Alcohol-Triggered Accident Detection and Alert System with GSM, GPS, ESP32 Integration

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Abstract: The new invention of Alcohol-Triggered Accident Detection and Alert System with GSM, GPS, ESP32 and utilizing ThingSpeak is a major step forward in road safety. This system uses an Arduino UNO board for data collection and management, an MQ-3 Alcohol Detection Sensor for measuring the alcohol concentration in the driver's breath, a collision sensor for detecting an accident, a GPS module to track the vehicle's location in real-time, and a GSM module for immediate remote communication. In case the alcohol level rises beyond the permissible limit or an accident happens, the system immediately initiates SMS notifications with the location of the car to the emergency services and the specified authorities. Further, the ESP32 module sends the data to ThingSpeak in real-time to monitor and analyze the driving behavior data. This interaction factor does not only contribute to the real-time response but also contributes to the systematic data compilation for better future road safety planning. Initial findings demonstrate the system's high reliability and responsiveness, promoting safe driving practices and supporting the goal of reducing road fatalities.

1 INTRODUCTION

Alcohol related incidents are considered to be one of the main road traffic safety concerns that are always associated with high risk of causing serious injuries or even demise. Related with eating is drinking and driving which reduces the capacity of observing events on the road, reduces decision making capacity and in- creases the possibility of an accident on the road making it a vital issue to consider on the road. The seventh season is devoted to such important problems as the present days technological progress can contribute to the improvement of many spheres of human life including the questions connected with road safety. In responding to this major issue, the proposed Alcohol- Triggered Accident Detection and Alert System with GSM, GPS, ESP32 Integration, and ThingSpeak Integration is one of the promising solutions to develop the road safety innovation.

This system involves the use of Arduino UNO Board for acquiring the data and regulating the processes of the system, MQ-3 Alcohol Detection Sensor for determining the alcohol level in breath of the driver, Collision Sensor for measuring an accident, GPS Module for the real-time location and GSM Module for immediate remote connectivity. In the event that the levels of alcohol are high or an accident occurred, the system immediately sends Standard SMS messaged containing the vehicle's location to the police and other contacts as may be tendered. Moreover, the collected data from the sensors are sent using the ESP32 module to ThingSpeak for real-time streaming and analysis of the driving behavior.

This solution does not simply improve the ability to respond to current incidents but also fosters the gathering of data for future road safety planning. From the perspective of meeting society's needs, the system assists in enhancing safe driving and ensures law violation penalties are meted out, reducing the rate of fatal road accidents. Preliminary results prove a considerably high level of the system's reliability and response speed; therefore, it can be stated that the de-signed system could act as an efficient solution aimed at enhancing the general standards of road safety.

The structure of this paper is as follows: Section 2 conducts a comprehensive review of related works. Section 3 tells us about the hardware requirements for the model. Section 4 discusses the methodology used.

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Section 5 gives a brief idea of all the algorithms used. Section 6 offers a thorough view of the results. Finally, Section 7 concludes the paper with future scope.

2 LITERATURE REVIEW

This section has conducted a thorough survey to understand the recent approaches towards the alcohol triggered accident detection system. The pr is about implementing a system for the Accident Alert and Vehicle Tracking using GPS and GSM. This system informs the patient's people directly and gives them the GPS instructions on how to get to the hospital. It comprises of the crash, impact, piezoelectric sensors and MEMS which are used to sense crush (Mounika., 2021) When the accident is noticed, the microcontroller sends a signal, which is transmitted to the GPS unit, which in turn, is connected with the GSM module, and so the driver is located and the authorities and registered contacts are informed. Besides, the system is also able to signal the vehicle's current location via SMS when it is tampered with (Vashista, B., 2021). The team developed "Vehicle Accident Location Tracking System Using GSM and GPS" informs the emergency services about accidents which results in the dispatching of alerts to the registered numbers through GPS and GSM modules which are triggered by the impact sensors. This system enables tracking in real-time, helps in the cases of theft and other emergencies and therefore, the first-aid services can respond fast and this might even save some lives (Chandra., 2023).

