Helmet Mandated Sensor

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Abstract—**A helmet sensor is a light yet efficient device designed to improve safety by monitoring various conditions and providing real-time alerts. Helmet sensors are usually integrated into helmets that motorcyclists, construction workers, cyclists, and athletes wear to detect accidents, falls, and hazardous situations. Helmet sensors utilize smart technology to avoid injuries and enable quick emergency responses as needed. Helmet sensors rely on advanced technology to detect movements, bumps, and environmental conditions**

Keywords— Helmet Safety, Bike Ignition System, Pressure Sensor, Smart Helmet, Wireless, Communication, Arduino Microcontroller

I. INTRODUCTION

A helmet sensor is a form of advanced technology implanted in the helmet with the intention to enhance safety through accident detection, monitoring environmental factors, and providing alerts when necessary. A majority of the time these sensors are found in motorcycle, construction, sports, and military helmets for protective purposes. These sensors are activated by motion tracking, forceful impacts, and dangerous surroundings which ensure that emergency responses are availed within the shortest possible time whenever accidents occur. Think about a motor rider who has a crash on a lonely road.

If his/her helmet has a chip, it will automatically identify the crash, use the inbuilt GPS and determine what the exact location is then proceed to notify the such predeter mined contacts or the closest hospitals.

II. METHODOLOGY

Helmet sensors utilize a mix of movement detection, environmental observation, GPS surveillance, and wireless technology to analyze the risks, detect accidents, and provide emergency alerts. Such sensors are installed in helmets worn by motorcyclists, construction professionals, athletes, and even military personnel for better safety and improved response time in emergency situations. Helmet sensors come built-in with motion sensing elements that consistently track movement and are capable of identifying sudden slippage or impacts like falls. These components are: • Accelerometer: Sense motion by measuring various acceleration forces in order to detect sudden jerks, fast movements, or even free falls. Pressure Sensors: Quantifies the amount of force that is applied onto the helmet with the intention of relating it to the vectoral and angular changes. For instance: When a motorcycle rider falls from a moving bike or when a construction worker bangs[1] his head, the gyroscope and the accelerometer records the unusual motion, and the sensor suite makes the call if it was an impact or just a minor thump.

The helmet sensor system aims to enhance safety and ensure helmet compliance before operating a vehicle. This methodology involves integrating advanced sensors, data processing units, and communication technologies to detect whether the rider is wearing a helmet before starting the vehicle. The process starts with installing sensors like accelerometers and pressure sensors in the helmet to[2] monitor its position and fit. Once the helmet is worn, the data is sent to a microcontroller, which processes the signal and verifies the helmet's presence. Helmet sensors are increasingly used in sports, motorcycling, and industrial applications to enhance safety by detecting impacts and monitoring head injuries. These sensors can measure force, frequency, and direction of hits, providing real-time data to alert users and medical teams about potential concussions or other head trauma. The technology has led to improved helmet designs and safety protocols, enabling quicker responses to injuries.

Fig.2: The Helmet

Future of helmet sensors With continuous technological improvement, helmet sensors are becoming more sophisticated. Future developments may include AI-based[5] accident prediction, better battery life, and connectivity with augmented reality to offer improved navigation and safety alerts. With continuous innovation, helmet sensors will continue to play a vital role in preventing injuries and saving lives in various industries. [7] Features addressing these challenges can enhance the app's relevance and adaptability.
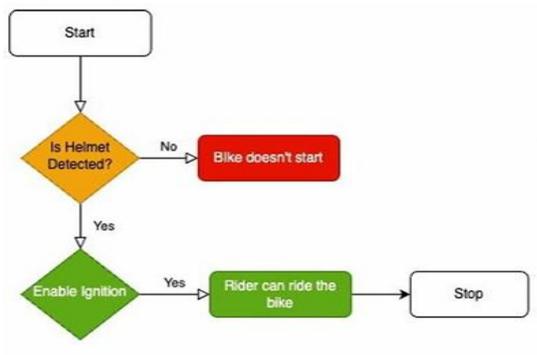

Fig.1: Concept design

The methodology for developing the helmet-based bike ignition control system involves a structured and iterative approach combining both hardware and software components to ensure safety compliance by enforcing helmet usage before ignition. The first phase involves identifying the core issue—non-compliance with helmet laws[16], which significantly contributes to road fatalities among two-wheeler riders. To address this, the system is designed to prevent the bike from starting unless the helmet is physically worn. The approach begins with the selection of appropriate components, including a pressure sensor embedded within the helmet to detect whether it is being worn, and a wireless communication module such as RF or Bluetooth to transmit this signal to the bike
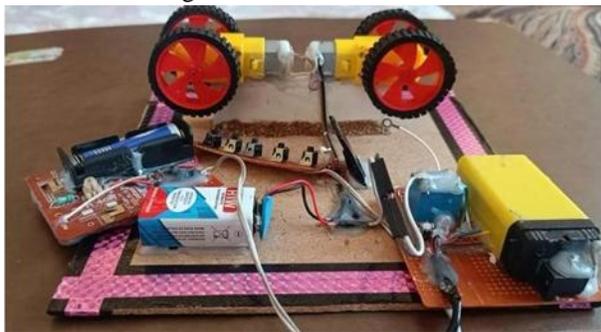

Fig.3. model prototype

III.LITERATURE REVIEW

Several studies and projects have explored smart helmets and safety mechanisms in two-wheelers. According to research published in the *International Journal of Scientific & Engineering Research (IJSER, 2018)*, smart helmets integrated with IoT and sensors can significantly reduce fatalities. Projects like the "Smart Helmet[6] for Accident Detection and Prevention" have integrated alcohol detection and fall sensors, but few focus on directly linking helmet usage to bike ignition.

