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IDENTIFICATION AND PREVENTION OF ACCIDENTS USING SMART HELMET AND GPS SYSTEM

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Abstract: In each one hour 17 people are dying in India because of street mishaps. According to the administration report practically 1.5 lacks people are passed on street mishaps in 2017 Most of mishaps is bikes in view of person not worn helmet and consuming alcohol. So in this proposed framework if the rider isn't worn helmet or consumes any alcoholic substance is distinguished, the bike will not start. In addition, it has a smart feature to identifying accidents and sends SMS to rescue vehicle, police headquarters and family members with location by using GSM and GPS module, thus aiding ambulance to reach the correct location. We want to integrate all the sensors inside the helmet, which will send the all the data to the receiver connected in motorcycle wirelessly. This brilliant head. protector framework comprises of two modules, one is head protector(transmitter) and another one is bike (receiver) Alcohol sensor, IR sensor and ultrasonic sensor are associated inside the helmet unit and vibration sensor, GPS and GSM are connected in vehicle unit. The transmitting and receiving unit communicate wirelessly using RF transmitter and receiver, using Arduino uno.

I. INTRODUCTION

In each one hour 17 people are dying in India because of street mishaps. According to the administration report practically 1.5 lacks people are passed on street mishaps in 2017 Most of mishaps is bikes in view of person not worn helmet and consuming alcohol. So in this proposed framework if the rider isn't worn helmet or consumes any alcoholic substance is distinguished, the bike will not start. In addition, it has a smart feature to identifying accidents and sends SMS to rescue vehicle, police headquarters and family members with location by using GSM and GPS module, thus aiding ambulance to reach the correct location. We want to integrate all the sensors inside the helmet, which will send the all the data to the receiver connected in motorcycle wirelessly. This brilliant head. protector framework comprises of two modules, one is head protector(transmitter) and another one is bike (receiver) Alcohol sensor, IR sensor and ultrasonic sensor are associated inside the helmet unit and vibration sensor, GPS and GSM are connected in vehicle unit. The transmitting and receiving unit communicate wirelessly using RF transmitter and receiver, using Arduino uno.

II. PROPOSED SYSTEM

The proposed system presents an intelligent smart helmet integrated with sensor and communication technologies aimed at enhancing rider safety and minimizing the consequences of road accidents. The system comprises a **Microcontroller Unit (MCU)** interfaced with an **Inertial Measurement Unit (IMU)** including an accelerometer and gyroscope, enabling real-time detection of sudden impacts, falls, and abnormal motion patterns. Upon detecting a potential crash, the system initiates a confirmation algorithm that analyzes multiple inputs, including post- impact immobility and location speed. If an accident is verified, the system automatically transmits the rider's **Global Positioning System (GPS)** coordinates to predetermined emergency contacts or rescue services via a **Global System for Mobile Communications (GSM)** module.

Additionally, the helmet features an **alcohol detection sensor** (MQ-3) configured to monitor the rider's breath for signs of intoxication. In cases where alcohol is detected beyond a calibrated threshold, the system alerts the rider and inhibits ignition through a vehicle interlocking mechanism. A **helmet-wearing detection subsystem**, implemented using an IR proximity sensor or pressure sensor, ensures that vehicle ignition is permitted only when the helmet is properly worn. Moreover, the GPS module provides continuous speed monitoring, and speed limit violations trigger real-time alerts through an internal buzzer or audio module, encouraging safe riding practices.

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The data acquisition and alerting mechanism are powered through a rechargeable battery with power management circuitry, ensuring uninterrupted functionality. The proposed smart helmet solution acts not only as a reactive safety device through automatic emergency communication but also as a **preventive safety mechanism** by enforcing responsible riding behavior, thereby addressing multiple dimensions of road safety and significantly reducing fatalities caused by motorcycle accidents.

III. LITERATURE REVIEW

Recent studies on smart helmet systems emphasize the integration of low-cost sensors and micro controllers to enhance rider safety through both accident prevention and rapid response mechanisms. Tilt sensors are widely used to detect abnormal orientation or sudden falls, serving as a primary indicator of accidents, while IR sensors ensure that the helmet is properly worn before the vehicle can be operated. Arduino UNO acts as the central controller, processing sensor inputs and coordinating outputs such as buzzer alerts and LCD displays. The L293D motor driver is often employed to enforce preventive measures, such as disabling ignition when the helmet is not worn, thereby linking rider compliance directly to system functionality. GPS modules add critical value by providing real- time location data, which can be displayed on the LCD or transmitted to emergency contacts, enabling faster rescue operations. Literature consistently highlights the strengths of such systems—affordability, modularity, and ease of implementation— while also noting limitations such as false positives from tilt-only detection, calibration challenges with IR sensors, and the need for ergonomic design to ensure rider comfort. Future research directions suggest incorporating accelerometers for more accurate crash detection, adding wireless communication for automated alerts, and refining power management to improve usability in real-world scenarios. Overall, smart helmet prototypes demonstrate promising potential in reducing accident severity by combining preventive enforcement with responsive localization.

