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# Intelligent Helmet using IOT

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***Abstract*—This paper presents the design and implementation of a smart helmet system utilizing the Internet of Things (IoT) for accident prevention and alcohol detection. The helmet is equipped with sensors that monitor the rider's alcohol levels and helmet usage, ensuring that the vehicle starts only when the rider is wearing the helmet and is sober. Additionally, the system integrates with IoT platforms to provide real-time accident detection and location tracking, enabling emergency response teams to be alerted promptly in case of an accident. The smart helmet aims to enhance rider safety by preventing alcohol-impaired driving, enforcing helmet use, and facilitating rapid medical assistance in the event of an accident. This solution not only promotes safer riding behavior but also contributes to reducing road accidents and fatalities. The goal of the smart helmet is to include functions that identify and report if a person has consumed alcohol while donning a helmet. In the modern world, thousands of people lose their lives in auto accidents each year. Wearing a smart helmet can typically lower the number of accidents. According to the document, the project's primary objective is to create a useful helmet that can detect alcohol and avoid accidents without the need for a helmet. If the user is wearing a helmet, the touch sensor detects it. The alcohol content of the rider's breath is detected by the sensor. If the rider has had drink or is not wearing a helmet, the bike won't start. Only when there are no indications of intoxication and a helmet is on can the bike be started. The system is built using sensor activities. Road accidents are a major global source of death, and riding under the influence of alcohol and rider recklessness are major contributing factors.**

***Index Terms*—Internet of Things,Sensor, Accidents, Alcohol, Detection**

## I. INTRODUCTION

The integration of Internet of Things (IoT) technology has brought about a transformation in a number of industries in recent years by providing creative solutions to improve safety, efficiency, and monitoring capabilities. The Internet of Things (IoT) smart helmet is one such innovative application that aims to greatly enhance operational efficiency and safety precautions in both industrial and recreational contexts.Traditional helmets have served the primary purpose of protecting the wearer's head from physical injury. However, advancements in sensor technology, connectivity, and data analytics have paved the way for smart helmets that go beyond mere protection. These intelligent helmets are equipped with a myriad of sensors and communication modules that enable real-time monitoring of environmental conditions, user health metrics, and critical safety parameters. The IoT-based smart helmet typically incorporates accelerometers for detecting impacts or falls, gyroscopes for orientation sensing, and environmental sensors for monitoring factors like temperature, humidity, and hazardous gases.These sensors collect data continually, which is then either analyzed locally within the helmet or wirelessly sent to a cloud platform or centralized server for additional analysis. Moreover, connectivity features such as GPS modules enable precise location tracking, facilitating Geo-fencing and real-time monitoring of users in large- scale industrial operations or during outdoor activities. This capability enhances safety by alerting supervisors to potential hazards and enables quick response in emergencies. These smart helmets hold immense promise across various sectors, including construction, mining, manufacturing, and sports. By leveraging IoT technologies, these helmets empower organizations to implement proactive safety measures, optimize operational workflows, and improve overall safety culture. This paper explores the design, functionality, benefits, and future implications of IoT-based smart helmets, highlighting their transformative impact on safety.

The importance of IoT-based smart helmets lies in their ability to revolutionize safety measures, enhance operational efficiencies, and improve overall well-being across various in- dustries and activities. IoT-based intelligent helmets represent a paradigm shift in safety technology, offering comprehensive solutions to mitigate risks, enhance operational efficiencies, and ensure the well-being of individuals across

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various sec- tors. Their importance extends beyond basic protection to encompass proactive safety management, data driven insights,and future-ready innovations that drive sustainable growth and resilience in modern workplaces and activities. The objectives of IoT-based smart helmets encompass improving safety out- comes, leveraging data for informed decision-making, enhanc- ing user experience, fostering innovation, expanding applica- tion versatility, and promoting sustainability in various sectors. These objectives collectively aim to establish smart helmets as indispensable tools for enhancing safety, efficiency, and well- being in modern workplaces and activities.

