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ORIGINAL CONTRIBUTION

DESIGN OF SMART ACCIDENT DETECTION AND PREVENTION SYSTEM USING IOT TECHNOLOGY

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ABSTRACT

To ensure effective communication and user engagement, the system provides intuitive interfaces for both emergency service providers and vehicle operators. Emergency services receive real-time alerts through dedicated applications or systems, enabling them to assess the severity of the incident and dispatch appropriate resources promptly. Vehicle operators can receive alerts or warnings for drivers, assisting them in making informed decisions and adapting their behaviour to mitigate potential issues.

The primary objective of the device is to detect accidents promptly and automatically alert emergency services for immediate response. It employs a combination of sensors such as accelerometers, gyroscopes, and GPS, WiFi module, receivers, which are integrated into vehicles or placed strategically along roadways. These sensors continuously monitor vehicle dynamics and environmental conditions, enabling the system to identify potential accidents based on sudden changes in acceleration, orientation, or location. Upon detection of an accident, the system initiates an emergency response protocol. It automatically transmits relevant information to the nearest emergency services, including the accident location, vehicle identification, and severity assessment. This enables rapid dispatch of medical aid, fire services, and law enforcement to the accident scene, potentially minimizing response time and improving chances of survival for those involved.

Furthermore, the system incorporates preventive measures to reduce the likelihood of accidents. It analyzes real-time data from multiple vehicles and identifies patterns or risk factors that contribute to accidents, such as aggressive driving behaviour, poor road conditions, or hazardous weather conditions. By collecting and analysing this data, the system can generate alerts or warnings for drivers, assisting them in making informed decisions and adapting their behaviour to mitigate potential risks.

KEYWORDS: IoT, Fire Detection, Fire Protection

1. INTRODUCTION

In this centuryThe incidence of road accidents has indeed increased with advancements in technology and motor vehicle manufacturing. This has highlighted the need for proper emergency facilities to improve the survival rate following accidents. Our concept aims to address this issue by developing system that detects accidents, determines their location, and communicates the information to the rescue team and the rider's emergency contacts. Additionally, there is a growing development effort for automated alcohol detection systems.

Sensor-based detection is the primary methodology for implementing the alcohol detection system. It is important for the

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system to have a high anti-interference ability to ensure accurate detection and alarm control. The main controller, acting as the brain of the system, will provide power, monitor inputs from various sensors, control output through circuits, and perform other necessary functions based on the appropriate code.

Innovation has led to more efficient accelerometers and diverse alcohol detection units with buzzers. However, the numerous additional features in these systems can make it challenging for consumers to evaluate and select the most suitable alcohol detector with an alarm for their needs. To address this obstacle, one approach is to educate consumers during the purchasing process, providing information on alcohol alarm performance systems. By the help wifi module we can clearly see the parametric value through IoT .This project aims to investigate and develop a prevention method for car accidents using alarm performance, providing valuable information to consumers.

Furthermore, it is crucial to emphasize the importance of installing car accident protection systems in all commercial buildings. By implementing such systems, we can enhance safety measures and reduce the impact of accidents on individuals and society as a whole.

2. Purpose

The main goal of our project is to prevent accidents caused by alcohol consumption and implement a rescue system using GPS technology to obtain the precise location of injured victims. By detecting accidents and promptly determining their location, we aim to communicate this information to the rescue team and the emergency contacts of the affected rider. By the help of Wi-fi module we can clearly see the parametric condition of the systems through IoT, this helps to monitoring the figure of the condition of the user

In India, a significant number of car accidents occur as a result of alcohol consumption. After an accident, it is crucial to provide immediate medical assistance to increase the chances of survival for the victims. By incorporating a GPS module into our system, we can quickly identify the location of the injured individual and ensure that they receive timely medical treatment.

This project intends to address the issue of alcohol-related accidents by leveraging technology to enhance safety measures. By detecting accidents and providing accurate location information to the rescue team and emergency contacts, we aim to expedite the provision of medical emergency services to the victims.

3. Literature Survey

These literature sources provide a comprehensive understanding of Accident detection and Prevention. They cover various aspects of this project, lighting systems, and energy management. By studying these papers, one can gain insights into the current state of the field, identify challenges and opportunities, and explore potential research directions for the development of Accident detection and Prevention system.