IV. INTERNET OF THINGS

IoT, or the Internet of Things, refers to a network of interconnected physical devices, vehicles, appliances, and other objects embedded with sensors, actuators, software, and connectivity capabilities that enable them to collect, exchange, and act on data. The fundamental idea behind IoT is to create a vast ecosystem where everyday objects can communicate with each other, share information, and make intelligent decisions without human intervention.

The Internet of Things (IoT) refers to the interconnection of everyday objects, devices, machines to the internet, allowing them to collect, exchange, and share data. This interconnected network enables devices to communicate and collaborate seamlessly, leading to increased efficiency, automation, and convenience in various industries and sectors. IoT devices can include everything from household appliances like smart thermostats and refrigerators to industrial machinery,vehicles, and wearable devices. These devices are equipped with sensors, actuators, and software that enable them to gather and transmit data, often in real-time. This data can then be analysed and used to make informed decisions, improve processes, and enhance user experiences.

The IoT has numerous applications, such as smart cities, where sensors monitor traffic, energy usage, and waste management to improve urban planning and sustainability. In healthcare, IoT devices can track patient's vital signs remotely and alert healthcare providers of any abnormalities. In agriculture, sensors can monitor soil conditions and weather patterns to optimize crop yield and reduce water usage. Despite its many benefits, the IoT also raises concerns about privacy, security, and data breaches, as the sheer number of connected devices increases the potential attack surface for hackers. As the IoT continues to evolve, it has the potential to revolutionize how we interact with technology and the world around [6].

V. ANALYSIS &DESIGN

1. Helmet Detection: The smart helmet is equipped with an IR sensor positioned near the inner surface to detect whether the rider is wearing the helmet. When the IR sensor detects the presence of the rider's head or strap, it sends a signal to the Arduino UNO.
2. This detection is crucial for enforcing helmet usage before vehicle ignition is allowed.
3. Accident Identification: A tilt sensor is integrated into the helmet to monitor its orientation. If the helmet experiences a sudden tilt beyond a predefined threshold, the system interprets it as a potential accident. To reduce false positives, the system checks for sustained tilt and inactivity before confirming an accident.
4. Control Unit: The Arduino UNO serves as the central processing unit. It receives inputs from the IR sensor, tilt sensor, and GPS module, processes the data, and controls the outputs. The Arduino executes logic to determine helmet status, accident detection, and coordinates display, ensuring smooth operation of the entire system.

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5. Safety Enforcement: The L293D motor driver is used to control an actuator or relay that governs vehicle ignition. If the helmet is not detected, the Arduino signals the L293D to disable the ignition system, preventing the rider from starting the vehicle. This mechanism enforces safety compliance automatically.
6. Alert System: A buzzer is connected to the Arduino to provide audio alerts. It emits different tones based on system status— short beeps for helmet not worn, warning tones for risky tilt, and continuous alarms in case of confirmed accidents. These alerts
help notify both the rider and nearby individuals.
7. Display Interface: A 16x2 LCD is used to provide real-time feedback to the rider. It displays system status messages such as "Wear Helmet," "System Ready," or "Accident Detected." In case of an accident, the LCD shows GPS coordinates, aiding in quick location identification.
8. Data Flow and Logic: The system follows a sequential logic flow. First, it checks helmet status using the IR sensor. If the helmet is worn, it enables ignition via L293D. During operation, the tilt sensor monitors orientation. If abnormal tilt is detected and followed by inactivity, the system triggers accident mode. The buzzer alerts the surroundings, and the LCD displays GPS coordinates. All decisions are made by the Arduino UNO based on sensor inputs and timing thresholds.

VI. SOFTWARE USED

Arduino is a prototype platform based on an easy-to-use hardware and software. It consists of a circuit board, which can be programmed and a ready-made software called Arduino IDE, which issued to write and upload the computer code to the physical board.

Key Features:

Arduino boards are able to read analog or digital input signals from different Sensors and turn it into an output such as activating a motor, turning LED on/off, connect to the cloud and many other actions.

