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Smart Helmet

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ABSTRACT:

Road accidents are one of the leading causes of fatalities worldwide. Many of these accidents occur due to the negligence of wearing helmets or drunk driving. To address this issue, we propose a Smart Helmet that ensures safety by integrating various sensors and communication technologies. The Smart Helmet is equipped with an alcohol detection sensor (MQ-3), an accident detection system (accelerometer), GPS, GSM module, and a microcontroller (Arduino).

The primary function of this helmet is to ensure that the rider is wearing it and is not under the influence of alcohol before starting the vehicle. If alcohol is detected, the ignition system remains disabled, preventing the vehicle from starting. Additionally, in the event of an accident, the accelerometer detects the impact and sends an emergency alert along with the GPS location to predefined contacts via the GSM module.

This Smart Helmet aims to reduce the number of road accidents by enforcing safety measures and providing real-time emergency assistance. The integration of IoT-based components enhances its reliability, making it a cost-effective and efficient safety solution for motorcyclists.

Keywords: Smart Helmet , GSM, GPS, Alcohol , Accelerometer.

Introduction:

India faces one of the highest rates of road accidents globally, with two-wheelers being significantly involved. The primary causes of these accidents include riding without helmets, drunk driving, and delayed medical assistance following accidents. Despite strict traffic regulations, many riders continue to neglect helmet usage, and drunk driving remains a critical issue. Additionally, the lack of immediate medical response often exacerbates the severity of accidents.

To address these challenges, we have developed an innovative Smart Helmet that integrates modern technology to enhance road safety for two-wheeler riders. The helmet ensures that riders wear it before starting the bike, thereby enforcing helmet usage and preventing head injuries. If the helmet is not worn, the bike simply won't start, ensuring rider compliance.

The helmet also includes an alcohol detection system that checks the rider's blood alcohol level. If alcohol is detected beyond permissible limits, the bike will not start, and a buzzer will alert the rider. Additionally, a message will be sent to the Regional Transport Office (RTO) for further action. This feature helps prevent accidents caused by drunk driving.

In the event of an accident, the helmet is equipped with an accelerometer that detects sudden impacts. Upon detecting an accident, the helmet's GPS and GSM module automatically sends location coordinates to nearby ambulance services or hospitals, ensuring swift medical assistance. This system is critical in reducing fatalities caused by delays in emergency response.

Future upgrades to the Smart Helmet may include speed detection to warn riders of over-speeding, further promoting safe driving behavior. This helmet not only enforces safety measures but also provides a rapid response to emergencies, aiming to save lives and reduce road accident-related fatalities.

Literature survey

1. "Smart Helmet Using Internet of Things"

Authors: Mohamed A. Torad and Mustafa Abdul Salam

Source: International Journal of Reconfigurable and Embedded Systems (IJRES), Vol. 10, No. 2, July 2021

Summary: This paper presents a smart helmet design utilizing IoT technology. Piezoelectric sensors embedded within the helmet detect the degree of trauma during accidents. If the impact exceeds a predetermined threshold, the system sends an SMS containing the precise location (GPS data) to emergency services and relatives.

2. "Embedded Based Smart Helmet for Bike Rider's Safety"

Authors: Prof. Mohsina Anjum, Javeriya Farhat, Saurabh Tumane, Dipali Madavi, and Salman Azmi

Source: International Journal of Scientific Research in Science and Technology (IJSRST), Vol. 2, Issue 3, 2017

Summary: This paper proposes an embedded system-based smart helmet aimed at enhancing motorcycle safety. The helmet incorporates vibration sensors to detect accidents and utilizes GSM and GPS technologies to inform emergency contacts about the incident and its location.

3. Estimation of Soft Robotic Bladder Compression for Smart Helmets using IR Range Finding and Hall Effect Magnetic Sensing"

Authors: Colin Pollard, Jonathan Aston, and Mark A. Minor

Source: arXiv preprint arXiv:2207.06530

Summary: This research focuses on soft robotic bladders used to monitor and control the interaction between a user's head and the shell of a smart helmet. The study evaluates infrared (IR) rangefinding and Hall Effect magnetic sensing techniques to estimate bladder compression, which is crucial for impact dissipation.