(I). "Real-time Accident Detection and Notification System using Arduino" (2017) by N. P. Patel, V. S. Kshirsagar, and S. M. Handore. This paper presents a real-time accident detection and notification system based on Arduino microcontroller and GPS module. The system detects accidents based on sudden changes in acceleration and orientation using an accelerometer and gyroscope. It then sends the accident location to predefined emergency contacts through a GSM

module. The authors conducted experiments to evaluate the system's performance and demonstrated its effectiveness in detecting accidents and notifying emergency services.

(II). "An Intelligent Accident Detection and Ambulance Rescue System using Arduino"

(2018) by N. D. Shaikh, K. M. Waghmare and M. N. Khan.

This research work proposes an intelligent accident detection and ambulance rescue system using Arduino Uno. The system utilizes accelerometers and GPS modules todetect accidents and determine the accident location. It facilitates quick response and rescue operations. The service implemented and tested the system, highlighting its efficiency in detecting accidents and improving emergency response time.

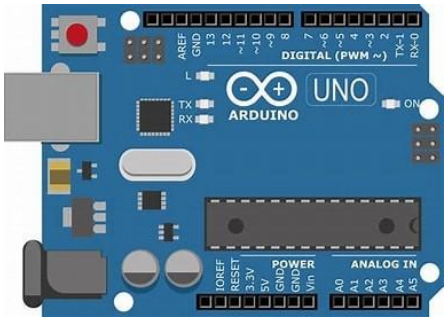
(III). "Arduino-Based Vehicle Accident Detection and Location Tracking System" (2019) by M A.I. Elkommos, A. Z. Gomaa, and M. A. Hossam-Eldin.

This paper presents an Arduino-based vehicle accident detection and location tracking system. The system integrates multiple sensors, including accelerometers, gyroscopes, and GPS modules, to detect accidents and determine the accident location. It employs an Arduino board to process sensor data and transmit accident information to emergency services via a GSM module. The authors conducted experiments to evaluate the system's accuracy and effectiveness in accident detection and location tracking.

(IV) Arduino interaction with esp32 Wi-Fi module by synthetic state YouTube channel it helps to setup the IoT function through this Wi-Fi module for the visuals and remote access activities like bulbs switch, LCD displays, alert sliders buttons in an app connected through Wi-Fi with the help of IoT.

4. Apparatus Required

- Arduino Uno R3:- The Arduino Uno is a microcontroller board based on the ATmega328P. It serves as the main control unit for the project, running the code and coordinating the operation of other components.



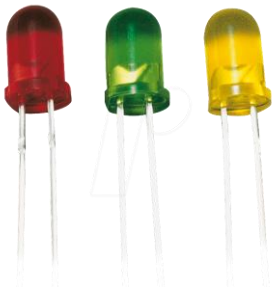
- Power supply:- The power supply provides the necessary electrical power to run the Arduino board and other connected components. It can be a battery pack, a USB connection, or an external power source.

- GPS Module:- The GPS (Global Positioning System) module is used to determine the precise location coordinates of the device. It receives signals from GPS satellites and provides accurate longitude and latitude data.

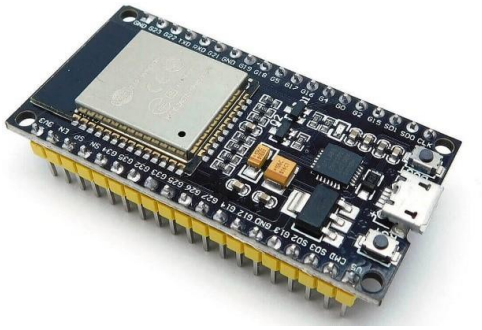
- MQ3 sensor-MQ3 sensor is a gas sensor which is designed to detect the presence of alcohol vapours in the air. It is commonly used to monitor alcohol consumption or the presence of alcohol in a specific environment.

- DC motors:- DC motors are commonly used for various purposes, such as actuating mechanical systems. In this project it is used to simulating the wheels of the vehicle or triggering for specific actions based on sensor inputs.

- LED:- Light Emitting Diodes(LEDs) are used to indicate specific states or provide visual feedback. They can be used to show the systems status, such as the activation of an alarm or successful sensor detection.



- ESP32 Wi-Fi Module:- ESP32 is designed for mobile, wearable electronics, and Internet-of-Things (IoT) applications. It features all the state-of-the-art characteristics of low-power chips, including fine-grained clock gating, multiple power modes, and dynamic power scaling. For instance, in a low-power IoT sensor hub application scenario, ESP32 is woken-up periodically and only when a specified condition is detected. Low-duty cycle is used to minimize the amount of energy that the chip expends. The output of the power amplifier is also adjustable, thus contributing to an optimal trade-off between communication range, data rate and power consumption.