- It can control the board functions by sending a set of instructions to the micro controller on the board via Arduino IDE.
- Most previous programmable circuit boards, Arduino does not need an extra piece of hardware (called a programmer) in order to load a new code onto the board. You can simply use a USB cable.
- Additionally, the Arduino IDE uses a simplified version of C++, making it easier to learn to program.
- Finally, Arduino provides a standard form factor that breaks the functions of the micro controller into a more accessible package.

After learning about the main parts of the Arduino UNO board, we are ready to learn how to set up the Arduino IDE. Once we learn this, we will be ready to upload our program on the Arduino board.

VII. RESULTS

The smart helmet system was successfully developed to enhance rider safety through accident identification and prevention. It integrates IR sensors to detect helmet usage, an alcohol sensor to monitor intoxication, and a vibration sensor for accident detection. Upon detecting unsafe conditions, the system disables ignition and sends emergency alerts via GSM, including GPS location data.

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The smart helmet includes a safety

feature that detects whether the rider is wearing the helmet before ignition. An infrared (IR) sensor placed inside the helmet identifies the presence of the rider's head. If the helmet is not worn, the system prevents the vehicle from starting and displays the message "PLEASE PUT ON THE HELMET" on the LCD screen. This ensures that the rider complies with safety protocols and helps reduce the risk of injury in case of an accident.

The "MESSAGE SENT" display on the LCD confirms that the smart helmet system has successfully transmitted an emergency alert. This message is triggered when the system detects an accident or unsafe condition, such as alcohol consumption or helmet absence. Once activated, the GSM module sends a predefined SMS containing the rider's GPS location to emergency contacts. The LCD then shows "MESSAGE SENT" to assure the rider or observers that the alert has been delivered, enabling timely assistance and improving overall safety response.

VIII. CONCLUSION

The integration of smart helmet technology with GPS systems presents a promising solution for enhancing rider safety and minimizing road accidents. By incorporating features such as real-time location tracking, accident detection, alcohol level monitoring, and automatic emergency alerts, this system offers a proactive approach to accident identification and prevention. The smart helmet not only ensures that riders follow safety protocols, such as wearing helmets and avoiding intoxicated driving, but also facilitates immediate assistance during emergencies through GPS-based tracking. Overall, this project demonstrates a significant step forward in leveraging technology to promote safer driving practices and reduce fatalities on the road. Future developments could include loT integration, advanced machine learning algorithms for predictive analysis, and broader connectivity with traffic management systems to further improve its effectiveness

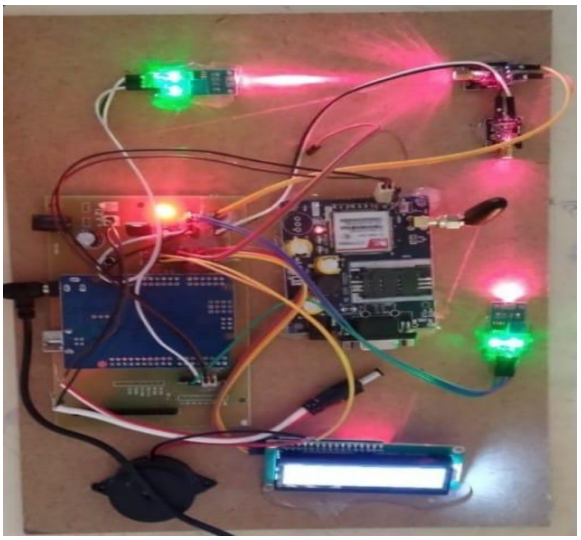

Figure: smart helmet

IX. FUTURE SCOPE

The smart helmet integrated with a GPS system offers a strong foundation for enhancing rider safety, and there is significant potential for future development:

1. IoT Integration: Connecting the smart helmet to the Internet of Things (IoT) can enable real-time data sharing with emergency services, traffic systems, and family members.
2. Al and Machine Learning: Implementing Al algorithms can help predict accidents based on riding patterns and provide alerts for dangerous driving behavior.
3. Health Monitoring: Future versions can include biometric sensors to monitor the rider's heart rate, body

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temperature, and fatigue levels, enhancing health and safety during rides.
4. Voice-Controlled Assistance: Integration with virtual assistants can allow for hands- free control of navigation, calling, and emergency services.
5. Solar Charging: Incorporating solar panels for charging the helmet can ensure continuous operation without frequent battery changes.
6. Cloud-Based Data Analytics: Centralized data storage and analytics can help in understanding accident trends and improving urban traffic planning.
7. Enhanced Connectivity: Using 5G or other advanced communication technologies can provide faster response times and improved data accuracy.

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2. Security and Fault Tolerance in Internet of Things.
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