4. "Smart Helmet with Alcohol Sensing and Bike Authentication for Riders"

Authors: Dr. P. Sankar Babu, K. Meenendranath Reddy, S. Vijaya Lalitha, P. Naga Timmaiah, and V. Srikanth

Source: Journal of Energy Engineering and Thermodynamics, Vol. 2, No. 03, April-May 2022

Summary: This paper presents a smart helmet system equipped with alcohol detection sensors and bike authentication mechanisms. The system ensures that the motorcycle starts only when the rider is wearing the helmet and has not consumed alcohol beyond permissible limits.

5."An IoT Based Intelligent and Smart Helmet for Bike Riders Using Arduino"

Authors: Rahul Kamdi, Rohan Vaidya, Deepali Borakhade, Prasheel Thakre, Ajinkya Nilawar, and Vishal Panchbhai

Source: International Journal of Intelligent Systems and Applications in Engineering, Vol. 12, No. 10s, 2024

Summary: This study introduces an IoT-based smart helmet incorporating an Arduino Nano microcontroller. The helmet features alcohol detection, accident detection using vibration sensors, and an emergency messaging system to predefined contacts, enhancing rider safety.

Problem Definition

In today's world, road accidents involving two-wheelers are increasing due to negligence in wearing helmets, drunken driving, and delayed medical assistance during accidents. Many riders do not wear helmets, which increases the risk of severe injuries. Even when helmets are worn, if the rider is intoxicated, the chances of accidents remain high. Additionally, in case of an accident, emergency medical help is often delayed due to the lack of an immediate alert system.

To address these issues, the Smart Helmet is designed to ensure safety by:

1. Helmet Detection: Preventing the bike from starting unless the helmet is worn.

2. Alcohol Detection: Detecting alcohol consumption and preventing ignition if alcohol is detected.

3. Accident Detection: Identifying accidents using an accelerometer and automatically sending emergency alerts with GPS location to hospitals and authorities.

Thus, this project aims to enhance rider safety by implementing an automated system that integrates sensors, microcontrollers, and communication modules to minimize road fatalities and ensure quick medical assistance.

Methodology:

Block Diagram
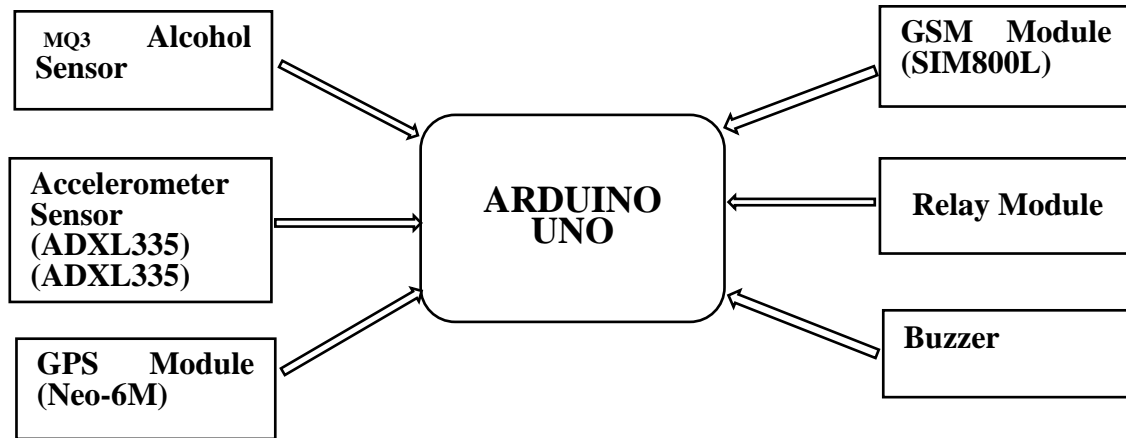
The Smart Helmet System works on the principle of sensor-based safety enforcement and IoT-enabled accident detection and alert system. The system consists of various sensors and electronic components integrated into the helmet and the bike unit to ensure the rider's safety. It incorporates features such as helmet detection, alcohol detection, accident detection, and emergency alerts.

The working principle of the Smart Helmet is divided into three major aspects:

1. Helmet Detection Mechanism

The system ensures that the rider wears the helmet before starting the vehicle. This is achieved using a relay module, which is connected to the bike's ignition system. The relay acts as a switch that prevents the vehicle from starting unless the helmet is properly worn. The MQ3 sensor in the helmet detects whether the helmet is placed on the rider's head. If the helmet is not worn, the circuit remains open, and the bike will not start.