The team demonstrated a GPS/GSM logger system that is suitable for the detection of violations of speeding and accidents. Through the use of an impact sensor, piezoelectric transducer, and accelerometer, the device finds the collisions and the exact location of the crash by GPS. The GSM module sends SMS alerts to predefined contacts; thus, the contact can get the message and respond at once. The system moreover identifies stolen cars, sending GPS, latitude and longitude, and a Google Maps link via SMS. This technology is designed to be a life-saver by guaranteeing quick emergency reactions through accurate location data (Kumar., 2023). The project is about creating a Road Accident Alert System by the means of GSM communication. This system, having a GPS module, sends the messages for the driver and the emergency services during the emergency accidents. Decelerometers detect the collision signs, and thus, the already set-up GPS location data is used to alert the person. The school is designed to cut down the dispatch times and to increase the location accuracy, hence saving lives. Besides, the Green Powered Fuel cells which are used in this system are low maintenance cost and are easy to install in several vehicles (Suhas., 2023).

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The paper proposed a system which is based on the use of the high-efficiency components which are efficient in the implementation, and therefore, the attempt to reduce the drunk driving accidents, in the city is well implemented. Data collection is of great significance, the one that enables us to get the results of traffic safety surveys as well as the updates of the system functionality used for policy formulation (Pradeepkumar, G, 2023). The team underline the ignition lock system that is activated by alcohol sensors, thus, they manage to stop drunk drivers by preventing the car from starting, if the driver's breath contains alcohol above 0.08 percent. This system is a very important tool of prevention that by means of provoking the driver by eliminating the driver vision it ensures that the car is immobilized when alcohol is detected in the driver's breath (Vaishnavi, T, 2023).

The team analyze a pattern intended to decrease the dangerous and significant increase in accidents and fatalities as a result of drunk driving. The implementation of this system will, of course, lead to the saving of many lives and the prevention of many injuries by successfully keeping the drunk drivers away from the highway. Besides, the projected cost-efficient, user friendliness and reliability of this blockchain-based system could, in turn, decrease the issues of drunk driving that are already present (Suresh, S, 2023) The team studied a car system

which is meant to boost driver security by means of detection of the alcohol level. Their research highlights a vital system development, the system that is very small, self-installing and continuously sending data through the blockchain to the blockchain itself. This system not only reminds drivers about alcohol levels but also promotes safe driving practices, thus, making its simplicity, flexibility, and safety features the foundation of credibility and reliability in preventing drunk driving cases (Sinha, A., 2023). Kumar et al. 's research is centered on increasing sensor sensitivity by including silver nanoparticles, which leads to an improvement in the performance of diagnosing and monitoring contaminated water or environments. The Fiber Bragg Grating is combined with silver nanoparticles; therefore, it can be improved in water quality sensors and it can be used for other medical purposes as well as the environment (Kumar, 2023). Ajagbe and his team focused on the creation and evaluation of the same system that makes it possible for us to recognize drunk driving with the help of the virtue devices. Through this work, the designers, the implementers will experience the various stages ranging from the design stage to the testing phase. The drastic changes that the system is making in the road safety will be the main focus. The virtual instruments usage in such a situation can be seen as a true representation of the modern era and a possibly efficient way of solving the problem of drinking and driving. This type of research could really be used to make a huge contribution in the field of drunk driving detection systems and a new method for alcohol level detection in drivers could be created. The main concept of the research might be utilized in the creation of efficient ways to ensure road safety and reduce, which are widely spread among alcohol impaired drivers (Ajagbe., 2023). Das et al, and others developed a solution to prevent drunk driving by measuring the blood alcohol level. This new system improves road safety by blocking the impaired drivers from starting their vehicles, thus, showing how technology can be used to reduce the ones requiring the risks of driving under the influence. The study underlines the vitality of the introduction of such innovative technologies to first of all, the safety and then the reduction of the road accidents influenced by the drunk drivers (Das., 2023) Upender et al. suggested a system that can be used for accident prevention involving Arduino and Eye Twitch and Alcohol sensors which can detect the driver's impairment in real-time. Through the observation of disciplines like eyebrow movements and alcohol concentration, the system intends to lessen the number of road accidents by alerting the impaired drivers and in the same time, it is promoting the safer driving habits (Upender., 2023).

Hyder G et al, and the others, have introduced to the world the Smart Automobile (SAM) application, which is a combination of drowsiness detection, alcohol monitoring, vital sign tracking, and lane-based auto drive features that will in the end make the highway safer and reduce the number of accidents. The holistic idea which is the basis of the problem (Hyder G, 2020). Tushaar et al, and others introduced a new way of finding the unsafe driving behavior by using the IoT technology. This system tracks the real time parameters that let us identify the dangerous driving practices, thus it sends the alerts and interventions in time and thus the roads become safe.

