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SMART HELMET

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ABSTRACT

The Internet of Things (IoT) has found applicationsin various fields such as wearables, home automation, smart appliances, and smart agriculture. One area where IoT can significantly improve safety is in motorbike riding. With theincreasing number of motorbike accidents and associated loss of lives, the use of Smart Helmets can play a crucial rolein enhancing safety. A Smart Helmet is a specialized headgear designed to provide enhanced safety for riders. It leverages advanced technologies and features such as alcoholdetection, GPS, a helmet key, IR sensors, and over-speedingdetection, effectively transforming it into a smart accessory for bikes. Wearing the helmet becomes mandatory, as the ignition switch will not activate without it. An RF module enables wireless communication between the helmet'stransmitter and receiver. The Smart Helmet incorporates an alcohol detection system, capable of determining if the rideris intoxicated. If alcohol is detected, the helmet automatically locks the ignition and sends a message to a registered mobilenumber, providing the current location. In the event of an accident, the helmet utilizes GSM technology to transmit an alert message along with the precise location. Additionally, if the rider falls from the bike, a message is sent to the registered mobile number, notifying them of the incident. By combining IoT technologies with helmet safety, these intelligent features can contribute significantly to reducing motorbike accidents and their associated risks.

KEYWORDS: *Radio Frequency, Pulse Width Modulation, Global Positioning System, Microcontroller Unit*

1. INTRODUCTION

Road accidents are a significant issue in highly populated and developing nations like India, and two-wheeleraccidents account for a substantial portion of these incidents. The factors such as drunk driving, rash driving, over speeding, and distractions while riding, are indeed major contributors to road accidents involving bikes. The use of helmets is essential for the safety of bike riders. Helmets are designed to protect the head, which is a vulnerable part of the body during accidents. Wearing a helmet significantly reduces the risk of head injuries and cansave lives. In many cases, head injuries sustained in accidents can be severe and even fatal, so wearing a helmetis crucial. Despite the importance of wearing helmets, theremay be instances where riders choose not to wear them dueto inconvenience or other reasons. However, it's essential toraise awareness about the importance of helmet usage and enforce regulations that make wearing helmets compulsory.Strict law enforcement, along with public education campaigns, can help emphasize the significance of helmet use and encourage riders to prioritize their safety.

2. SCOPE OF THE PROJECT

The scope of the proposed project is to enhance road safety byimplementing a system that promotes responsible riding behavior and discourages drunk riding. The project involves integrating a module into the bike that interacts with the helmet and an alcohol sensor. The first part of the system ensures that the rider wears a helmet before starting the bike. This can be achieved by incorporating a mechanism that prevents the bike from starting unless the helmet is worn. This requirementencourages

riders to prioritize their safety and reduces the chances of head injuries in case of an accident. The second part involves the use of an MQ-3 alcohol sensor to detect alcohol content in the rider's breath. If the sensor detects alcohol, the bike will not start, regardless of whether the rideris wearing a helmet. This feature acts as a deterrent against drunk riding, which is a significant cause of accidents. In casean accident does occur, the system incorporates GPS and GSM modules to send messages to emergency contacts,providing them with the rider's location. This feature can helpin facilitating prompt medical assistance and aid in reducing the response time during emergencies. By combining these functionalities, the proposed project aims to reduce roadaccidents by promoting the use of helmets, preventing drunkriding, and enabling faster emergency response in case of accidents. It addresses some key factors contributing to roadaccidents in India and focuses on enhancing rider safety.

3. SYSTEM DESIGN

The functions of the component are described as follows:

3.1. Alcohol Sensor

The alcohol sensor plays a crucial role in promoting road safety by detecting the presence of alcoholin the rider's breath. It is an essential component of the Smart Helmet's system to prevent the bike from starting ifthe rider is under the influence of alcohol.

Alcohol sensors typically work based on the principle of gas detection. They contain a sensing element that reacts to specific gases or vapours present in the surrounding environment. In this case, the alcohol sensor is designed to detect the presence of alcohol vapor in thebreath of the rider.

Figure 1. Spam traffic sample

When the rider exhales into the sensor, the alcohol sensor analyses the breath sample and measures the concentration of alcohol present. It then provides an outputsignal that indicates whether alcohol is detected or not. If alcohol is detected above a certain threshold, the sensor sends a signal to the bike's ignition system, preventing it from starting.

