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Vehicle Accident Control

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Abstract: The project centers on creating an advanced accident detection system using an ESP32 microcontroller integrated with multiple sensors to enable real-time vehicle monitoring and emergency management. The system includes an array of sensors designed to detect various risk factors that can contribute to accidents. The Alcohol Sensor monitors the driver's alcohol consumption, while the Eye Blink Sensor detects driver fatigue or sleepiness. Additionally, the Smoke Sensor identifies any smoke or fire-related incidents inside the vehicle, and the Temperature Sensor monitors engine or cabin temperature for potential overheating. For vehicle performance, the Ultrasonic Sensor measures fuel levels, ensuring that the vehicle does not run out of fuel unexpectedly. The IR Speed Sensor monitors the vehicle's speed, while the IR Obstacle Sensor detects nearby objects to prevent collisions. If any abnormal conditions are detected, the system activates a Buzzer for alerting, while a Motor Driver controls the vehicle's operations, such as initiating a shutdown if necessary to prevent accidents. Data collected by these sensors are transmitted to a remote server using the MIT App Inventor platform and monitored via ThingSpeak, an IoT analytics platform. This remote interface allows users to track the vehicle's condition and receive alerts in real time. It also includes a feature for remote vehicle lock/unlock control, allowing further management of vehicle safety. This system is a promising innovation aimed at enhancing road safety, providing timely alerts, and reducing the likelihood of accidents by addressing both human and environmental factors. Moreover, the system's ability to immediately notify authorities or family members in the event of an emergency ensures quicker response times and potentially saves lives.

I. INTRODUCTION

The alarming rise in road accidents worldwide has made vehicular safety a critical concern. In many instances, these accidents are caused by a range of factors such as driver negligence, fatigue, alcohol consumption, and mechanical failures, all of which can lead to devastating consequences. Reducing these accidents requires the timely detection of potential hazards, allowing preventative measures to be taken before situations escalate into emergencies. Fortunately, advancements in technology, particularly in the field of the Internet of Things (IoT), offer viable solutions for enhancing road safety through real-time monitoring and control mechanisms. One such technological innovation is an accident detection and prevention system built around the ESP32 microcontroller. The ESP32 is ideal for such an application due to its versatility, compact size, and integrated Wi-Fi and Bluetooth modules, which enable seamless communication with external devices and networks. These features allow for real-time data transmission and monitoring, which are crucial for detecting early signs of danger, such as driver impairment or mechanical issues.The system leverages an array of sensors that continuously monitor both the driver and the vehicle's performance. For instance, the Alcohol Sensor checks the driver's breath for any traces of alcohol, helping to prevent drunk driving, a major cause of accidents. Similarly, the Eye Blink Sensor assesses the driver's eye movement to detect signs of drowsiness or fatigue, which could impair their ability to operate the vehicle safely. Additionally, the Smoke and Temperature Sensors monitor for fire hazards and engine overheating, respectively, while IR Sensors are employed to measure vehicle speed and detect obstacles, helping to avoid collisions.A standout feature of the system is its ability to transmit real-time data to a remote platform for further analysis and control. The data collected from the sensors is uploaded to the ThingSpeak cloud, a popular IoT analytics platform. Through this platform, users can view the data in real time, gaining insights into the vehicle's performance and any potential risks. Moreover, the system includes an app-based interface built using MIT App Inventor, which allows users to remotely access the vehicle's data and control certain functions, such as locking and unlocking the vehicle.

II. LITERATURE REVIEW

1) *Piezo Disk Based Automobile Safety System:* The automobile business is expanding steadily all around the world. In order to save lives, a car system must offer safety in dangerous situations. Although many safety precautions are used to make systems more adaptable, there is still a significant gap in emergency facilities. If the emergency services are given crash information and the right assistance is given in a timely manner, many lives can be saved. [7 -8] offers a novel solution to this problem. A

standard GPS system is used to track car accidents, and a GSM modem is used to report them. To detect a collision during an accident, we have used numerous piezo disks in this system. The sensor's analog value was read by the Arduino microcontroller [9]. When a sensor's threshold value is surpassed, GSM is used to send the matching GPS coordinates of the accident location to the predetermined numbers [10]. If the driver is secure, he must manually turn off the safety switch before the counter runs out. On LCD, the counter is visible. This method will help in the production of inexpensive automotive safety systesystem