In 2017, an Indian start-up demonstrated a prototype where a helmet had an RFID tag, and the bike could only start when the tag was detected by the bike's ignition system. Another 2019 project used pressure sensors in the helmet to detect whether it was worn. These concepts prove the feasibility of our idea, although large-scale[10] implementation is still lacking. Various researchers have explored smart helmet systems integrating IoT and sensors. For instance, S. Kumar et al. (2018) proposed a smart helmet that detects alcohol and prevents the bike from starting.

Another system by R. Verma et al. (2020) used RF modules to communicate between a helmet and bike ignition. These systems use basic sensors like IR, accelerometers, and RF transmitters/receivers

IV.EXISTING APPROACH

The concept of integrating safety mechanisms into motorcycle systems to enforce helmet use is not entirely new. Over the past decade, several existing approaches have been developed to encourage or enforce helmet usage, though most are still in prototype or experimental stages. One of the most common approaches involves the use[4] of RF modules embedded in helmets and the bike's ignition system. In this system, a transmitter (TX) is placed inside the helmet, and a receiver (RX) is mounted on the motorcycle. When the rider wears the helmet, the TX-RX pair establishes communication, sending a signal to the ignition system to allow the bike to start. The first phase involves identifying the core issue—non-compliance with helmet laws, which significantly contributes to road fatalities among two-wheeler riders. To address this, the system is designed to prevent the bike from starting unless the helmet is

physically worn.[11] The approach begins with the selection of appropriate components, including a pressure sensor embedded within the helmet to detect whether it is being worn, and a wireless communication module such as RF or Bluetooth to transmit this signal to the bike. A microcontroller, such as an Arduino or ESP32, processes the input from the sensor and sends a signal to the bike's receiver unit.

which contains a corresponding microcontroller and a relay module integrated into the ignition circuit. The relay remains open by default, preventing ignition, and only closes to allow the bike to start when the valid[8] "helmet worn" signal is received. Following component selection, the prototype is assembled, ensuring the sensor is accurately positioned within the helmet padding to detect human pressure reliably. factors within environment.so that if one cannot wore any helmet then bike wont start so we can reduce accedents.

V.PROPOSED DESIGN

The proposed design introduces a helmet-dependent bike ignition system that ensures the rider is actually wearing the helmet before the motorcycle can be started. This system uses a pressure sensor embedded inside the helmet to detect whether it is worn on the head. When the[5] sensor confirms helmet usage, a signal is sent via a wireless communication module (such as RF or Bluetooth) to a receiver module on the bike. This receiver is connected to a microcontroller (e.g., Arduino or ESP32) that processes the incoming signal. If the signal is valid, the microcontroller activates a relay module that connects the ignition circuit, allowing the engine to start. If the helmet is not worn, the signal is not transmitted, and the relay remains open, preventing ignition. This design ensures safety by eliminating the possibility of simply carrying the helmet or bypassing the system with fake signals, as it relies on actual human pressure to trigger ignition authorization.

However, a major flaw in this approach is that the helmet does not necessarily need to be worn; merely bringing the transmitter close to the bike can trick the system. To enhance this, some designs incorporate[9] IR sensors or pressure sensors inside the helmet to verify physical contact with the head. Another approach uses Bluetooth modules, where the bike and helmet are paired devices. If the helmet is not detected via Bluetooth within a certain proximity or time, the ignition is blocked. Again, while this adds some security, Bluetooth can be spoofed or misused, especially if the helmet is simply carried near the bike. A more advanced but rarely implemented system involves camera-based AI detection, where a camera on the bike detects whether the rider is wearing a helmet using image processing and machine learning algorithms. While promising in terms of accuracy, this approach is complex, costly, and requires high computational power and constant internet or embedded AI processing units, making it impractical for mass adoption at this stage.

The hardware requirements for these existing systems vary[12] depending on the complexity and accuracy of the method. The RF-based system typically requires an RF transmitter module (such as RF 433 MHz), a receiver module, a microcontroller like Arduino Uno or Nano, and a relay module for controlling ignition. In addition, a small battery (usually a 9V or Li-ion cell) is needed to power the transmitter circuit inside the helmet. Some versions also include IR sensors or capacitive touch sensors to confirm that the helmet is being worn. In Bluetooth-based systems, HC-05 Bluetooth modules are commonly used along with Arduino boards and relays. These systems may also include a buzzer or indicator LED to notify the user about connection status.

