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ADCS- ALCOHOL DETECTION AND CONTROL SYSTEM

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Abstract: The estimates of risks indicate that drinking and driving is a major contributor to automobile crashes. Many lives can be saved if intoxicated drivers were prevented from driving. The amount of alcohol in human breath can be measured using the alcohol sensor (MQ-3) which has been used in this prototype. The alert system includes visual and auditory notifications i.e., the subsequent blinking of the parking indicators. The Bluetooth module HC-05 allows us to send an SMS about the location of the driver to his emergency contacts while he is under the influence of alcohol. When alcohol concentration is discovered, the engine's RPM is likewise gradually decreased until the vehicle comes to a halt.

***Index Terms* - MQ-3 sensor, Bluetooth module HC-05, RPM (Revolutions Per Minute), SMS (Short Message Service).**

I. INTRODUCTION

With the continuous growth of population and urbanization, traffic volumes have been increasing, placing strain on existing infrastructures. This rise in traffic volume, coupled with limited resources for infrastructure development and maintenance, has led to challenges in ensuring road safety. As a result, accident rates have been steadily increasing, posing a significant concern for public safety and transportation authorities.

Drunk driving remains a major contributing factor to serious accidents. When drivers operate vehicles under the influence of alcohol, their cognitive and physical abilities become impaired, leading to a higher likelihood of accidents. These accidents can have devastating consequences, resulting in injuries, loss of lives, and extensive property damage. It is not only the intoxicated driver who is affected but also innocent individuals who become victims of someone else's negligence. To address the issue of drunk driving, traffic police employ breath analyzers to screen drivers for alcohol consumption. These devices measure the alcohol content in a driver's breath and provide an immediate reading of the amount of alcohol present. While breath analyzers serve as a useful tool for on-the-spot testing, they typically only display the current alcohol level and do not save the data for further communication or analysis. One limitation of the current breath analyzer systems is the slow access to data. The information gathered from these devices is often manually recorded or not stored for future reference. This makes it difficult to track and analyze trends, patterns, or repeat offenders effectively. The lack of timely access to data hampers efforts to monitor and respond to the issue of drunk driving efficiently. To address these limitations, the proposed Alcohol Detection and Control System aims to provide a more comprehensive solution. By integrating advanced sensors, data storage, and communication capabilities, the system can offer real-time and centralized access to alcohol detection data. This enables authorities to identify and respond promptly to instances of drunk driving, track historical data for analysis and pattern recognition, and implement targeted measures to reduce accidents on the road.

II. LITERATURE SURVEY

In this project, an alcohol detection system with engine locking for automobiles is designed and put into practice utilizing an ultrasonic sensor and an Arduino UNO as the MCU (Master Control Unit). The device constantly monitors the alcohol detection sensor's level of concentration and, if it rises above a certain level, it automatically turns off the vehicle's engine. Additionally, the model uses the SIM900A to transmit data pertaining to the location of the car. The concept offers a practical way to reduce accidents caused by intoxicated driving. **[1]**

The information gathered is not saved for future communication, which is the main problem, according to the authors of this research paper. They developed a cutting-edge solution to alleviate this drawback using virtual instrumentation. The main objective was to create a system that could assess whether or not the person driving the car is completely cognizant. The vehicle's engine is shut off when the driver is severely inebriated, and an email is also sent via IOT to the concerned person depending on this state, among other automatic steps. Depending on the alcohol concentration, a different number of LEDs will light up. If the blood alcohol content is between 1 and 5, the LEDs will glow, but the engine will still be running and the buzzer won't sound. If the blood alcohol level is between 6 and 8, the engine shuts down, the alarm continually sounds, and the user also receives an email. To connect to and communicate with Arduino, NI LabView's back panel was utilized. They used the VISA (Virtual Instrumentation Software Architecture) toolset to connect serially to the Zigbee transceiver. LabView is used to store the measured alcohol level from the sensor.**[2]**

