IoT-Powered Smart Helmet with Speed Control for Riders to Prevent Accidents

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Abstract: **Smart bike helmets a revolutionary solution geared toward addressing the alarming boom in bike accidents. These helmets contain RF technology to put into effect usage before ignition, thereby minimizing the danger of head injuries. An included alcohol sensor detects impairment, signaling riders with a visible pink light to promote accountable behavior and deter driving below the influence. Moreover, a Road Speed Limiter Device curbs vehicle pace, enhancing adherence to hurry limits and lowering accidents due to dashing. By amalgamating these advanced safety functions, smart helmets attempt to mitigate accidents, maintain lives, and foster a subculture of responsible driving. In mild of the consistently excessive accident costs, the enormous adoption of smart helmets emerges as a critical degree to decorate avenue safety and shield riders globally.**

Index Terms: **Arduino UNO, RF Transmitter and Receiver, IR-Sensors, Helmet, Alcohol Detector, RSL Device, RSL Calibrator.**

1. INTRODUCTION

The recent increase in motorcycle accidents, there has been a growing urgency to enhance rider safety through innovative approaches. One crucial aspect under scrutiny is the design of motorcycle helmets, which serve as the primary defense against head injuries. This paper embarks on an exploration of modern helmet layouts, focusing on a groundbreaking concept aimed at addressing the paramount problem of rider safety. Through the combination of twist of fate prevention, ignition logic, and alcohol detection, a groundbreaking clever helmet concept emerges. Central to this design is an embedded circuit ensuring the motorbike stays inactive until the rider dons the helmet, drastically decreasing the threat of excessive injuries or fatalities. Building upon previous discussions, the incorporation of an alcohol detection tool, coupled with a conspicuous red mild alert, enhances protection measures by efficiently figuring out intoxication upon helmet utilization. Furthermore, this holistic approach introduces a unique street speed restricting device, in addition bolstering rider protection with the aid of constraining car speed and promoting adherence to speed limits. This comprehensive strategy represents a sizable leap forward in motorbike safety, highlighting proactive initiatives towards safeguarding riders on the street.

2. RELATED WORKS

A variety of studies for identifying drunk drivers and overspeeding have been proposed in recent research. These methods include biological sensors, online parametric identification, and on-road sensors that measure a driver's reaction time. The identification system relies heavily on on-road sensors to track vehicles that stray from approved lanes or safe driving behaviours.

[1] Explored methods for detecting inebriated drivers within blended self-reliant platoons by way of studying automobile speed measurements. This study contributes to the development of self-sufficient automobile era by means of addressing the vital trouble of figuring out impaired drivers within automated driving structures. By using speed facts from cars within platoons, the proposed approach aims to enhance safety and performance in combined traffic environments, ultimately selling the giant adoption of self-sufficient riding era.

[2] Integrated more than one advanced capabilities to mitigate dangers on the street. Prior paintings have explored clever helmet generation, alcohol detection systems, accident detection and notification structures, and velocity restricting gadgets for bikes. The gadget consists of an alcohol sensor to prevent under the influence of alcohol riding, a accident detection device with GPS and GSM modules for activate assistance.

[3] Offers a singular method to helmet era leveraging the Internet of Things (IoT). This research introduces an automated smart helmet gadget designed to

beautify safety for motorcyclists via IoT integration. By incorporating IoT sensors and connectivity, the proposed system gives actual-time tracking of helmet usage, making sure riders adhere to protection protocols.

[4] Proposed with a comprehensive literature review, encompassing traditional methods such as voltage regulation alongside modern approaches like power electronics-based solutions, distributed energy resources (DERs), and smart grid technologies.

[5] Contributes to the sphere of motorcycle safety through exploring the combination of IoT technology into clever helmet structures. This research probably presents a unique method to improving rider protection via actual-time monitoring and shrewd remarks mechanisms enabled with the aid of IoT capabilities. Building on present clever helmet generation, the paper discusses the improvement and implementation of a gadget that utilizes sensors, communication modules, and other IoT components to provide riders with more suitable situational attention and accident prevention measures.

[6] Proposed with the associated works in bike safety era. This includes research in smart helmet era, where improvements in sensors, conversation systems, and IoT integration aim to offer real-time tracking and feedback to riders, lowering the threat of injuries. Additionally, research on IoT-based totally safety systems discover far flung tracking and automated responses to beautify safety throughout diverse domains.

[7] Explores the development of a shrewd helmet gadget aimed at presenting superior caution to motorcyclists approximately the method of large vehicles, contributing to twist of fate prevention efforts. Related works in this place can also include studies on intelligent helmet designs integrating diverse sensors and communique structures to beautify rider protection.

[8] Observes in all likelihood provides an revolutionary method to enhancing motorbike safety thru the combination of IoT era into smart helmet systems, with a specific focus on motorcycle safety capabilities. Related works in this area may additionally include studies on IoT-enabled helmet designs incorporating numerous sensors, conversation systems, and safety mechanisms to improve rider safety and prevent robbery. Additionally, research on IoT-based bike safety structures and clever automobile technologies may offer insights into similar processes aimed at enhancing standard safety and safety for motorcyclists.