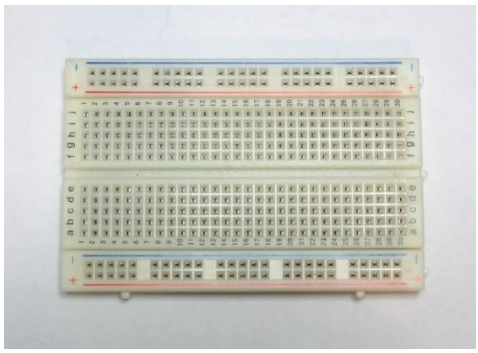


- MPU6050 Accelerometer:- An accelerometer measures acceleration forces , allowing detection of changes in motion and orientation. It can be used to detect sudden movements or impacts, which may indicate an accident.

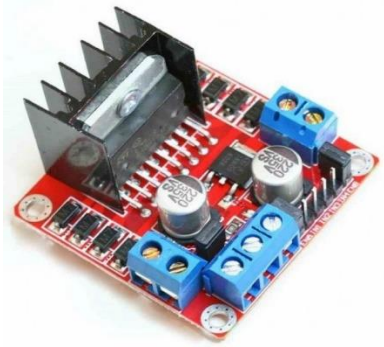
- Jumper Wires:- jumper wires are used to establish connections between different components on the breadboard or between the components and to Arduino board. They facilitate the flow of electrical signals.

- Alarm:-The alarm is a sound-producing device that can be triggered in response to specific events or conditions. In this project, it may be used to alert individuals or emergency services when an accident or alcohol detection occurs.

- Breadboard:-A breadboard is a prototyping platform used to create temporary electrical connections. It allows for easy experimentation and quick circuit assembly without the need for soldering.



- L298N Motor Driver :-L298N Motor Driver is full dual H-Bridge module which allows you to control the speed and direction of the two dc motors.



5. Flowchart

6. Working Principle

In this excellent module, the Arduino which acts as a centre of the system which receives various data inputs from the different sensors attached. The external power supply acts as a main source of power to the system to power the Arduino and the other related power supply. The working starts with the stating of the motor which replicates the engine of a vehicle in abnormal cases where the car meets an accident which in turn will activate the accelerometer sensor or the detection of alcohol sensor in our system which will detect the drunken state of the driver. In both the cases our engine will stop working and an appropriate message along with the coordinates of the vehicle will be sent to the driver's relative or centralized system which checks these data to send rescue team in cases of accident detection with the help of blynk IoT application, Along with that there will be a siren attached to let others know about the accident along with the flashing of led for easier locating the vehicle with that through Wi-Fi module node mcu we can see the parametric value detected by the sensors as a proof for investigation of exactly what happened like the drive was drunk or not ,vehicle crashed or met accident or not ,and gives location coordinates of the vehicle for the medical help.

After the completion the assembling the model, we can start the system.

Case 1:

When there is no accident or alcohol detection, the motor will be turned on, the alarm and green led will be on and lcd will clearly shows that the vehicle is safe and the motor will be continuing its motion without any interruption.

Case 2:

If alcohol is detected with a value higher than the normal threshold, the motor will stop, the

alarm will activate, and a message will be sent through the IoT esp32 node mcu including the current location and lc display will clearly shows that the driver is drunk , vehicle is in danger and the engine of the vehicle will be starting to slowing down and motor will be stopped automatically.

Case 3:

In the event of a vehicle crash or accident, the motor will turn off, the alarm will activate with a red LED, and a message will be sent to the application with the sensor ic values as well as the current location.

Case 4:

In the case somehow , if the car has met any collision by another vehicle or an obstacle or maybe just crashed at not drunk condition, then alarm will activate with a red LED, and a message will be sent to the lcd of the application that will clearly mention that the driver is not drunk and external collision has met, the after getting the location coordinates from gps module through with the help of IoT via ESP32 Node mcu, the user or driver will be medicated soon by rescued team for medical emergencies.

