU and other components are powered using a USB adapter or battery, with a 7805-voltage regulator providing a consistent power management system is tested under different operating conditions to ensure stable and uninterrupted performance, minimizing the risk of malfunction due to power fluctuations.

D. TelegramBotConfiguration

The integrationof aTelegrambot adds real-time messaging capabilities to the system. A bot is created using Telegram's `BotFather`,where a unique token and chatID are generated for secure communication. This configuration is embedded into the NodeMCU code, enabling it to interact with the Telegram API via the ESP8266 Wi-Fi module. This feature allows the system to send instant alerts and updates to a designated Telegram chat, improving monitoring and safety.

E. SensorandSystemCalibration

TheMQ-3alcohol sensor under goes thorough calibration to ensure accurate detection of alcohol concentrations. The sensor is tested under varying conditions to establish are liable threshold value, which is then in corporate into theNodeMCU code. The system is also tested in simulated scenarios to validate its response to alcohol detection. This includes verifying that:

- The relay disables the DCmotor(engine).
- The buzzer sounds an alert.
- Real-time messages are sent to theTelegrambot.

F. Real-Time Messaging

The system leverages **Telegram** for real-time alerts, ensuring timely notifications to stakeholders. Messages

Such as "ALCOHOL DETECTED...PLEASE TAKECARE"are sent when alcohol is detected, while "ALCOHOL NOT DETECTED" is sent during safe operation. The messaging functionality's rigorously tested to confirm that alerts are accurate, prompt, and consistent with the system's status.

G. System Operation

The system operates in two modes: **alcohol detection** and **safe operation**. When the MQ-3 sensor detects alcohol above the threshold, the following actions occur:

- The **red LED** and **buzzer** are activated.
- The **relay** disables the engine.
- An **"ALCOHOL DETECTED** "alert is sent to theTelegram bot.

In **safe operation mode**,the following actions take place:

- The **greenLED** lights upto indicate noalcoholdetection.
- The engine remains operational.
- An"**ALCOHOL NOTDETECTED**"message is sent to the Telegram bot.

This dual-mode operation ensures safety and efficiency inreal-time scenarios.

VII. RESULT

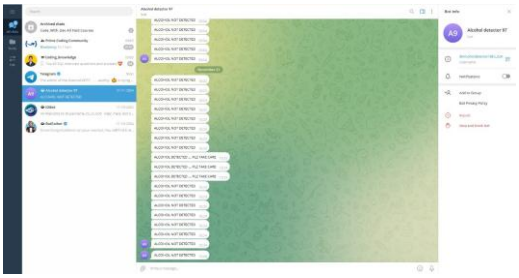

Fig.3.Results

1) SuccessfulDetectionofAlcoholLevels
   The system will accurately detect the driver's alcohol concentration using the MQ-3 alcohol sensor. The system should consistently identify when the driver'sBlood Alcohol Concentration (BAC) exceeds the predefined legal limit
2) Automatic Engine Locking
   The system will prevent the vehicle from starting if the alcohol concentration exceeds the threshold. The relay module is detected, thereby reducing the risk of accidents due to impaired driving.
3) User-Friendly Interface
   The system will provide clear, real-time feedback to the driver via an LCD display and audible alarms.TheLCD display will show messages such as"AlcoholDetected

- Engine Locked," and the buzzer will sound an alert, making the system easy for users to understand and interact with.

4) Enhanced RoadSafety
The project will contribute to the overall reduction of road accidents caused by drunk driving. By preventing drivers from operating the vehicle while intoxicated,the system is expected to significantly reduce the likelihood of alcohol-related traffic accidents.

5) Cost-Effective andScalableSolution
The system will be developed using cost-effective components and scalable design. The use of Node MCU and other low-cost components will make the system affordable, with the potential for easy integration into a wide range of vehicles.

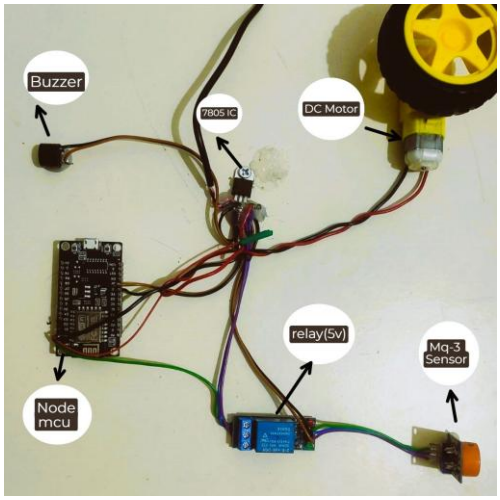

Fig.4.AlcoholDetectionandAutomaticEngineLockingSystem

VIII. CONCLUSION

The Alcohol Detection and Automatic Engine Locking System using NodeMCU effectively enhances road safety by addressing key concerns of impaired driving. By integrating alcohol detection through the MQ-3 sensor with IoT capabilities and automated engine control, the system provides: • Real-time Monitoring and Alerts: Instant alerts through the Telegram bot, notifying the user when alcohol levels exceed the set threshold.

• Automatic Engine Locking: Ensures that the engine cannot be started when the alcohol concentration surpasses safe limits, preventing potentially dangerous driving.

• Cost-Effective and User-Friendly: The system is designed to be affordable, easy to implement, and accessible for various vehicles.

Overall, this project demonstrate show modern technology can play a critical role in ensuring road safety by automating the detection and prevention of drunk driving.

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