[9] Contributes to associated works on street protection and traffic regulation. This takes a look at possibly delves into the exam of street pace limit devices, exploring their regulatory framework, differing types, and financial significance. Additionally, research on the economic effect of road safety measures and the effectiveness of pace limit enforcement mechanisms might also offer insights into similar tactics to mitigate coincidence dangers and beautify ordinary visitors control techniques.

3. SYSTEM IMPLEMENTATION

A. Arduino UNO Microcontroller:

This device is centered around the Arduino microcontroller, known for its affordability and excellent performance, making it a popular choice for IoT applications. Its ability to handle various parameters efficiently makes it well-suited for integrating with different components and microprocessors. Moreover, its simple coding process enhances its adaptability for a wide range of IoT applications.

B. Alcohol Sensor (MQ3):

Situated within the helmet, the alcohol sensor identifies alcohol vapors in close proximity to the wearer's breath. By analyzing the concentration of alcohol in the breath, the sensor effectively detects and measures alcohol content.

C. RF Transmitter and Receiver:

The RF transmitter converts electrical data into radio waves for wireless transmission, while the RF receiver captures and reverts these signals back into their original electrical form. This technology finds broad application in communication systems, remote controls, and IoT devices, facilitating seamless wireless data exchange.

D. Relay:

A relay acts as an electromagnetic switch, using a low-power signal to control high-power electrical devices. When energized, the relay's coil generates a magnetic field that activates a set of contacts, enabling the opening or closing of a circuit. These are pivotal in automation, remote control systems, and electrical protection.

E. Road Speed Limiter (RSL) Device:

This device, which controls the vehicle's speed by regulating fuel flow through the engine, consists of several cables each serving different functions. The red cable acts as the power source, while the black cable serves as the grounding connection. The light blue cable is responsible for initiating shutdown once the speed limit is exceeded, and the orange cable handles ignition. Connecting to the green relay, the deep blue cable is vital, while the green cable facilitates switching via the relay. Finally, the pink cable is designated for the fuel sender.

F. Road Speed Limiter Calibrator:

This calibrator allows setting the preset speed of the RSL device in kilometers. It includes Menu and Delete buttons for control.

G. Accelerator Fulcrum Lever:

Attached to the accelerator linkage, it is stopped by an arrestor when the vehicle reaches the preset speed, preventing further acceleration.

H. Limit Switch:

Activated at the extreme end of the 2nd gear lever, it triggers a solenoid and electromagnetic force to withdraw the axle, allowing free movement of the accelerator linkage.

I. Solenoid:

Activated by the limit switch, it develops electromagnetic force to withdraw the axle, facilitating free movement of the accelerator linkage.

4. METHODOLOGY

This project involves developing and integrating two critical systems: a Smart Helmet and a Speed Limiter device. Each system comprises various components and stages, including hardware setup, testing, integration, and optimization. Here, we outline the methodologies necessary for the successful execution of the project.

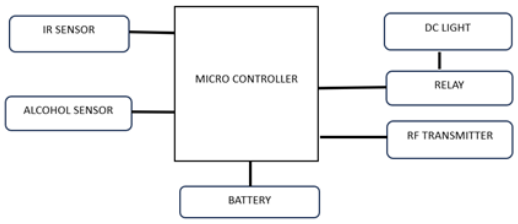

Fig.1 Block diagram for Smart Helmet

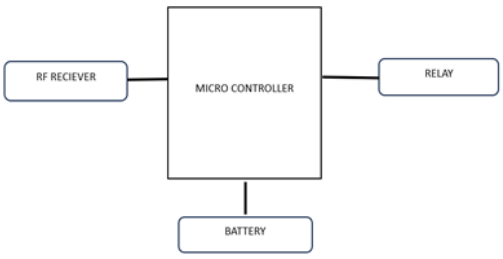

Fig.2 Block diagram for Motor Bike

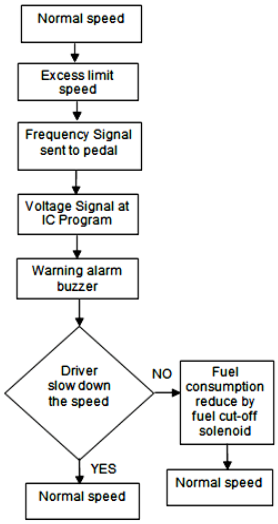

Fig.3 Flow chart for RSL

4.1 Components and Hardware Setup:

A. Smart Helmet:

Arduino microcontroller, Infrared (IR) helmet-mounted sensor, RF transmitter (helmet), RF receiver (bike), Relay (bike ignition control), Alcohol detection sensor with LED indicator, Battery (power supply).

B. Speed Limiter Device:

Road Speed Limiter (RSL) device, RSL calibrator, Various cables and connectors.