The authors of this work have developed an unconventional approach to addressing the problems brought on by drunk driving. They claim that it is not difficult to detect the presence of alcohol beyond the legal limit and to shut off the engine, but there are several ways or processes by which individuals might prevent it from operating as it should. The ignition terminals can be directly shorted out to stop it, although doing so has drawbacks and raises the risk of fire hazards. To solve this issue, the fuel pump system now controls the ignition system. A relay is utilized, which is an electromagnetic switch, to turn on and off a circuit with a low-power signal. They found that automated systems today are reliable, flexible, and accurate with no need for manual operation. Every domain has a need for these automated systems capabilities; however, automated control systems are preferred.**[3]**

According to this paper's authors, a vehicle's alcohol-detecting system is a rudimentary model of this kind. Six alcohol sensors are employed by this system, which provides the information for processing. An O-SNN is used to process the data that has been created. The analysis's findings demonstrate the system's excellent performance, which resulted in a detection accuracy rate of 99.8% and a 2.22 μs inference hold-over time. The hardware component of this system consists of six MQ-3 sensors and a memory unit connected by an ARM Cortex M4 microcontroller. Since sensors that measure alcohol content give analog resistive output, it was attached to the microcontroller using an analog-to-digital converter unit. 14,400 samples were included in the massive amount of data that was gathered and saved as a CSV file for the studies. Following a uniform division into in-vehicle with alcohol and out-of-vehicle without alcohol, these test results were then used to create a balanced dataset that would make the research and modeling easier. This system's software module consisted of a Supervised Machine Learning problem that was created as a classification system employing Shallow Neural Networks and the modules and algorithms that were specific to it. They arbitrarily divided the dataset into a number of folds for the purpose of data cleaving and distribution, with each fold consisting of 70% of the dataset for training and the remaining 30% for testing. There was a 5-fold cross-validation operation. By averaging the results of the five experiments, the overall performance was generated. Five essential performance indicators were used to evaluate this system. These five indicators include the Binary confusion matrix analysis, predictive accuracy, harmonic predictive average, predictive kappa index, and predictive time. This paradigm includes a computational intelligence model, which necessitates the use of extremely powerful computers for both the implementation and experimental phases.**[4]**

The research and statistics cited in the article are from Nigeria. According to the WHO, more than 1.25 million people died on the roads in 2013. Here, the calculation of the driver's blood alcohol content (BAC) determines whether or not driving is considered safe. The prototype was developed using an ATmega328 microcontroller, DC motor, buzzer, and MQ-3 alcohol sensor. The embedded software dwells on the Arduino board, while the hardware implementation is emulated using the Proteus VSM emulator. Depending on the driver's level of intoxication, certain activities are completed in each step. Green and red LEDs display the engine's status. The buzzer notifies the passengers. The microcontroller and a DC motor are used to explain how the car engine works. The engine won't start if the alcohol content is over 40%. The microprocessor examines the analog values of the sensor, which must be greater than 2 volts, up to the predetermined limit; if they don't match, the microcontroller will stop.**[5]**

The subject matter of this paper seeks to improve both general public safety and, more specifically, road safety. The Arduino Uno, which is based on the ATmega328P microprocessor, is utilized because of its large open-source community and inexpensive price. The MQ-3 sensor, which makes use of SnO2-sensitive material, provides an analog resistive output that is influenced by the amount of alcohol present. GPS and GSM modules are employed to determine the whereabouts of a person who has been found to be severely inebriated. The motor and buzzer are connected to the BC547 transistor, which makes up the driver IC. Last but not least, the 16X2 LCD is utilized to broadcast alarm messages to the passengers and other riders of the vehicle, instructing them to take precautions to ensure their safety.**[6]**