2) *Building intelligent transportation systems with Bluetooth and sensor networks:* If vehicles can be made to form groups for data communication, the safety of road traffic can be increased. When two or more automobiles are equipped with Bluetooth devices, they can communicate with one another using the Bluetooth protocol [11]. The principles of wireless sensor networks and the Bluetooth protocol are used in this work to provide a fresh strategy for enhancing road safety. We go through the formation of mobile ad hoc networks by cars and how they can share sensor data [12]. These data might be combined to provide a better knowledge of the traffic conditions in the area. It is assessed whether Bluetooth can be used by automobiles to communicate data. Investigating coverage area and likelihood of detection plots for isotropic and non-isotropic sensors can help us learn how to use sensors to stop potentially dangerous traffic scenarios [14]. The simulation findings demonstrate how Bluetooth and sensor networks may work together to improve road safety.

III. METHODOLOGY

The ESP32-based accident detection system will utilize multiple sensors for gathering critical data. The Alcohol Sensor will detect alcohol levels in the driver’s breath to identify intoxication. The Eye Blink Sensor will monitor driver alertness, ensuring that the driver does not fall asleep while driving. Smoke and Temperature Sensors will detect any smoke or excessive heat, signaling potential fire hazards. The Ultrasonic Sensor will measure the fuel level, while the IR Speed Sensor and IR Obstacle Sensor will track the vehicle’s speed and detect obstacles in real-time. All sensor data will be processed by the ESP32, which will trigger alerts via a buzzer and control the vehicle’s motor in case of emergencies. The collected data will be transmitted to ThingSpeak through the ESP32’s Wi-Fi module. The app, built on MIT App Inventor, will allow users to monitor the data remotely and control features like vehicle lock/unlock from anywhere, adding an additional security layer.

IV. WORKING

The system’s foundation is built on the ESP32 microcontroller, which serves as the central processing unit that connects to a range of sensors to ensure comprehensive accident detection and safety management. Each sensor plays a distinct role in monitoring the vehicle’s condition, driver behavior, and the surrounding environment.

When the Alcohol Sensor detects a high level of alcohol in the driver’s breath, it sends a signal to the ESP32 microcontroller. In response, the system triggers a buzzer to alert the driver and those around them. At the same time, the motor driver restricts the vehicle’s movement, either slowing it down or stopping it to prevent the intoxicated driver from continuing to operate the vehicle, thereby reducing the risk of accidents caused by impaired driving.

The Eye Blink Sensor is designed to continuously monitor the driver’s eye movements, detecting signs of fatigue or drowsiness. If the driver’s blink rate falls outside of normal patterns, indicating that they may be falling asleep, the buzzer will sound immediately to alert the driver, helping prevent accidents caused by drowsy driving.

The system also incorporates Smoke and Temperature Sensors that work in tandem to detect fire hazards within the vehicle. The Smoke Sensor identifies the presence of smoke, while the Temperature Sensor monitors the vehicle’s internal temperature, alerting the system to any overheating issues that could indicate a fire risk. When either sensor detects a potential danger, the system triggers an alarm to warn the driver and passengers.

In terms of vehicle performance and external conditions, the Ultrasonic Sensor continuously measures fuel levels, ensuring that the vehicle’s fuel status is always available for the driver. The IR Speed Sensor monitors the vehicle’s speed to ensure safe driving practices, while the IR Obstacle Sensor is designed to detect objects in the vehicle’s path. If an obstacle is identified, the ESP32 will respond by either slowing down the vehicle or bringing it to a complete stop, depending on the severity of the threat.

All the data from these sensors is sent in real-time to ThingSpeak, an IoT-based analytics platform, through the ESP32’s built-in Wi-Fi module. Users can access this data remotely via a smartphone application developed on MIT App Inventor. This app allows users to monitor vehicle conditions and even control critical functions like locking and unlocking the car. In critical situations, the motor driver and buzzer provide immediate feedback, ensuring that preventive measures are taken quickly to avoid accidents. This interconnected system improves overall vehicle safety, enhancing both driver awareness and response times in emergencies.