4.2 Testing Process:

A. Component Testing:

Verify the functionality and circuitry of each component. Isolate any components not meeting the required specifications.

B. Road Speed Limiter (RSL) Device Testing:

Connect the RSL device to the engine to regulate fuel flow and vehicle speed. Ensure proper cable connections.

C. RSL Calibrator Testing:

Set the preset speed of the device using the RSL calibrator. Verify the correctness of signals produced by different modules.

4.3 Functionality and Operation:

A. Helmet Presence Detection:

Continuously monitor helmet presence using an IR sensor. If the helmet is not detected, the signal is sent to the relay to keep the bike ignition off.

B. Wireless Communication:

Utilize an RF transmitter on the helmet for signal transmission. RF receiver on the bike communicates with Arduino upon signal reception.

C. Bike Ignition Control:

Process received signal from helmet using Arduino. If helmet detected, trigger relay to enable bike ignition.

D. Alcohol Detection:

Employ an alcohol detection sensor to measure breath alcohol content. Arduino activates the LED indicator on the helmet upon detection.

E. Speed Control:

Use an RSL device to regulate vehicle speed when it reaches the preset limit. Prevent further acceleration by stopping the accelerator lever.

F. Gear Shifting:

Shift gears as necessary for torque requirements, such as ascending a steep hill. Activation of the limit switch triggers the solenoid for gear shifting.

4.4 System Advantages:

A. Smart Helmet:

Enhances rider safety by ensuring helmet presence and detecting alcohol consumption. Improves bike security with ignition control.

B. Speed Limiter Device:

Enhances vehicle safety by limiting speed and optimizing fuel management. Provides a reliable solution compared to existing cable linkage arrangements.

4.5 Integration and Optimization:

Seamlessly integrate all components of both systems. Optimize code and configurations to improve overall performance.

4.6 Integration and Optimization:

Thoroughly test all functionalities of both systems. Implement safety measures and fail-safes to ensure accurate operation.

By following these methodologies, the successful execution of both the Smart Helmet and Speed Limiter device projects can be achieved, providing enhanced safety and performance for riders and vehicles alike.

Fig.4 Road Speed Limiter Device and Power Cable

Fig.5 Smart Helmet

5. RESULT

The implemented machine notably has more advantageous rider safety via implementing helmet utilization before motorbike beginning, facilitated by specific IR sensor detection. Seamless wireless connectivity among motorcycle and helmet, facilitated by means of RF transmitter and receiver, underscored the system's responsiveness. Controlled bike ignition, facilitated by using Arduino and relay, ensured compliance with protection standards. Accurate alcohol detection sensor effects brought on a visible warning mild on the helmet, with ongoing algorithm optimization for improved precision. The integration of the MQ3 gas sensor, superior to previous variations in each consumption and detection precision, similarly strengthened protection measures. Additionally, the Road Safety Limit (RSL) device, controlling gasoline and enforcing pace regulations, effectively mitigated the dangers associated with speeding. Overall, the gadget validated promising consequences, offering an integrated technique to mitigate dangers associated with helmetless driving, speeding, and intoxication, consequently improving typical avenue protection.

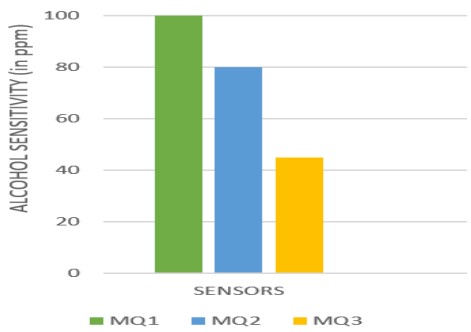

Fig.6 Sensitivity of Sensors (Lower the level of ppm Higher the level of Accuracy)

6. CONCLUSION

The "IoT-Powered Smart Helmet with Speed Control for Riders to Prevent Accidents" project prioritises motorcycle safety without depending on a mobile app. It makes it easier for riders to interact, while wearing a helmet is essential for safety. The hardware foundation is formed by smart helmets, which are fully connected with the ignition system and prioritise emergency response, security, and calibration. The use of fuel is effectively controlled and vehicle speed is regulated by an effective speed control system. Reliability is improved by strategic safety checks and user education, demonstrating how technology may save lives. This project emphasises the role that technology plays in saving human life and represents a major step towards a future where safety and innovation come together.

7. FUTURE WORKS

In order to prevent accidents, the "IoT-Powered Smart Helmet with Speed Control for Riders to Prevent Accidents" project will continue to develop sensor technologies that will enable accurate helmet presence recognition while taking strap integrity into consideration. A complete safety solution is promised through integration with smart helmets, which incorporate communication networks and augmented reality. System accessibility and intuitiveness are enhanced by expanding compatibility across motorbike models and helmets, obtaining user feedback, and improving user-centric design. Universal standards are established through collaboration with international safety organisations. Rider safety is improved by the integration of emergency services and environmental sensors.

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