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"PRASHI" (PRANA RAKSHAK SHIRASTRANA)

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Abstract -This paper presents an advanced smart helmet system designed to detect accidents and provide alerts using an ESP32 microcontroller, alcohol sensor, IR sensor, buzzer, and accelerometer to monitor the x, y, z axes in the helmet. The bike section includes a DC motor, keypad, LCD display, ESP32, power supply, and GPS module. The system utilizes cloud technology to send and receive OTPs and GPS locations, ensuring timely assistance during accidents. This comprehensive approach enhances rider safety by integrating multiple sensors and real-time communication capabilities.

1.INTRODUCTION

The integration of technology in transportation safety has led to significant advancements in accident prevention and emergency response. This paper explores the development of a smart helmet system that utilizes an ESP32 microcontroller, various sensors, and cloud technology to detect accidents and alert emergency services. The helmet section is equipped with an alcohol sensor, infrared (IR) sensor, buzzer, and accelerometer to monitor the rider's condition and detect collisions. In the bike section, components such as a DC motor, keypad, LCD display, ESP32, power supply, and GPS module ensure robust performance and seamless communication with cloud services for sending and receiving one-time passwords (OTPs) and GPS locations. This innovative solution aims to enhance rider safety by preventing drunk driving, ensuring helmet usage, and providing prompt assistance in case of accidents through real-time monitoring and alerts. Additionally, the integration of cloud technology enables real-time communication with emergency contacts, significantly improving the efficiency of the accident response process and potentially saving lives.

2. Methodology

2.1. Proposed System:

The sensor checks if the rider is drunk and driving. If the rider is drunk then the ignition of the bike is avoided and the hence not letting the rider to ride the bike. In this system we use an Arduino cloud interfaced with alcohol sensor and it is used to monitor user's breath and constantly sends signals to microcontroller. The Arduino cloud on encountering alcohol signal from sensor and send the data to motor. The system needs push button to start the engine. If the alcohol is detected the system locks automatically. The system also sends a message stating "Accident occurred" including the latitude and longitude location of the incident using

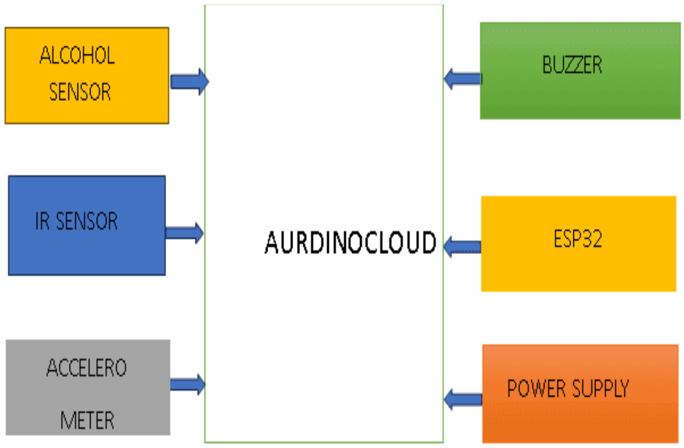

Fig-1: Helmet Section

2.2. Operational procedure:

The advanced smart helmet system is designed to enhance the safety of motorcycle riders through a combination of sensors, microcontrollers, and cloud technology. The system is divided into two main sections: the helmet section and the bike section, each playing a critical role in ensuring rider safety.

In the helmet section, an ESP32 microcontroller serves as the central processing unit, collecting data from various sensors. An alcohol sensor is strategically placed to detect the presence of alcohol in the rider's breath. If alcohol is detected, the microcontroller activates a buzzer to alert the rider and sends a signal to the bike section to prevent the bike from starting. Additionally, an infrared (IR) sensor is used to determine whether the helmet is being worn. The bike ignition is only enabled if the helmet is properly worn, ensuring that the rider cannot start the bike without wearing the helmet. An accelerometer in the helmet measures acceleration along the x, y, and z axes, detecting any sudden impacts or unusual movements that could indicate an accident. This data is continuously monitored by the ESP32, which, upon detecting an accident, sends an alert to the bike section along with the rider's location coordinates.

In the bike section, another ESP32 microcontroller receives data from the helmet section and controls the bike's systems accordingly. The bike section includes a DC motor that simulates the bike's engine, a keypad for the rider to input a one-time password (OTP), and an LCD display that provides real-time feedback and status updates to the rider. Before the bike can be started, the rider must enter an OTP received via the cloud system, ensuring secure and authenticated access. This OTP is verified through cloud communication, and only if the verification is successful, the bike ignition is enabled. Additionally, a GPS module tracks the bike's location, providing real-time data that can be used for navigation or in case of theft.