Their studies in turn have a great impact on the intelligent transportation systems, which is the proposed way to solve the problems caused by unsafe driving (Tushaar., 2022).

Chaganti et al, and others presents a new approach that uses IoT technology for real-time accident detection and prevention. Their method of work will surely find out possible accidents, thus, the intelligent systems for accident prevention and road safety improvement become significant and should be looked into. Moreover, their research will be a step forward in the technological innovation to improve road safety. (Chaganti., 2023).

Sethuraman et al, and others presents the way in which IoT technology helps in the improvement of vehicle monitoring and safety. The system of IoT collects data on vehicle performance and driver behavior in real time and then gives insights to accident analysis and reconstruction. The research proves that the usage of IoT-based solutions would be very helpful in the improvement of vehicle safety and accountability through advanced data collection and analysis (Sethuraman., 2020). Kumar et al and others introduces a new way using smart sensors and communication systems to detect accidents in time. The system they are working on is designed to decrease the time of emergency response and to improve accident management, hence, it is possible to see the usage of smart systems for the transportation safety and their findings show that there are advancements in the accident detection and response mechanisms for the safer roads (Kumar., 2021).

3 HARDWARE REQUIREMENTS

The developed model for alcohol-triggered accident detection system and the hardware requirements needed to develop the above model are as follows

3.1 Arduino UNO

Arduino UNO, plays the role of the microprocessor to manage data acquisition processes from alcohol sensor, accelerometers, GPS and GSM modules. One of them works with the sensors' data input and applying algorithms predetermined in advance to measure alcohol levels and collision and other collision sensor for engine locking system. If it identifies an event such as alcohol level above the threshold and collision, it initiates the correct responses, including immobilizing the car's engine and sending out recall notifications.

Due to the modularity and flexibility of the device, it should be integrated into environments where real-time response is crucial in safety-conscious operations.

3.2 Alcohol Sensor

MQ-3 Alcohol Sensor is an integral element for probing the breath alcohol content in the driver. This is highly sensitive to the alcohol vapor and will give correct measure of the percentage of ethanol in air.

Due to alcohol influence, when the level is over the legal limit, the sensor delivers a signal to the Arduino UNO to lock the engine and set an alarm. The accuracy and dependable of this sensor are significant in reducing the incidences of drunk driving thus improving the safety of drivers on the roads.

3.3 Collision Sensor

Collision sensors measure abrupt changes in the vehicle motion that signal crash occurrence. This consists of continuously measuring the vehicle's acceleration in all three axes and triggering the Arduino UNO whenever there is a large impact. This it causes the system to invoke an emergency mode, and which sends out notification messages with the location of the vehicle. Also important is the ability of the collision sensor to promptly and accurately alert of the accident for prompt and appropriate reaction.

3.4 GSM Module

GSM Module 900A provides the system with the ability to send out text messages to contact emergency services and any persons that the system may wish to inform in case of an emergency. There are signs, for instance, an alcohol level beyond the permissible limit or an accidental situation, the module receives signals from the Arduino UNO to issue alert messages. Such messages contain data important for the responder, like the position of the vehicle and the type of event that has occurred. The GSM Module 900A's connectivity hence guarantees timely and efficient notification, emphasizing the key importance of timely response to disasters and emergencies.

3.5 GPS Module

GPS module plays a critical role where it assists in the tracking of the real-time location of the vehicle. To ascertain the exact latitude and longitude coordinates of the car's location, it utilizes satellites. If an incident occurs the GPS module provides geolocation data that can be incorporated as part of the message to be sent to the outcry contacts. This comes in handy when it is time to dispatch help because the GPS technology makes it easier to pin point where the vehicle is located thus boosting the chances of giving the needed help on time.

3.6 ESP-32 Module

ESP-32 module is used for data transmission by connecting the da sensor and ThingSpeak platform in real time. It also maintains continuously monitoring and which improves the function of the system. This real-time data streaming feature makes it easy to intervene and also gather more data in preparation for additional road safety enhancement in the future.

4 PROPOSED METHODOLOGY

The proposed methodology for alcohol-triggered accident detection system is showcased in Figure 1, and explained in detail in the following subsections.