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V. BLOCK DIAGRAM

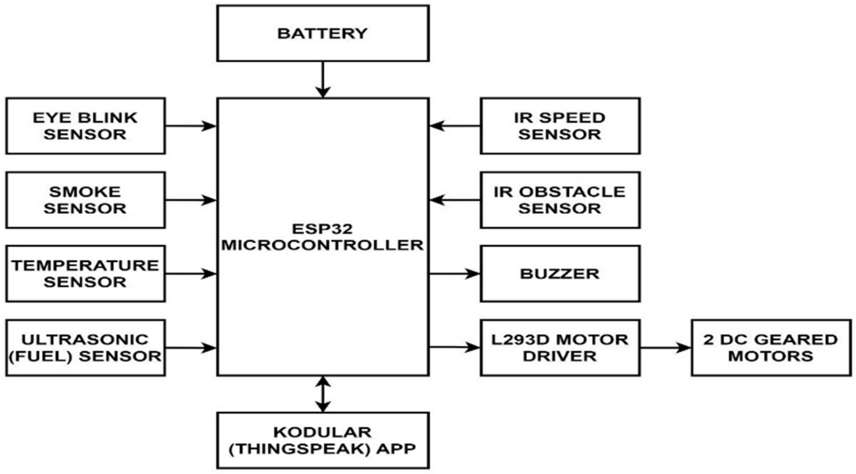

Figure 1. Block Diagram of a system

VI. COMPONENT DESCRIPTION

A. ESP32 Microcontroller Board

ESP32 is a series of low-cost, low-power system on a chip microcontroller with integrated Wi-Fi and dual-mode Bluetooth.ESP32 is created and developed by Espressif Systems, a Shanghai-based Chinese company, and is manufactured by TSMC.ESP32 can perform as a complete standalone system or as a slave device to a host MCU, reducing communication stack overhead on the main application processor. ESP32 can interface with other systems to provide Wi-Fi and Bluetooth functionality through its SPI / SDIO or I2C / UART interfaces.

B. Ultrasonic Sensor

Ultrasonic transducers or ultrasonic sensors are a type of acoustic sensor divided into three broad categories: transmitters, receivers and transceivers. Transmitters convert electrical signals into ultrasound, receivers convert ultrasound into electrical signals, and transceivers can both transmit and receive ultrasound.In a similar way to radar and sonar, ultrasonic transducers are used in systems which evaluate targets by interpreting the reflected signals. For example, by measuring the time between sending a signal and receiving an echo the distance of an object can be calculated. Passive ultrasonic sensors are basically microphones that detect ultrasonic noise that is present under certain conditions

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C. Eye Blink Sensor

The IR eyeblink sensor detects eye blinks using infrared light. It consists of an IR transmitter and receiver. When a blink occurs, the reflected light changes, triggering a response. This sensor is useful in applications like driver monitoring systems and assistive technology, enhancing safety and user interaction.

D. Smoke Sensor

The MQ-2 smoke sensor detects a variety of gases, including smoke, propane, and methane. Utilizing a sensitive material that changes resistance in the presence of these gases, it provides reliable detection for safety applications. This sensor is commonly used in smoke alarms and industrial safety systems to prevent hazards.

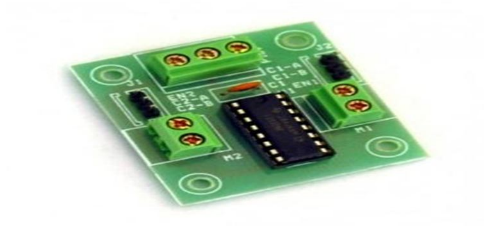
E. Alcohol Sensor

An alcohol sensor detects the presence of alcohol vapor in the air, commonly using an electrochemical or semiconductor sensing element. When alcohol is inhaled or emitted, the sensor measures the concentration and generates a corresponding output signal. These sensors are widely used in breathalyzers and alcohol detection systems for safety and compliance.