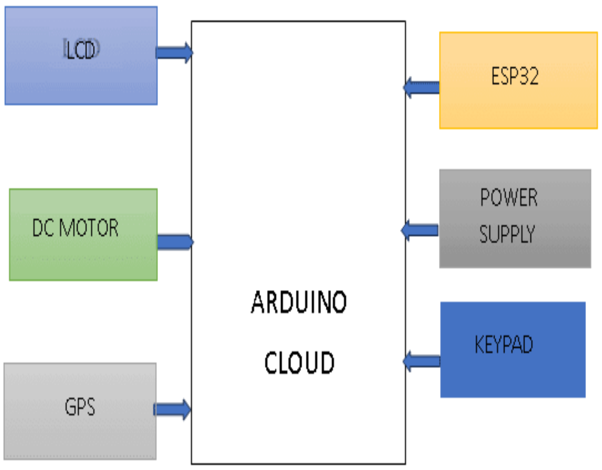

Fig-2: Bike section

The system's communication relies on the wireless capabilities of the ESP32 microcontrollers, which use Wi-Fi or Bluetooth to transmit data between the helmet and bike sections. The cloud technology plays a pivotal role in managing OTPs and processing accident alerts. When an accident is detected, the system sends the GPS coordinates and an alert to predefined emergency contacts through the cloud, enabling a prompt response.

Overall, the advanced smart helmet system works seamlessly to ensure that the rider is sober, wearing a helmet, and safe on the road. By integrating sophisticated sensors and leveraging cloud technology, the system not only prevents unsafe riding conditions but also provides immediate alerts and location data in the event of an accident, significantly enhancing the safety and security of motorcycle riders.

3.Specifications of the Hardware

3.1The ESP32 Module

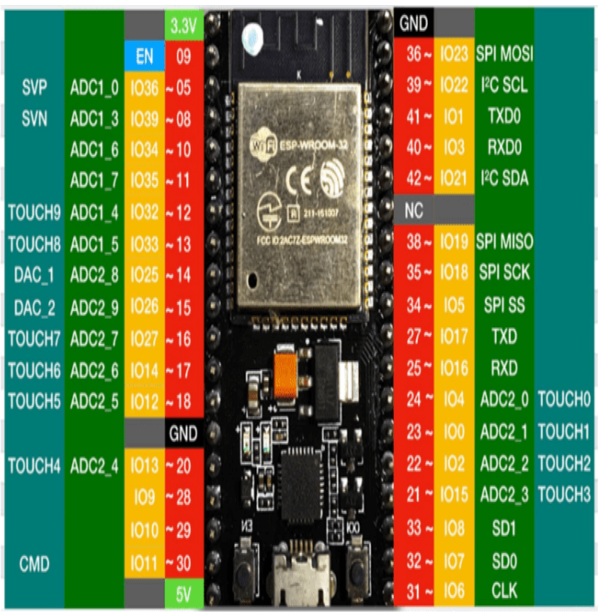

Fig-3: Pin Diagram for ESP32

The ESP32 microcontroller features a variety of pins that support diverse functionalities. It has 38 GPIO pins, which can be programmed for digital input or output, and multiple analog-to-digital converter (ADC) channels for reading analog signals. The ESP32 includes several power pins such as 3.3V, GND, and a battery input (VBAT) for flexible power options. Communication interfaces include UART, SPI, I2C, and I2S, facilitating connection with peripherals like sensors and displays. The microcontroller also has PWM pins for controlling devices like motors and LEDs, and dedicated pins for touch sensors, making it suitable for touch-sensitive applications. Additionally, the ESP32's built-in Wi-Fi and Bluetooth capabilities are supported by dedicated antenna and RF pins, enabling robust wireless communication.

Numerous pins on the ESP32 microcontroller support a wide range of functions. It contains numerous analog-to-digital converter (ADC) channels for reading analog signals in addition to 38 GPIO pins that can be configured for digital input or output. For a variety of power choices, the ESP32 has many power pins, including 3.3V, GND, and a battery input (VBAT). UART, SPI, I2C, and I2S are examples of communication interfaces that make it easier to connect to peripherals like displays and sensors. Touch-sensitive applications can benefit from the microcontroller's PWM pins, which can be used to drive devices like motors and LEDs, as well as its specific touch sensor pins. Furthermore, specialized antenna and RF pins support the ESP32's integrated Wi-Fi and Bluetooth features, allowing for reliable wireless communication.

3.2 GPS Unit

A GPS module is a compact device that packs an antenna and receiver to interact with the Global Positioning System. By picking up signals from GPS satellites, it calculates your location (latitude, longitude) and time. It typically communicates this information serially, using NMEA messages which are text-based strings containing your coordinates. When choosing a GPS module, factors to consider include the number of tracking channels (affecting signal reception), how often it updates your location, and its accuracy level. These modules are low-power and come in various configurations to suit different projects.

3.3. DC Motor

DC modules, sometimes referred to as solar panels, are the workhorses of solar power generation. They capture sunlight and convert it directly into DC electricity through photovoltaic cells made from silicon. These cells rely on the photovoltaic effect to generate electricity. Multiple cells are wired together in series and parallel within a module to achieve the desired voltage and current output. When selecting a DC module, key factors include its power rating in watts, output voltage, efficiency in converting sunlight to electricity, and how well it handles temperature variations. These modules are the building blocks of solar power systems and often work in conjunction with inverters to convert the DC output to AC for powering homes and feeding electricity into the grid

Alcohol Sensor: Placed near the rider's mouth, the alcohol sensor detects the presence of alcohol in the rider's breath. If alcohol is detected, the system prevents the bike from starting, ensuring that an intoxicated rider cannot operate the vehicle.