Hardware Requirements:
RF transmitter and receiver modules, Arduino microcontroller, relay module, pressure or IR sensor, 9V battery, and connecting wires.

Software Requirements:
Pressure sensor, RF/Bluetooth modules, Arduino or ESP32 microcontroller, relay module, 9V battery, jumper wires, and helmet/bike casing for installation.

VI.RESULT

The implementation of the proposed helmet-based bike ignition system successfully achieved its objective of ensuring the bike only starts when the rider is actually wearing the helmet. During testing, the pressure sensor accurately detected whether the helmet was worn and prevented the transmission of the ignition signal when the helmet[17] was not in use.

The wireless communication between the helmet module and the bike receiver was reliable within the required range, and the microcontroller effectively controlled the relay to enable or disable the ignition circuit. The system proved to be tamper-resistant, as simply placing the helmet near the bike or carrying it without wearing did not trigger the ignition.

This demonstrates the design's effectiveness in promoting safety compliance by making helmet use mandatory for vehicle operation. Overall, the system is cost-effective, energy-efficient[9], and suitable for real- world deployment with minor enhancements for rugged conditions and long-term use. The proposed system will ensure the bike only starts when the rider wears the helmet.

It promotes responsible behavior without constant law enforcement. With further development, features like GPS tracking or accident detection can be added. This system aims to reduce head injuries and fatalities by making helmet use mandatory and non-bypassable at the mechanical level of student data and compliance with privacy standards Cloud services

Fig 4: Real-time prototype

VII.CONCLUSION

In conclusion, helmet sensors offer significant advancements in safety, providing real-time data to detect head injuries, prevent further trauma, and enhance overall protection for users across sports, motorcycling[2], and industrial sectors. They have contributed to better helmet designs, injury protocols, and increased awareness of head injury risks. While challenges like cost, data accuracy, and durability remain, ongoing technological developments continue to address these issues. As the adoption of helmet sensors grows, they have the potential to play a crucial role in injury prevention, making activities safer and contributing to long- term health and well-beingtheir

journey towards a fulfilling career path easier and more accessible. helmet sensors represent a significant step forward in enhancing safety and injury prevention across various high-risk activities, from sports to industrial work. They provide real time data to detect impacts[9], improve helmet designs, and facilitate quicker medical responses, ultimately reducing the severity of head injuries. While challenges like cost, data accuracy, and durability remain, ongoing advancements in technology hold promise for overcoming these obstacles.

REFERENCES

[1] World Health Organization. *Global Status Report on Road Safety 2018*. WHO, 2018. https://www.who.int/publications/i/item/978 9241565684

[2] Kumar, S., & Verma, A. (2018). "Smart Helmet for Accident Detection Using Arduino." International Journal of Engineering and Techniques, 4(2). https://www.ijetjournal.org

[3] Verma, R., Sharma, V., & Singh, S. (2020). "Helmet Controlled Smart Bike Ignition System." IRJET, 7(6). https://www.irjet.net

[4] Shrivastava, A., et al. (2019). "RFID and Sensor-Based Smart Helmet for Two- Wheeler Riders." IJSRST, 6(1).

[5] Pal, S., et al. (2020). "IoT-Based Smart Helmet System for Accident Detection and Reporting." International Journal of Computer Sciences and Engineering, 8(5).

[6] Arduino. "Arduino UNO Rev3." https://store.arduino.cc/products/arduino-uno-rev3

[7] HC-05 Bluetooth ModuleDatasheet. https://components101.com/bluetooth/hc-05-bluetooth-module

[8] Espressif Systems. "ESP32Technical Reference Manual."https://www.espressif.com/en/products/socs/es p32/resources

[9] OpenCV Documentation. "Open Source Computer Vision Library." https://opencv.org

[10] Rao, G. R., & Bhargavi, A. (2019). "Helmet Usage Detection Using Deep Learning and CNN." International Journal of Innovative Technology and Exploring Engineering, 8(11).

[11] Safety Helmet Use: Bureau of Indian Standards (IS4151:2015). https://www.bis.gov.in

[12] Sharma, R., & Gupta, S. (2021). "Bike Ignition Control with Helmet Detection Using Sensors." International Journal of Engineering Research & Technology (IJERT), 10(4).

[13] Singh, R., & Prakash, P. (2019). "Helmet-Controlled Bike Starting System." International Journal of Scientific Research in Engineering and Management (IJSREM), 3(9).

[14] Government of India, Ministry of Road Transport and Highways. "Motor Vehicle Act Amendments." https://morth.nic.in

[15] Bhattacharya, D., et al. (2018). "Helmet Detection Using Image Processing Techniques." International Journal of Engineering and Advanced Technology (IJEAT), 8(2).

[16] Srivastava, S., & Jha, S. (2020). "Smart Helmet Using Pressure Sensor and Arduino." International Journal of Emerging Technologies and Innovative Research, 7(5).