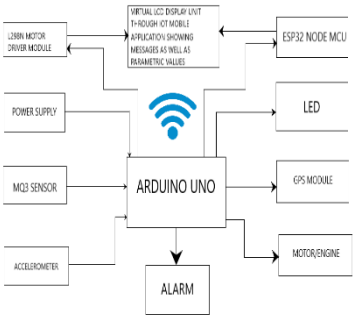
The main salient features for which working principle depends are:-

- Sensor Integration: The system incorporates sensors such as accelerometers, gyroscopes, collision detection sensors, and GPS modules. These sensors are connected to the Arduino microcontroller, which acts as the central unit.
- Acquisition: The sensors continuously monitor the vehicle's dynamics, including acceleration, orientation, and position. Accelerometers and gyroscopes detect sudden changes in acceleration or orientation that may indicate an accident. Collision detection sensors sense impacts or collisions. GPS modules provide accurate location data.
- Data Processing The Arduino microcontroller receives data from the sensors and processes it using appropriate algorithms. It analyzes the sensor readings to identify patterns or events that signify an accident. For example, a sudden change in acceleration beyond a threshold or a significant impact detected by collision sensors can trigger the accident detection process.
- Accident Detection:- Once the system detects an accident, it initiates a series of actions. It can activate an emergency alert mode and generate an alarm or alert signal to attract attention. Additionally, it records relevant accident data, such as the time, location, and severity of the impact.
- Emergency Notification :-The system uses communication modules, such as GSM (Global System for Mobile communication) or Wi-Fi, to transmit accident information to emergency services. It sends the accident location and other relevant data to predefined emergency contacts, such as ambulance services or law enforcement agencies. This enables swift response and assistance.
- Preventive Measures:- The system can also incorporate preventive measures to reduce the likelihood of accidents. By continuously monitoring vehicle behaviour and environmental conditions, it can identify risky driving patterns or hazardous situations. Based on this analysis, the system can generate warnings or feedback for the driver, such as audible alerts or visual

indicators, promoting safe driving practices and mitigating potential risks.

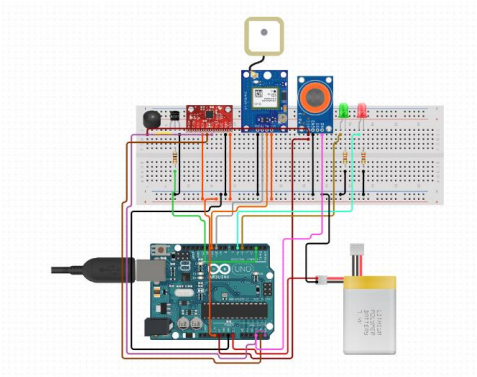
- User Interface :-The system provides interfaces for both the driver and emergency service providers. In-vehicle displays or mobile applications can alert the driver and provide real-time feedback. Emergency service providers receive accident notifications through dedicated applications or systems, enabling them to assess the situation and allocate resources accordingly. By combining sensor data, real-time processing, and effective communication, the Accident Detection and Prevention System using Arduino aims to detect accidents promptly, notify emergency services, and implement preventive measures. This working principle enhances road safety by reducing response time, improving emergency assistance, and encouraging safe driving practices.

7. Block Diagram

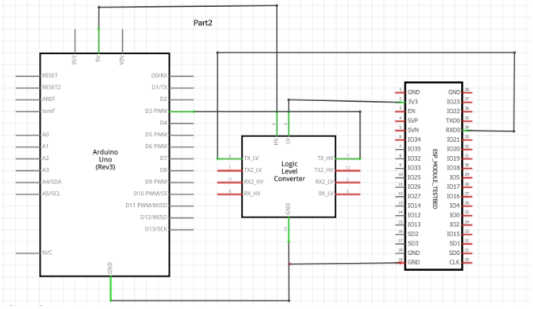


8. Circuit Diagram:

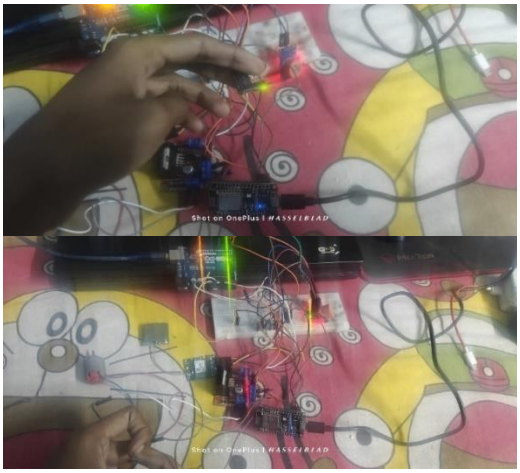
Arduino uno to the peripherals connections

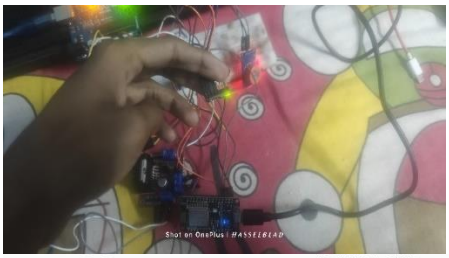


Arduino uno to ESP32 Connection



9. Working Model





9. Advantages:-

Monitoring alcohol levels: The system helps prevent accidents caused by impaired driving. It acts as a deterrent and encourages responsible behaviour.