It's becoming more and more necessary to use wearable technology to monitor physiological signals in order to evaluate people's physical and mental health in natural settings. Small-scale analog and digital integrated circuit technology, along with on-chip processing capability to handle movement-induced aberrations in biopotentials—which arise during routine activities—have made this possible. Real-world physiological signals are typically faint and have a poor signal-to-noise ratio (SNR). In order to do this, a high common mode rejection ratio amplifier is needed; big stationary devices usually incorporate these superior bio-appliers into their analog front ends. Due to the large number of leads and electrodes needed, these devices are ideal for clinical settings where patients are typically immobile. The goal of this project is to create an intelligent, or smart, helmet that serves as a security system, monitoring system, and assistance system for riders of two-wheelers. This embedded system is made up of a sensor network with communication modules that assist in stopping or preventing driving in emergency or unusual situations. We also hope to configure an accident detection system.

## II. LITERATURE SURVEY

Studies demonstrate how several IoT sensors and communication technologies are incorporated into bicycle helmets.Sensors such as accelerometers, gyroscopes, GPS modules, and en- vironmental sensors (e.g., temperature, humidity, air quality) are commonly incorporated to monitor biking conditions in real time [1]. Studies emphasize the role of smart helmets in improving biking safety by detecting potential hazards and alerting bikers. For instance, sensors can detect sudden braking or impacts, hazardous road conditions, and proximity to vehicles or obstacles, thereby reducing the risk of accidents [2]. IoT-based smart helmets enable seamless communication between bikers and other road users through technologies like Bluetooth, Wi-Fi, and cellular networks. This facilitates real-time communication, emergency alerts, and navigation assistance, enhancing situational awareness and response ca- pabilities [3]. Research explores the use of data analytics to derive insights from sensor data collected by smart helmets. Machine learning algorithms analyze biking patterns, accident data, and environmental factors to provide actionable insights for improving biking safety and infrastructure planning [4]. Studies emphasize the importance of user-centric design in smart helmet development, focusing on comfort, usability,and aesthetics. The research evaluates user acceptance factors such as helmet weight, fit, ventilation, and interface design to enhance user satisfaction and adoption rates [5]. The literature identifies challenges in smart helmet adoption, including cost, regulatory compliance, integration with existing biking infrastructure, and ensuring robust cybersecurity measures. Future research directions include enhancing sensor accuracy, developing advanced communication protocols, and integrating emerging technologies like augmented reality for enhanced navigation and user interaction [6]. Case studies and field trials provide insights into the practical application of IoT-based smart helmets in real-world biking scenarios. These studies evaluate the effectiveness of smart helmets in improving safety outcomes, user behavior, and biking experience across different geographic and environmental conditions [7]. Ac- cording to the recent Research paper in 2016, author specifically created this idea, "2 Helmets using GSM and GPS Technology for Accident Detection and Reporting System," to increase rider safety. [8] Studying and comprehending the idea of an RF transmitter and RF receiver circuit is the aim of this endeavor. GSM, GPS, and ARM7 modules are used in the project. A buzzer is also used in the project as an indicator. When an accident happens, the location will be recorded, and the registered cellphone number will receive information. [9] The helmet can use technology such as radio frequency modules to stop the bike from starting if the rider is not wearing it. Just one feature alone can motivate motorcyclists to put their safety first and lower the number of incidents where people fail to wear helmets as required by law.[10] The primary drawback of this project is that no display device is being used to indicate the current condition. Furthermore, because a helmet is made for just one use, its price is still very high. According to a research paper published in 2015 with the title "Microcontroller based smart wear for driver safety," the author of the document talked about the vehicle's speed. In this instance, the project's task will be to keep an eye on the regions that the car will be driving through. When the vehicle enters any cautionary zones, such as schools, hospitals, etc., its speed will be restricted to a predetermined level. After donning the helmet, many kinds of messages are displayed on an LCD. The author's focus has only been on the phenomenon of accidents that are typically caused by intoxicated driving. However, as is well known, alcohol consumption is not the only factor contributing to the accidents in the area; speed is one of the other contributing factors. As per the 2016 research paper titled "Smart Helmet," the primary aim of the author is to compel the rider to wear a helmet. According to a poll, the number of people killed in motorcycling accidents is rising in this cutthroat society. Every day, the majority of these deaths are caused by people not wearing helmets. The feature that the author suggests is that the bike won't start unless the rider does not wear a helmet. The rider's checksum is handled by the other module, which also uses an ultrasonic sensor to determine whether the rider was wearing a helmet at all. The next module, a voice recognition module used for authentication, receives the