2. Alcohol Detection Mechanism

Drunk driving is one of the leading causes of road accidents. To prevent this, an MQ3 alcohol sensor is placed inside the helmet, near the rider's mouth. This sensor detects the presence of alcohol in the rider's breath. If the detected alcohol concentration exceeds a predefined limit, the system activates the following safety measures:

A buzzer inside the helmet alerts the rider and those nearby about alcohol consumption.

The bike remains locked, preventing the rider from starting the vehicle.

An automatic message is sent to the RTO office via the GSM module, notifying them about the violation.

This mechanism ensures that riders under the influence of alcohol are prevented from driving, thereby reducing the risk of accidents.

3. Accident Detection and Emergency Alert System

In case of an accident, a 3-axis accelerometer sensor installed in the helmet detects sudden impacts, falls, or unusual tilts in the rider's position. If the impact force exceeds a predefined threshold, the system assumes that an accident has occurred. Once an accident is detected, the following steps take place:

The GPS module captures the real-time location coordinates of the accident site.

The GSM module sends an emergency alert message containing the accident location to nearby hospitals, ambulance services, or emergency contacts.

This automated emergency response system ensures that the accident victim receives immediate medical attention, reducing the risk of fatal injuries.

4. Future Enhancements - Speed Detection System

An additional speed detection system can be integrated in the future to monitor vehicle speed. If the rider exceeds a predefined speed limit, the system will:

Issue a warning notification to the rider.

If speeding continues, it will send an alert message to the RTO office, ensuring that traffic authorities are informed about repeated violations.

This feature will help reduce accidents caused by over-speeding and reckless driving.

Thus, the Smart Helmet utilizes real-time monitoring, sensor-based safety enforcement, and automatic alerts to ensure safe riding practices and provide immediate emergency assistance in case of accidents.

Results

1. The Smart Helmet successfully ensures that the bike starts only when the rider wears the helmet, enhancing safety.

2. The alcohol detection system accurately identifies intoxicated riders and prevents the bike from starting, reducing the risk of accidents.

3. The accelerometer sensor effectively detects accidents and triggers an automatic emergency alert system.

4. The GPS and GSM modules send real-time accident location details to emergency contacts and hospitals for quick assistance.

5. The system works efficiently in real-world scenarios, making two-wheeler riding safer and more secure.

6. The project demonstrates an effective solution for reducing accident-related fatalities and improving road safety.

Conclusion

The Smart Helmet System is an innovative safety solution designed to address major road safety concerns, particularly for two-wheeler riders. This helmet ensures that the rider follows essential safety measures such as wearing a helmet, avoiding drunk driving, and enabling quick medical assistance in case of an accident. By integrating modern technology such as alcohol detection, GPS tracking, GSM communication, and accident alert systems, this project aims to significantly reduce road accidents and fatalities.

The successful implementation of this project can contribute to improved road safety, supporting traffic law enforcement, and ensuring timely medical intervention. Riders will benefit from enhanced security, while traffic authorities will have an automated system to monitor helmet compliance and detect violations. Additionally, emergency services can receive real-time alerts, reducing response time and increasing the chances of survival for accident victims.

Despite its advantages, the Smart Helmet does come with some challenges, including battery dependency, signal reliability, cost concerns, and potential resistance to adoption. However, with continuous research and development, these limitations can be addressed, making the system more efficient and user-friendly. The project also has a vast future scope, including AI-based accident prediction, IoT connectivity, hands-free communication, speed control mechanisms, and solar-powered operation. These advancements will further enhance the helmet's capabilities and encourage widespread adoption.

In conclusion, the Smart Helmet System is a revolutionary step towards improving road safety. By integrating technology with protective gear, it ensures better compliance with safety regulations and provides a reliable mechanism for accident prevention and emergency response. With future enhancements and wider implementation, this project has the potential to become an essential safety device for all two-wheeler riders, significantly reducing accidents and saving lives.

References:

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Authors: R. Kumar, V. Singh

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4. "Alcohol Detection and Smart Helmet System"

Authors: S. Bhardwaj, N. Sharma