According to this research paper, a police breathalyzer that is more efficient is meant to prevent drunk drivers from operating motor vehicles. By using this breathalyzer to check for blood alcohol content (BAC), road accidents that are frequently caused by careless driving are reduced. To assess the blood alcohol content of the car driver, a 16F877A microcontroller is interfaced with an MQ2 alcohol gas sensor in this simplified breathalyzer. Using the keypad on the microcontroller, the breathalyzer's threshold value is set to 400 BAC. If the value the system detects is lower than the threshold value, it will transfer control to the motor and start the car. In the event that the sensed value exceeds the threshold value, a buzzer sounds, the BAC value is displayed on the LCD screen connected to the microcontroller, and the automobile won't start. If the vehicle is moving and the BAC level is high, the microcontroller sends a signal to the L293D motor driver instructing the motor to stop the vehicle.**[7]**

The results of this study suggest that iris scans of the driver can be used to assess their level of intoxication. Additionally, iris identification algorithms are created, and the Gabor Filter is used in their implementation. When the driver logs into the system using his or her credentials via the Graphical User Interface (GUI), an infrared-light-capable Charge-coupled device (CCD) camera is utilized to take photos of the driver's iris. The driver must first select the Recognition Process button before the iris photos may be processed to assess the driver's level of intoxication. This transforms the analog iris photos into digital images that the MATLAB program may utilize to differentiate between pupil diameters before and after consuming alcohol. The microcontroller then decides whether to start the automobile if the system finds that the driver is intoxicated or not. There is another way to avoid facial recognition if the pupil photographs don't work. The driver's eye and the device's CCD camera need to be close enough to one another in order for the device to capture superior iris images with less noise and reflection. This is one of the project's limitations. The camera has to be able to observe more of the driver's iris pattern in order to increase accuracy. The driver must shift their eyes properly while taking the photo in order to position their iris properly for a better charting of the whole image of their iris.**[8]**

According to this research report, a study on drunk drivers was done to see how drinking affected their ability to drive. 25 drivers with an average age of 25 and at least three years of driving experience are considered for this study. These drivers had to operate AutoSim driving simulator systems for the study, which took the risks of drunk driving into account. The stimulator setting was designed to be as close as feasible to really drive a car. The drivers were given a variety of driving circumstances, including urban straight roads and some curved roads. The blood alcohol levels of the drivers were measured using a detector owned by the Beijing traffic police while they were running their cars at varying blood alcohol levels. The BAC level was assessed five times for each test to minimize measurement errors. According to the results, 60% of the drivers were more courageous, 68% were driving faster, 88% were less vigilant, 84% were paying attention to something else while driving, 64% thought the speed they were traveling at was slower, 72% were losing their sense of direction, 84% were lacking in judgment, 72% were unable to control the direction of the car, and 84% were losing their ability to react to circumstances as they were escalating.**[9]**

A study on drunk drivers was conducted with different alcohol dosages to examine the effect on steering habits when driving on curved roads. Alcohol can impair a driver's ability to steer while they are operating a vehicle, which can result in collisions. The following article makes a point of citing material from other articles about the impact of drinking alcohol on driving behavior. 25 male drivers between the ages of 20 and 35 who had at least three years of driving experience were supposedly recruited for this study. A simulator that was built with a realistic design was used to do research on the risks associated with drunk driving. At several points during the trial, the driver's Breath Alcohol Concentration (BrAC) was monitored. There were several scenarios available for the drivers to navigate in the simulator. There were some straight roads and curved highways of varied radii that bent both left and right. The following variables were taken into account when compiling data for the study: the vehicle's speed prior to curves, its speed on straight roads, the number of collisions that occurred while driving around curves, the steering speed, the steering angle, the rate of steering reversal, and the peak-to-peak value of the steering angle. The researchers found that the consumption of alcohol by drivers affected their steering speed, steering angle, steering reversal rate, and peak-to-peak value of the steering angle. Along with the increase in BrAC levels, these metrics also increased. The high BrAC level had a similar effect on the number of lane offenses per kilometer. Higher steering speed, steering angle, steering reversal rate, and peak-to-peak values of the steering angle were seen in smaller curves at the same alcohol content.**[10]**