3.2. RF Transmitter

The RF transmitter plays a crucial role in wirelessly transmitting data from the helmet to the bike's receiver. The RF transmitter module operates at a frequency of 434 MHz, which allows it to transmit data using radio frequency signals.

The RF transmitter module typically consists of an antenna and a transmitter circuit. The transmitter circuitreceives data from the helmet module, which includes information about the helmet's status (e.g., whether it is worn or not) or any other relevant data. The transmitter circuit then converts this data into radio frequency signals.

The antenna connected to the RF transmitter is responsible for emitting these radio frequency signals intothe surrounding environment. The signals contain the encoded information from the helmet module and are transmitted wirelessly over the air.

The RF transmitter and receiver modules shouldoperate on the same frequency and use compatible

protocols to establish communication. In this case, the RFreceiver module would be integrated into the bike's system,allowing it to receive the data transmitted by the helmet module. Once the data is received, it can be processed by the microcontroller or other relevant components within the bike's system.

Figure 2. RF Transmitter

3.3. Arduino UNO

The Arduino Uno serves as the central control unit, receiving input from various sensors, processing data, and controlling the system's functionality based on programmed logic. It facilitates communication betweendifferent components and coordinates their actions to achieve the desired functionalities, such as detecting alcohol, helmet status, and triggering safety measures.

The Arduino Uno is based on the ATmega328 microcontroller and offers several digital and analog input/output pins for connecting and interacting withexternal devices. The key features of the Arduino Uno are:

3.3.1. Digital I/O Pins: The Arduino Uno provides 14 digital I/O pins, of which 6 can be used as PWM (PulseWidth Modulation) outputs. These pins allow to interface with and control various components of the system, such as sensors, actuators, and communicationmodules.

3.3.2. Analog Inputs: The Arduino Uno has 6 analog input pins that can be used to read analog voltage levelsfrom sensors or other analog devices. These inputsenable gathering data from analog sensors, such as the alcohol sensor or other environmental sensors.

3.3.3. Crystal Oscillator: The Arduino Uno is equippedwith a 16MHz crystal oscillator, which provides the necessary clock signal for precise timing and synchronization of operations performed by the microcontroller.

3.3.4. USB Connection: The USB connection on the Arduino Uno allows to connect it to a computer for programming and communication. It simplifies the process of uploading code and interacting with theArduino board.

3.3.5. Power Options: The Arduino Uno can be powered through a USB connection from a computer orvia an AC-to-DC adapter or battery. This flexibility enables one to choose the most suitable power source forthe system.

3.4. Switch

The switch serves as a mechanism to detect whether the rider is wearing the helmet or not. It is placed inside the helmet, typically on the top, and is pressed when the rider wears the helmet and released when the helmet is taken off. The switch is connected to the bike's ignition system and plays a crucial role in controlling the bike's power. When the switchis pressed, indicating that the helmet is worn, it sends a signalto the bike's ignition system to turn on or enable the bike's power. Conversely, when the switch is released, indicating that the helmet is taken off, it sends a signal to the ignition system to turn off or disable the bike's power.

The purpose of this switch is to ensure that the rider must wearthe helmet in order to start and operate the bike. This safety feature helps promote responsible riding behavior and reduces the risk of accidents caused by not wearing a helmet. By integrating the switch with the bike's ignition system,the project

ensures that the bike can only be started and usedwhen the rider is wearing the helmet. This adds an extra layerof safety and helps enforce the usage of helmets for rider protection.

Figure 3. Switch

3.5. *GPS*

GPS stands for Global Positioning System, and a GPStracker is a device used to determine and track the precise location of people, vehicles, or animals. The GPS tracker utilizes signals received from multiple satellites to calculate its position accurately.

The information collected by the GPS tracker is typically stored on the device itself and can be transmitted through wireless networks or cellular networks for real- time tracking. The transmitted data includes the current location of the tracked object, which is then displayed on a map in near real-time.

To access and view the location information, dedicated tracking software or applications are available forsmartphones. These applications allow users to monitor and track the movement of the tracked objects, providingvaluable information about their real-time whereabouts.

Overall, GPS trackers serve as valuable tools for tracking and monitoring the location of various entities, offering real-time tracking capabilities and providing users with important data for navigation, safety, and logistical purposes.