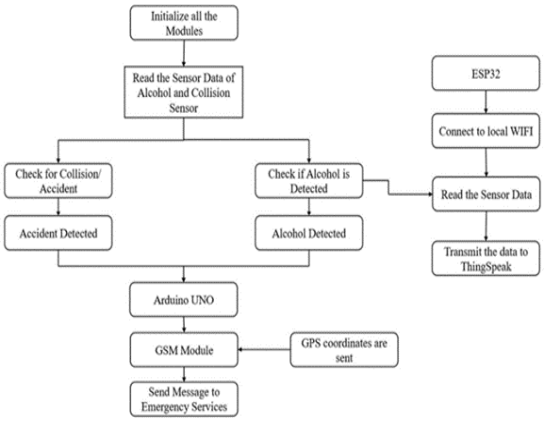

Figure 1: Proposed Methodology for Alcohol-Triggered Accident Detection System.

4.1 System Initialization

The process of powering up which involves activating all the sensors which includes but not limited to the Arduino UNO, MQ-3 Alcohol Detection Sensor, Collision Sensor, Global Positioning System, Global System for Mobile Communications, and ESP32. Each one of them is set up to monitor and integrate with other modules as required in its functioning. The ESP32 module is interfaced to the local WIFI network to ensure continuity in a data transfer process at ThingSpeak.

4.2 Sensor Data Acquisition

The system thus, retrieves data from the MQ-3 Alcohol Detection Sensor and from the collision sensor with the data concerning the level of alcohol in the blood of the driver and possible accidents at any given time. This data is then sent to the Arduino UNO where the data is processed and appropriate action is initiated based on the particular instruction. The integration of such sensors offers confidence to the tracking of important events that may require an adequate and prompt response.

4.3 Accident Detection

With the collision sensor, the system constantly checks and waits for a collision though it employs other parameters which may include sharp jolts or jerkiness that may point to an accident. In this case, the sensor produces a signal that needs to be interpreted by the Arduino UNO, in order to react according to the set emergency response strategy. This entails capturing the GPS coordinates of the vehicle and send an SMS alert comprising of any relevant information through the GSM module. These instant notification procedures help in providing quick response and support, which at times could be fundamental in saving a life in emergency conditions.

4.4 Alcohol Detection

There is a presence of a sensor MQ-3 Alcohol Detection Sensor which constantly measures the driver's breath alcohol level. In the case when the sensor de- fines the level of alcohol secretion higher than the threshold value, the Arduino UNO analyses this data and triggers an alarm.

This alert makes the system to send an SMS text message with the vehicle's location to the emergency services as well as the contacts that have been identified. This mechanism ensures there is immediate action is taken, which may likely reduce cases of alcoholic induce mishaps on the road.

4.5 Data Transmission to ThingSpeak Using ESP32

The ESP32 module is of particular importance when it comes to sharing the sensor data with the ThingSpeak cloud. Through Wi-Fi access, the ESP32 mean that data from the alcohol and collision sensors is streamed in real-time to the local WIFI network. This constant transfer of data helps track the behavior and patterns of drivers on the roads continuously, and therefore used to address upcoming future road safety strategies.

Use of ThingSpeak also helps augment the capacity of the existing system and enhance the effectiveness of giving a better outlook on the risky regions of the roads.

5 ALGORITHMS USED

5.1 GSM Module

Initialize GSM 900A() check network availability() send("AT+CMGF=1") if accident detected() or alcohol detected(): coordinates = get GPS coordinates() send SMS("Alert! Location: " + coordinates).

5.2 GPS Module

Initialize GPS() while not gps signal available(): check gps signal() if accident detected() or alco- hol detected(): coordinates = get GPS coordinates() format and send alert(coordinates).

5.3 ESP32 Module

Initialize ESP32() connect to WIFI(ssid, pass- word) initialize ThingSpeak() while True: if accident detected() or alcohol detected(): coordinate = get GPS coordinates() send data to ThingSpeak(coordinates, sensor data) delay(interval).

6 RESULTS AND DISCUSSION

The developed model proves that both alcohol detection and collision sensing are integrated highlights that there has been a positive advancement on im- proving road safety. The system blocks the

engine of the vehicle when it analyses alcohol concentrations which is unlawful. In the case of presence of alcohol, the GSM and GPS are switched on by the system as described above. The GSM module makes a request for the longitude and latitude of the vehicle which is implemented through the Global positioning system (GPS). This will ensure that any information on the real-time tracking produced by the tracking device is conveyed to the concerned parties on the intended lo- cation of the vehicle.