III. Working Principle

The prototype is designed to detect alcohol concentration in the vicinity of the driver and take appropriate actions to alert both the passengers inside the vehicle and the surrounding vehicles. The system utilizes several components and mechanisms to achieve this goal. The primary trigger for activating the alert system is when the concentration of alcohol in the driver's breath exceeds a given threshold. This threshold is likely set to a legally defined limit, i.e., the maximum permissible alcohol limit for driving. Once the threshold is crossed, the system initiates the alert sequence. The alert system consists of a buzzer and LED lights, which serve as indicators. These indicators are analogous to the parking indicators of a vehicle. By using these existing visual and auditory cues commonly found in vehicles, the prototype ensures that the alert is recognizable to other drivers and pedestrians. To provide a visual alert to surrounding vehicles, parking indicators are utilized. The prototype gradually reduces the speed of the vehicle by gradually decreasing the RPM (Revolutions Per Minute) of the DC (Direct Current) motor. This gradual reduction in speed helps to avoid sudden or jerky movements, minimizing the risk of collisions. In order to take further precautions and notify emergency contacts, the system incorporates a Bluetooth module called HC-05. This module enables communication with a mobile application. When alcohol is detected, the system uses the Bluetooth module to establish a connection with the mobile application, allowing it to send alerts and notifications to preconfigured emergency contacts. These contacts can then be informed about the situation and take appropriate actions, such as contacting authorities or providing assistance.

Overall, this prototype system combines the use of parking indicators, gradual speed reduction, visual alerts, and auditory cues to effectively notify passengers and surrounding vehicles about the presence of an intoxicated driver. Integrating a Bluetooth module, also ensures that emergency contacts are promptly informed, enabling them to respond appropriately and take necessary action.