Figure 4. GPS

3.6. Microcontroller

A microcontroller is a compact and integrated device that combines various components of a microprocessor system onto a single chip. It typically includes a central processing unit (CPU), memory, and peripherals, making it a self-contained computing unit.

The microcontroller's CPU is responsible for executing instructions and performing computations. The built-in memory, such as Flash memory, stores the programcode that instructs the microcontroller on how to operate. RAM (Random Access Memory) provides temporary storage for data during program execution.

Microcontrollers are widely used in various industries and applications, including automotive engines, medical devices,home appliances, and embedded systems. They provide the necessary computing capabilities to control and monitor the operation of these devices. Microcontrollers are designed to be power-efficient, cost-effective, and compact, making themsuitable for use in small-scale systems and devices.

With their integrated components and decision-making capabilities, microcontrollers enable the development of intelligent and autonomous systems that can perform specifictasks or functions. Their versatility and wide range of applications make them a fundamental component in many electronic devices and systems we encounter in our daily lives.

Figure 5. Microcontroller

3.7. RF Receiver

An RF receiver is an electronic device that enables wireless communication between two electronic devices. It receives transmitted signals in the form of radio waves, which are a type of electromagnetic radiation.

The RF receiver is a vital component in the project as it plays a key role in receiving the data transmitted by the helmet module (transmitter). It enables wirelesscommunication between the helmet and the vehicle module (receiver).

The RF receiver is responsible for capturing the signals transmitted by the helmet module. These signals may contain important information such as the status of the helmet (e.g., whether it is being worn or not), alerts or warnings triggeredby sensors in the helmet, or other relevant data related to therider's safety.

When the helmet module transmits data, it does so by converting the information into radio waves. These radio waves carry the encoded data and propagate through the air.The RF receiver, which is a part of the vehicle module, is designed to pick up these radio waves and extract the transmitted data.

Once the RF receiver receives the radio wave signals, itprocesses the received data and provides it to the vehicle module's microcontroller or other relevant components forfurther action. This data can include information about thehelmet status, such as whether it is worn or not, and other relevant parameters.

The wireless communication facilitated by the RF receiver enables the real-time transmission of data betweenthe helmet module and the vehicle module. This allows forseamless interaction and coordination between the twocomponents.

By utilizing RF technology, the project eliminates the need for physical wired connections between the helmet and the vehicle module. This wireless communication ensures flexibility, convenience, and ease of use for the rider whilestill providing vital data to the vehicle module for safety and control purposes.

Figure 6: RF Receiver

4. IMPLEMENTATION

The implementation of this project involves two major components: the Helmet Unit and the Vehicle Unit. The implementation details of each part are:

4.1 Helmet Unit:

The Helmet Unit consists of the following components:

4.1.1. Alcohol Sensor: The alcohol sensor is integrated into the helmet and is used to detect the presence of alcohol in the rider's breath.

4.1.2. Switch: The switch is also placed in the helmet and is pressed when the rider wears the helmet. This switch indicates that the helmet is being worn.

4.1.3. RF Transmitter: The RF transmitter is connected to both the alcohol sensor and the switch. It receives the digital output from the sensors and encodes the data into a coded binary output. The RF transmitter then transmits this encoded data wirelessly.

4.2 Vehicle Unit:

The Vehicle Unit is placed on the bike and includes the following components:

4.2.1. RF Receiver: The RF receiver receives the coded binary data transmitted by the RF transmitter in the Helmet Unit. It captures the transmitted signal wirelessly.

4.2.2. RF Decoder: The RF decoder receives the input from the RF receiver and decodes the coded binary data. It provides a four-bit digital output to the microcontroller unit (MCU).

4.2.3. MCU: The MCU receives the digital data from the RF decoder. It checks if the address bits of the encoder and decoder match. If they match, it operates the engine of the vehicle.

4.2.4. Relay Circuit: The relay circuit is controlled by the MCU and is responsible for operating the engine DC motor based on the conditions being satisfied.

The power for the Vehicle Unit is typically sourced from the bike's battery. The visual indication or output operations, such as engine operation, are controlled by the MCU according to the specific coding and requirements of the project.