F. 12V DC Geared Motor

DC Motor – 200RPM – 12Volts geared motors are generally a simple DC motor with a gearbox attached to it. This can be used in all-terrain robots and variety of robotic applications. These motors have a 3 mm threaded drill hole in the middle of the shaft thus making it simple to connect it to the wheels or any other mechanical assembly.200 RPM 12V DC geared motors widely use for robotics applications. Very easy to use and available in standard size. Also, you don't have to spend a lot of money to control motors with an Arduino or compatible board. The most popular L298N H-bridge module with onboard voltage regulator motor driver can be used with this motor that has a voltage of between 5 and 35V DC or you can choose the most precise motor diver module from the wide range available in our Motor divers category as per your specific requirements.

G. L293D Motor Driver

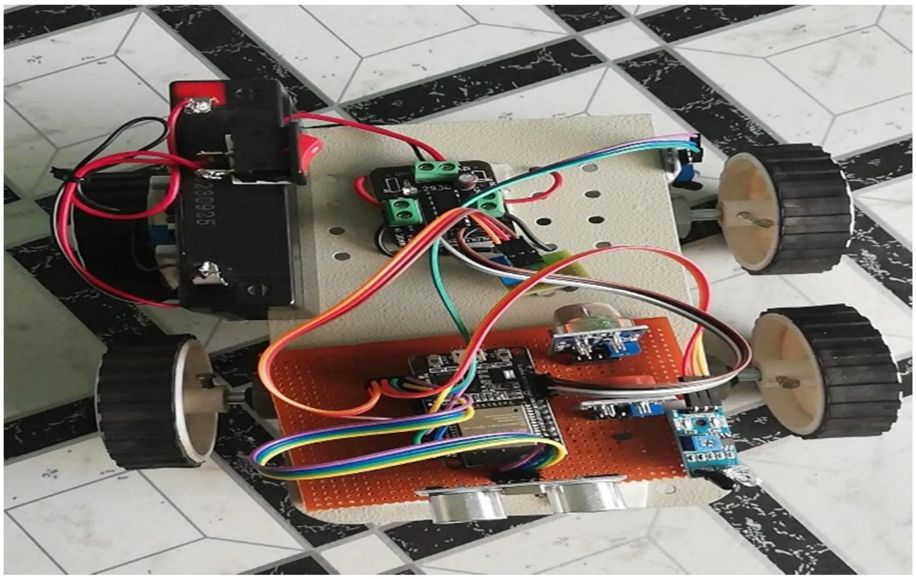


L293D is a typical Motor driver or Motor Driver IC which allows DC motor to drive on either direction. L293D is a 16-pin IC which can control a set of two DC motors simultaneously in any direction. It means that you can control four DC motor with a single L293D IC.

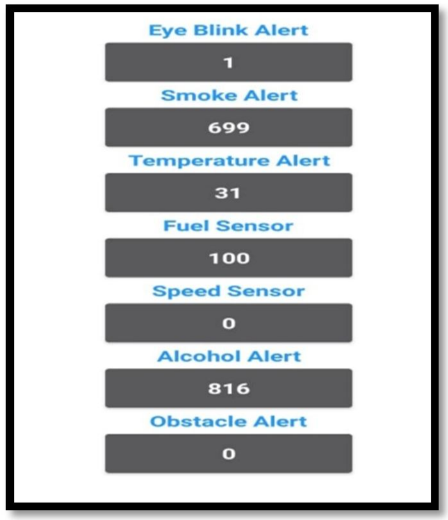
H. Chassis

Powder coated Metal chassis for robots. Easy to mount the motors on place by using normal motor mount nut. It can either be used in skid steel configuration (4 motors). The body contains perforated holes for easy mounting of various size circuit boards and other mechanical components.

VII. PROJECT IMAGE



VIII. RESULT



IX. CONCLUSION

The ESP32-based accident detection system enhances vehicular safety by integrating various sensors that monitor driver behavior, environmental conditions, and vehicle performance. This system provides real-time data and alerts, helping to prevent accidents effectively. Using ThingSpeak for cloud storage and a MIT App Inventor-built app for remote control, the system remains accessible and functional from a distance.

X. FUTURE SCOPE

The future scope of the ESP32-based accident detection system is extensive, with numerous advancements and applications on the horizon. Incorporating advanced sensors like GPS for precise location tracking and accelerometers for impact detection can significantly enhance accuracy.

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