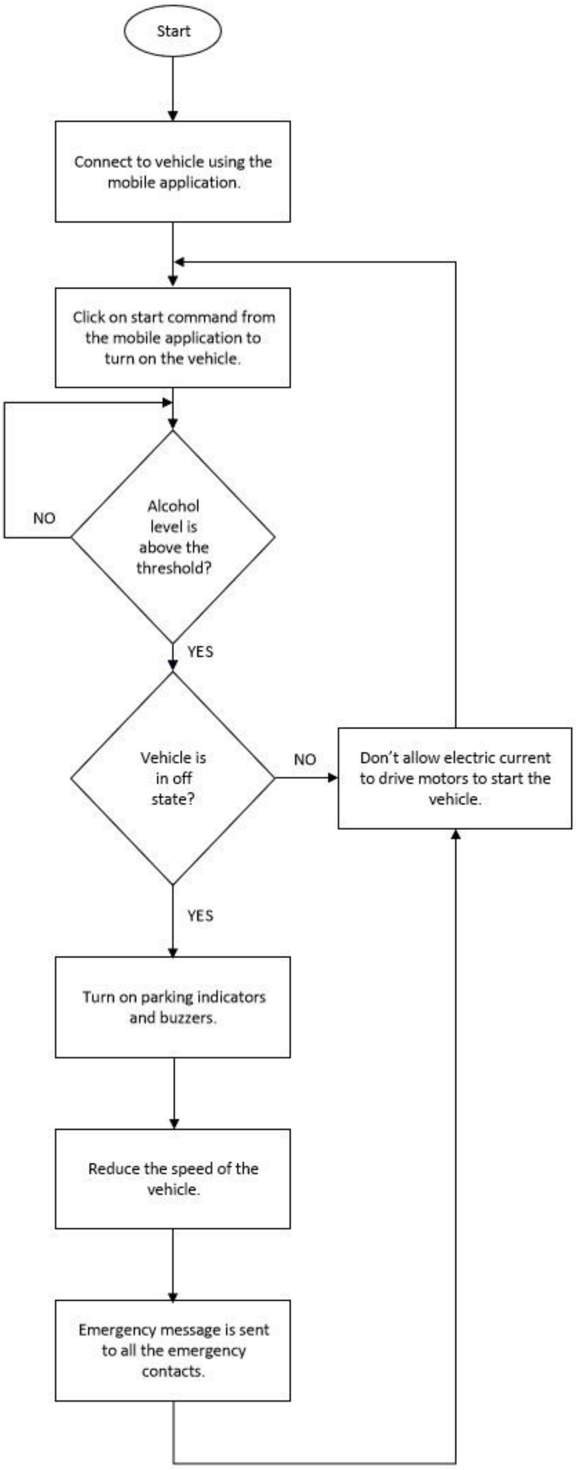

Figure 1: Workflow of the prototype

IV. IMPLEMENTATION

The Alcohol Detection and Control System utilizes an MQ3 sensor, which is a highly sensitive device designed specifically to detect the presence of alcohol in the immediate vicinity. As soon as the Arduino board is powered on, the MQ3 sensor begins its operation, continuously analyzing the air for any traces of alcohol. This real-time detection capability ensures that the system is always actively monitoring potential alcohol-related risks, providing a proactive and robust safety measure. To establish seamless communication between the user and the Arduino board, the system incorporates a Bluetooth module HC-05. Through the mobile application, the user can log into their account, securely connecting with the Arduino board. This login process establishes a personalized connection, enabling the user to access and control the system's features conveniently from their mobile device. Before the driver can start the car and activate the alcohol detection system, they are required to create an account within the mobile application. This account creation process involves providing their personal information, such as username and password, and adding an emergency contact. By doing so, the system ensures that crucial information is readily available to promptly notify designated individuals in the event of alcohol-related incidents. This feature adds an extra layer of safety and enables quick response and appropriate actions to be taken in emergency situations.

When the driver attempts to start the car, the alcohol detection system is automatically activated, initiating continuous monitoring for the presence of alcohol in the surrounding environment. If the alcohol level detected exceeds the predefined threshold, indicating that the driver is likely intoxicated, the system prevents the DC motor responsible for starting the car from activating. This safety mechanism acts as an immediate and definitive warning to the driver, indicating that it is unsafe and illegal to proceed with starting the car while under the influence of alcohol.

Conversely, if the alcohol level in the environment is below the set threshold, the car can start normally, indicating that it is safe for the driver to proceed. However, if the driver consumes alcohol while the car is already in motion, the alarm system is triggered. The alarm system consists of a combination of a buzzer and LED lights, working synergistically to produce both visible and audible alarm notifications. This dual-alert system is designed to capture the attention of the passengers inside the car and other vehicles on the road, effectively warning them about the potential danger posed by an intoxicated driver and prompting them to take appropriate actions. To ensure the safety of everyone involved, the system takes further action when the alcohol detection system is activated while the car is in motion. It progressively reduces the speed of the DC motor, gradually bringing the vehicle to a controlled stop. This gradual deceleration provides a smooth and controlled transition, minimizing the risks associated with sudden stops and allowing the driver to safely maneuver the vehicle to the side of the road or a designated stopping area. This feature significantly reduces the potential for accidents or harm caused by an impaired driver.

In addition to its primary alcohol detection and control features, the mobile application offers users a range of additional functionalities. Users can manage their emergency contacts within the app, including the ability to add, delete, and view these contacts. This feature allows users to easily maintain an up-to-date list of emergency contacts who can be promptly notified in the event of an alcohol-related incident. This ensures a quick and coordinated response, with designated individuals receiving immediate notifications and information to take appropriate actions. Whenever alcohol is detected in the immediate vicinity, an "Emergency" message is immediately sent to the mobile application. This urgent notification serves as a direct alert to the driver, conveying the presence of alcohol and emphasizing the importance of refraining from driving. Simultaneously, the system automatically sends SMS messages to all of the driver's registered emergency contacts. These messages include crucial information about the situation and their location which strongly encourages the contacts to take immediate and appropriate actions, such as contacting the driver or notifying relevant authorities. This comprehensive notification system ensures that all necessary parties are promptly informed, facilitating a coordinated response to the situation.