5. RESULT

Figure 7. Smart Helmet

6. APPLICATIONS

Smart Helmet focuses on improving road safety, reducing accidents, and protecting lives. Its implementation can bring significant benefits to riders, particularly school students, while also contributing to a safer and more responsible road environment. The Smart Helmet has various applications and potential benefits:

6.1 Useful for school students: The safety system canbe particularly beneficial for school students who commute on bikes or scooters. It helps enforce the use of helmets and discourages riding under the influence of alcohol, ensuring their safety during their daily commutes to and fromschool.

6.2 Useful for bikes and scooters: The safety system is designed specifically for bikes and scooters, addressing the safety concerns associated with two-wheeler accidents. Itpromotes responsible riding behaviour, such as wearing helmets and avoiding drunk riding, making it highly valuable for bike and scooter riders.

6.3 Helps protect lives in accident cases: By ensuringthe use of helmets and preventing drunk riding, the safetysystem can significantly reduce the risk of severe head injuries and fatalities in accidents. It plays a crucial role inprotecting the lives of riders and minimizing the impact ofaccidents.

6.4 Reduces violations of traffic rules: The safetysystem acts as a deterrent to violating traffic rules such asnot wearing helmets or riding under the influence ofalcohol. Enforcing these safety measures helps reduce thenumber of traffic rule violations and encourages riders to follow traffic regulations more responsibly.

6.5 Real-time safety system: The safety system incorporates real-time monitoring and feedback. It provides immediate feedback to the rider, preventing the bike from starting unless the helmet is worn and detectingalcohol to prevent the bike from starting. This real-time aspect enhances safety and ensures compliance with safety measures.

6.6 Potential extension to other vehicles: The technology used in this safety system can be extended to other vehicles by adapting the system's components and replacing the helmet with seat belt monitoring for cars or other vehicles. This could enhance safety in differentmodes of transportation and promote responsible driving behaviour.

7. CONCLUSION

In conclusion, the Smart Helmet focuses on enhancingthe safety of bike riders by enforcing the use of helmets and preventing drunk riding. By incorporating the necessary components such as the helmet switch, alcohol sensor, RFtransmitter, and receiver, the system ensures that the ridermust wear a helmet and not consume alcohol beyond the allowed limit in order to start the bike.

The implementationof the Smart Helmet provides several benefits. It improvesthe overall safety of the rider by reducing the risk of headinjuries and accidents caused by impaired judgment. The system's budget-friendly design and ease of operation make it accessible and feasible for implementation. Additionally, the system incorporates features such as sending SMS notifications with the biker's location to registered mobile numbers in the event of an accident. This helps facilitate prompt medical attention and efficient handling of post- accident situations.

REFERENCES

[1] Bindu Sebastian, Hridhya krishanan, "Smart *Helmet" International Journal of Technology & Advanced Engineering, Volume5,* Issue:12,December 2015.
[2] Professor Chitte P.P., Salunke Akshay S., Thorat Aniruddha, N Bhosale, "*Smart Helmet with Intelligent Bike System"*, International Research Journal of Engineering and Technology (IRJET).
[3] S. Chandran,E. Elizabeth N, "Konnect: An Internet of Things (IoT) based Smart Helmet for Accident Detection.
[4] Arnab Kumar Saha, Dr Himadri Nath Saha, Shinjini Ray, Robin Karlose "Accident and Alcohol detection in Bluetooth enabled SmartHelmets for motorbikes".

[5] Mohammed, M. N., et al. "*Novel COVID-19 detection and diagnosis system using IOT based smart helmet*." International Journal of PsychosocialRehabilitation 24.7 (2020): 2296-2303.
[6] Chandran, Sreenithy, Sneha Chandrasekar, and N. Edna Elizabeth. "Konnect: An Internet of Things (IoT) based smart helmet for accident detection andnotification." *2016 IEEE Annual India Conference (INDICON). IEEE, 2016.*
[7] Nanda, Sayanee, Harshada Joshi, and Smita Khairnar. "An IOT based smart system for accident prevention and detection." 2018 Fourth International Conference on Computing Communication Control and Automation (ICCUBEA).IEEE,2018.
[8] Jayasree, V., and M. Nivetha Kumari. "IOT based smart helmet for construction workers." 2020 7th International Conference on Smart Structures and Systems (ICSSS). IEEE, 2020.

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