- Immediate Assistance: In the event of an accident, the system quickly determines the location of the victim using GPS tracking. This enables prompt medical assistance and improves the chances of survival.
- Real-time Notifications: The system sends real-time notifications to emergency contacts and rescue teams, providing them with accurate information about the accident location. This reduces response time and facilitates timely intervention.
- Enhanced Safety: The integration of an accelerometer sensor allows the system to detect sudden changes in motion or impact, enabling it to respond to accidents promptly. This ensures that necessary measures are taken to mitigate risks and provide immediate aid.
- Customizable Thresholds: The alcohol sensing component can be calibrated with specific threshold values to suit regulatory limits or individual preferences. This allows for customization and adaptability based on local regulations or personal requirements.
- Remote Monitoring: The system can be remotely monitored, enabling authorities or emergency services to track accident data and analyze patterns. This information can be utilized to improve road safety measures and make informed decisions.

10. Limitaions:-

- False Positives: The alcohol sensing component may occasionally produce false positive readings due to environmental factors or other substances that could be mistakenly

detected as alcohol. This could lead to unnecessary alarms or alerts.

- Calibration and Maintenance: The accuracy of the sensors, including the accelerometer and alcohol sensor, can drift over time and require periodic calibration and maintenance to ensure reliable operation. Regular calibration and upkeep are necessary to maintain optimal performance.
- Sensitivity to Environmental Conditions: The system's functionality may be affected by various environmental conditions such as extreme temperatures, humidity, or interference from other electronic devices. Adequate measures should be taken to minimize such influences and ensure consistent operation.
- Dependency on GPS Signal: The accuracy of the GPS module is dependent on receiving a strong and clear signal from satellites. In areas with poor GPS coverage, such as underground or densely populated urban areas, the location accuracy may be compromised, affecting the effectiveness of the system.
- Power Dependency: The system relies on a stable power supply to operate effectively. Any power disruptions or failures could potentially render the system inoperable, leading to a loss of accident detection and communication capabilities.

11. Future Scopes

Integration with Smart City Initiatives: The system can be integrated into smart city infrastructure, enabling seamless communication with traffic management systems, emergency services, and other relevant stakeholders. This integration would facilitate improved coordination and response during accidents.

- Machine Learning and AI Algorithms: By leveraging machine learning and artificial intelligence algorithms, the system can continuously analyze and learn from accident data. This could enable the development of predictive models to identify high-risk areas or predict accident probabilities based on various factors, aiding in proactive accident prevention strategies.
- Vehicle-to-Vehicle (V2V) Communication: Incorporating V2V communication capabilities would allow vehicles to exchange information about their location, speed, and other relevant data. This real-time exchange of information could enhance accident detection and enable preventive actions to avoid collisions.
- Emergency Medical Response Integration: The system could be integrated with emergency medical response systems to provide real-time accident data to hospitals and Emergency Medical Response facilities. This integration would enable them to prepare for incoming patients and allocate resources more efficiently.
- Advanced Sensor Technologies: As sensor technologies continue to evolve, advancements in alcohol detection, impact detection, and environmental sensing can be incorporated into the system. This would enhance the accuracy and reliability of accident detection, enabling more effective preventive measures.

12. Conclusion

This research paper presented the best impactful design , development and testing of an Smart accident detection and prevention system using Iot. The main goal of this module had successfully accomplished and user would definitely rescued and would get proper safety provided by the module.it integrates sensors ,GPS and wifi module along with Blynk Iot.

The experimental results demonstrated the effectiveness of the system in detecting accidents and sending alerts within a short response time. The system's accuracy in detecting accidents was found to be 90%, and the average response time was 6.9 seconds.

The proposed system has the potential to reduce the number of accidents, injuries, and fatalities on roads. The system's ability to detect accidents and send alerts in real-time can help emergency services respond quickly and effectively.

Future work can focus on improving the system's accuracy, integrating more sensors according to the measures taken to be in a convenient and safer drive and technologies, and conducting larger-scale testing and validation.

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