The Alcohol Detection and Control System provides a comprehensive and proactive approach to enhance safety and promote responsible behavior while operating a vehicle. With its advanced alcohol detection, control, and alarm functionalities, combined with the user-friendly mobile application for interaction and emergency contact management, the system aims to prevent alcohol-related accidents, protect the well-being of drivers and passengers, and contribute to creating a safer road environment for all road users.

V. RESULTS

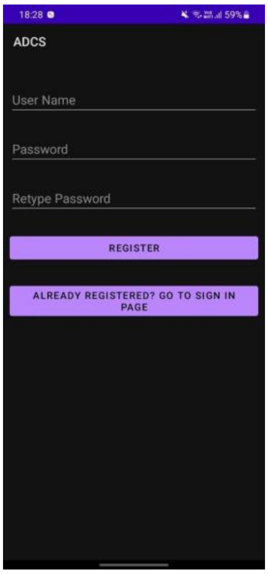

Figure 2: Registration of a new user

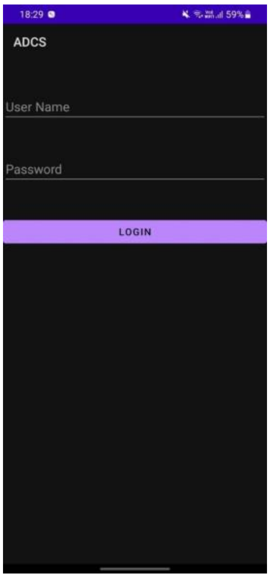

Figure 3: Login using the user's credentials

The User Interface (UI) of the mobile application ADCS provides a convenient and user-friendly way for individuals to interact with the application. One of the key features of the UI is the ability to register as a new user or log in using existing credentials. For individuals who are new to the application, the registration process is mandatory. Once registered, users can easily log in to the mobile application using their credentials. This login process verifies their identity and grants access to the features and controls of ADCS. By logging in, users can interact with the application's various functions, which include even turning on the vehicle.

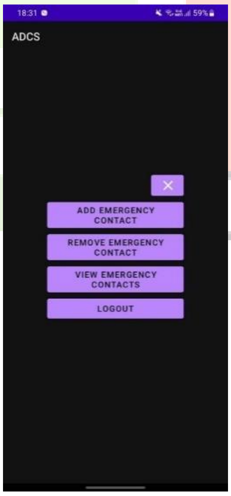

Figure 4: Features of the app ADCS

The mobile application described provides several functionalities related to managing emergency contacts for a driver. These functionalities include adding, removing, and viewing emergency contacts, as well as a logout feature to support multiple users on a single device.

1. Adding Emergency Contacts: This feature allows the driver to add one or more emergency contacts to their profile. By adding multiple emergency contacts, the driver ensures that there are several people who can be notified in case of an emergency.

2. Removing Emergency Contacts: This functionality allows the driver to modify their emergency contact list by removing specific contacts. If the driver's circumstances change, or they no longer want a particular contact to be notified in case of an emergency, they can simply remove that contact from their profile.

3. Viewing Emergency Contacts: This feature enables the driver to view the complete list of their emergency contacts. By accessing this section, they can verify and confirm the details of all the individuals who would be notified during an emergency situation. It provides an overview of the emergency contact list of the driver.

4. Logout Feature: The application includes a logout functionality that allows the current user to log out from their account. This is particularly useful when multiple users need to access the application from a single device. By logging out, the driver can ensure that their personal data and emergency contact information are not accessible to others who may use the same device.