Infrared (IR) Sensor: This sensor checks if the helmet is being worn by detecting the presence of the rider's head. The bike will only start if the helmet is worn, promoting the use of helmets for safety.

Buzzer: The buzzer provides audio alerts for various conditions, such as when alcohol is detected or if the helmet is not worn.

Accelerometer: The accelerometer measures the helmet's orientation and acceleration along the x, y, and z axes. This data helps in detecting falls or collisions, triggering an alert system if an accident is detected.

Power Supply: A compact power supply unit powers all the components in the helmet section.

Key pad: Allows the rider to input an OTP, Verifies the rider’s identity before enabling bike ignition.

4.SOFTWARE TECHNOLOGY

Fig-4: MIT App for Smart helmet

MIT App Inventor's real-time location sharing is enabled through Firebase. You can create a system that stores user location data in their real-time database by integrating Firebase. To get location updates, the app uses the device's GPS. The application adds the user's coordinates to the appropriate location in the database whenever the user's location changes. Your app reads other users' data from the same database to display their positions. When a user's location changes, Firebase's listener feature updates in real-time, enabling your app to continuously update the locations shown on a map. Recall that Firebase can't operate without an internet connection. For enhanced security, consider adding user authentication and privacy controls to manage who sees each user's locatio

5.RESULT

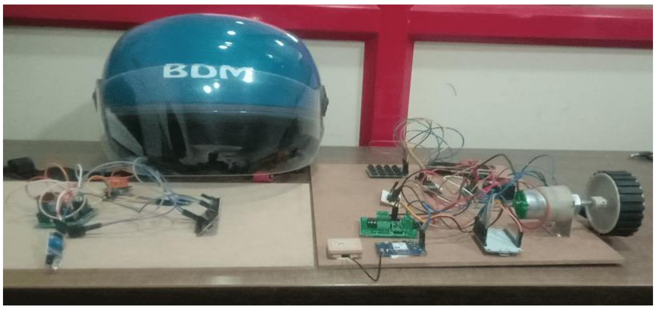

Fig-5: Operational Helmet and Bike Section Model

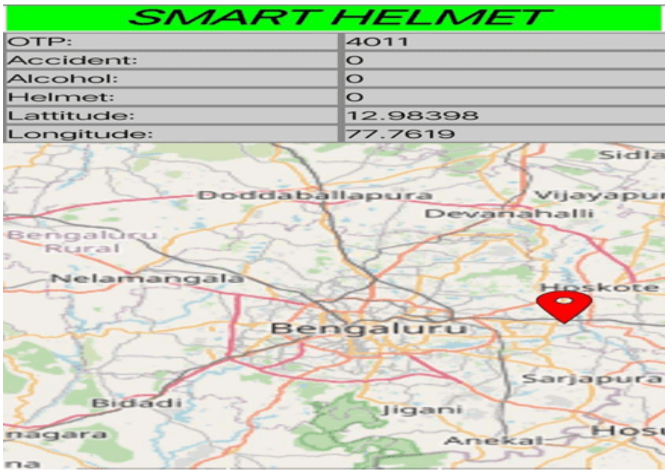

Fig-6:Real time location

The implementation of the advanced smart helmet system yielded promising results in enhancing motorcycle rider safety. The alcohol sensor reliably detected alcohol presence, preventing the bike from starting when alcohol was detected. The IR sensor ensured the helmet was worn before the bike could be operated, enforcing helmet usage. The accelerometer accurately detected impacts and unusual movements, triggering immediate alerts in case of an accident. The GPS module provided precise location data, which was successfully transmitted to emergency contacts via cloud services. The OTP verification system effectively secured bike ignition, preventing unauthorized use. Overall, the system demonstrated high reliability and effectiveness in real-world scenarios, significantly improving the safety and security of motorcycle riders

3. CONCLUSIONS

The development of an advanced smart helmet for accident detection and alert systems represents a significant leap forward in enhancing motorcycle rider safety. By integrating an ESP32 microcontroller with an array of sensors, such as an alcohol sensor, IR sensor, buzzer, and accelerometer in the helmet section, the system effectively monitors the rider's condition and detects collisions in real-time. The bike section, equipped with a DC motor, keypad, LCD display, ESP32, power supply, and GPS module, ensures robust performance and seamless communication with cloud services for OTP verification and GPS location tracking. This innovative system not only prevents drunk driving and enforces helmet usage but also provides immediate accident alerts and precise location data to emergency contacts via cloud technology. The comprehensive integration of these components and technologies offers a reliable and efficient solution for reducing motorcycle accidents and ensuring prompt emergency response. The project demonstrates the potential of combining modern microcontrollers, sensors, and cloud connectivity to create a safer and smarter transportation environment, paving the way for future advancements in vehicular safety systems.

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