In practical tests, the device of detecting alcohol gave the correct result in raising the higher amount of alcohol in the driver's breath which activated the lock of engine immediately. This automatic response helps to reduce the potential for accidents that stem from driving while under the influence. Then the GSM module electronically transmitted, through an SMS, the position of the vehicle to the pertinent individuals. This capability entails that operations of the emergency services can be coordinated efficiently and responded to as they happen thus enhancing cost effective solution or prevention or incidents.

Moreover, in the context of simulations, the collision detection sensor was also implemented in a rather effective manner. The movement and impact sensors sensed abrupt variations to the motion of the vehicle and the active emergency procedure was launched. This included forwarding details of the accident and the current location of the car to the contacts that the car owner had listed. Another feature of the system is that it can identify not only the alcohol level but also collisions, thereby expanding the potential for improving road safety.

Figure 2: Messages sent by the Model when the accident and crash is detected in the car

In the Fig-2, the bottom figure shows the message when the Alcohol is detected and if it is more than the legal limits this is sent by the model. In the top shows the message when the collision sensor gets reading when it is being collided the message is sent by the model.

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In the Figure 2, the bottom figure shows the message when the Alcohol is detected and if it is more than the legal limits this is sent by the model. In the top shows the message when the collision sensor gets reading when it is being collided the message is sent by the model. Moreover, the ESP32 module has a significant function of transmitting data to ThingSpeak for immediate streaming and analysis of the driving behavior. The ESP32 module has been configured to upload data to the ThingSpeak by connecting to the local WIFI network; thus, yielding a thorough analytical insight. The integration with other types of data that focus on cars enables the purpose of identifying the most common driving patterns and the prevention of accidents in the future.

Figure 3: The Analysis of the readings of MQ-3 Alcohol Sensor in ThingSpeak

Fig.3, displays the graph related to alcohol readings over time as recorded by the system and trans- mitted to ThingSpeak. Notably, there are fluctuations in the alcohol levels throughout the day. Around 12:00, there is a significant peak in alcohol concentration, reaching above 0.1 (100 parts per million), indicating a potentially dangerous level of alcohol in the driver's breath. Following this peak, the readings show some variation but remain relatively high until approximately 16:00.

These fluctuations highlight the system's ability to continuously monitor and record real-time alcohol levels, ensuring timely alerts and interventions when dangerous levels are detected. When the model is compared, our system can be more effective than other studies in terms of alcohol detection while integrating it with accident detection, real-time car tracking and notification and the usage of ESP32 along with the integration of ThingSpeak makes our system unique. Systems developed earlier by the authors were confined to giving out alerts in case of accidental happenings using GPS as well as GSM, without addressing the problem of alcohol detection as a prelude to these alerts. Further enhancing the

idea, all these functionalities can be integrated into one system which is effectively tackling various aspects of road safety at once.

Thus, the Alcohol-Triggered Accident Detection and Alert System corresponds to the development of the road security topic. The features of the system, such as alcohol level identification, collision detection and, in real-time data reporting specifically target qualities that may lead to reckless driving accidents. About the future, more advancements could be seen in improving the sensors, observing the drivers' activities in real time, and connecting the smart car system with traffic signals. These enhancements would further encourage greater safety for the users and help in ticket prevention for unsafe driving leading to safer traffic flow.

7 CONCLUSION AND FUTURE SCOPE

In Conclusion, The Alcohol-Triggered Accident Detection and Alert System offers an advancement in road safety by incorporating alcohol detection, collision sensing capabilities, GPS tracking, GSM connectivity, and real-time data transmission through the ESP32 module and ThingSpeak. This sophisticated system prevents the car engine from operating when there is presence of alcohol above the defined limit and the vehicle can also phone the emergency services with position of the vehicle hence the probability of having an accident due to presence of alcohol is al- most negligible. This makes a significant difference in real-world circumstances and ensures higher levels of accuracy and reliability; improving safety by pre- venting hazardous events before they happen.

Further developments may turn to have machine learning mechanisms for the analysis of the sensor data and to understand the driving patterns to better identify risks and warn a driver in real time. Machine learning approaches could also improve the effectiveness of alcohol identification and collision sensing. These improvements would improve a personal safety and increase the rate of preventable events and general road safety.

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