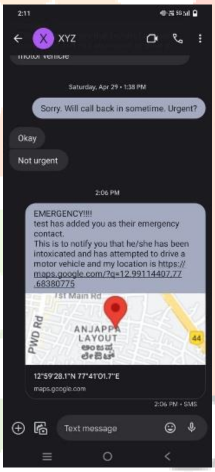

Figure 5: Alert SMS sent to the emergency contacts

The MQ-3 sensor is a gas sensor that is specifically designed to detect the presence of alcohol vapor. It can be used in various applications, including breathalyzer devices or alcohol detection systems. When the driver exhales or there is alcohol vapor in their immediate vicinity, the MQ-3 sensor detects it and provides an output signal indicating the presence of alcohol. The Bluetooth module HC-05 is a commonly used module for wireless communication. In this system, the HC-05 module is employed to establish a connection between the alcohol detection system and the driver's mobile phone. This module allows data transfer between the system and the mobile phone via Bluetooth. The system utilizes the mobile phone's SMS capabilities to send an alert message to designated emergency contacts. The alert message would typically include information about the driver's intoxication status and current location. The detection of location can be achieved through the means of GPS (Global Positioning System) or by utilizing the location services provided by the mobile phone. The system retrieves the current location data and includes it in the alert message.

VI. Advantages

- The system incorporates components that are reliable and robust, ensuring a high degree of stability in its operation.
- The system is designed to be energy-efficient, utilizing minimal power resources to carry out its functions effectively.
- The driver's emergency contacts are promptly informed in case of imminent danger or alcohol-related incidents, the system utilizes SMS notifications.
- The alcohol detection system is designed to operate continuously even while the car is in motion.
- It gradually slows down the vehicle's speed until it comes to a complete stop in a controlled manner. This progressive deceleration helps maintain stability and safety, allowing the driver to safely maneuver the vehicle to the side of the road or a designated stopping area.
- By integrating the system into vehicles at the time of manufacturing, the installation becomes more streamlined and efficient.

VII. Applications

- Collaborative effort with manufacturers ensures that the system can be seamlessly incorporated into new vehicles, offering enhanced safety features right from the start.
- The target market for the Alcohol Detection and Control System includes various stakeholders in the transportation industry. Taxi services, such as traditional taxi companies or ride-sharing platforms like Ola, Uber, and Zoom, can benefit from this technology to enhance passenger safety and mitigate risks associated with drunk driving.
- Car rental companies can also consider implementing this system to ensure responsible usage of their rental vehicles.
- Owners of various types of commercial vehicles, such as trucks or delivery vans, can find value in integrating this technology to promote safe driving practices among their drivers.

VIII. Future Scope

1. Artificial Intelligence (AI) Integration: Implementing AI algorithms and machine learning techniques can enhance the system's ability to detect and analyze alcohol presence. AI can help improve the accuracy of detection, enable more advanced pattern recognition, and adapt to changing environmental conditions, making the system more reliable and effective.
2. Cloud Connectivity and Data Analysis: By incorporating cloud connectivity, the system can securely transmit data to a centralized server for further analysis. This allows for data monitoring, trend analysis, and identification of patterns or areas of concern. It can also facilitate real-time alerts and notifications to relevant stakeholders, such as law enforcement agencies.

IX. Conclusion

Statistics show that a significant number of drinking and driving incidents involve individuals who are under the legal drinking age. By implementing the system, particularly in vehicles commonly used by young drivers, such as private cars or college transportation, the system can play a crucial role in preventing underage drinking and driving. The system's ability to detect alcohol and prevent the vehicle from starting if the threshold is exceeded acts as a deterrent for young drivers to engage in risky behavior. By targeting this specific demographic, the system aims to promote responsible decision-making and reduce the occurrence of drinking and driving incidents among minors, ultimately protecting their lives and the lives of others on the road. As technology advances and societal needs evolve, the Alcohol Detection and Control System can be continuously improved and refined. Ongoing research and development can lead to advancements in sensor technology, detection algorithms, and overall system performance. Moreover, feedback from users, drivers, and other stakeholders can contribute to the system's improvement. By actively seeking and incorporating user feedback, the system can be refined to better meet the needs and expectations of the target audience. This iterative approach ensures that the system remains relevant and effective in addressing the ever-changing landscape of drinking and driving prevention.

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