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signal based on this. This project also makes use of Arduino, an open-source platform for creating computers with senses. An infrared sensor is used by the system Nataraja N et al. [11] designed to determine whether the helmet is on or off. Two modules make up the project: an RF-communicating vehicle module and a helmet module.In addition, the system can identify signs, accidents, and the amount of alcohol in a rider's breath. A method that employs a 3-axis accelerometer to detect accidents and PagerDuty to report the accident was created by Serenity Chandran et al. [12]. Numerous phone calls, emails, and online messages are sent to emergency contacts. There are two units in the system that Aakriti Suman et al. [13] implemented. To determine if a rider is wearing a helmet or not, a PIR sensor is employed. The rider's breath is tested by the alcohol sensor to see if alcohol is present. The helmet unit and bike unit can connect with each other thanks to a variety of communication protocols. Prof. Shikha Gupta et al.'s smart helmet was Internet of Things (IoT) enabled and could detect drinking and accidents [14] In the event of an accident, the smart helmet sends a message with the location. Additionally, live location tracking is used. In the event of an accident, the location can be captured on video. The helmet has all of the parts installed. A Raspberry Pi 3 is used as an IoT module in an IoT-enabled helmet with a data recording system developed by Manish Uniyal et al. [15]. There are two switches: one to determine if the rider is wearing the helmet and the other to determine if the buckle is fastened. To determine if the cyclist has put on the helmet or not, the system contains two switches in the helmet unit.

## III. SIGNIFICANCE

The significance of IoT-based smart helmets for bikes lies in their potential to revolutionize biking safety and enhance the overall biking experience through advanced technology integration. Here are several key aspects highlighting their importance:

1. Enhanced Safety Features: IoT-based smart helmets are equipped with a range of sensors such as accelerometers, gyroscopes, and environmental sensors. These sensors continuously monitor factors like speed, acceleration, braking patterns,the quality of the air, the weather, and the distance from obstructions. These helmets can help prevent accidents by quickly identifying possible risks and risky riding circumstances by giving the rider real-time data and notifications.
2. Improved Communication and Connectivity: Smart helmets incorporate communication technologies such as Bluetooth, Wi-Fi, and cellular connectivity. This allows bikers to stay connected with other riders, pedestrians, and vehicles on the road. In case of emergencies or accidents, these helmets have the ability to notify authorities or emergency contacts, enabling quicker response times and potentially saving lives.
3. Data-Driven Insights: IoT-enabled smart helmets collect and analyze data on biking behaviors, accident occurrences, and environmental factors. This data can be used to generate insights that inform bikers, urban planners, and policymakers about safety improvements needed in biking infrastructure, regulations, and behaviors.
4. User Experience and Convenience: Smart helmets are designed with user-centric features such as comfortable fit, lightweight materials, ventilation systems, and intuitive interfaces. They enhance the overall biking experience by integrating seamlessly with other biking accessories like lights and navigation systems, providing a holistic and convenient solution for bikers.
5. Promotion of Safety Culture: By promoting the use of advanced safety technologies among bikers, IoT-based smart helmets contribute to fostering a safety-conscious biking culture. They encourage bikers to prioritize safety and adhere to traffic rules and regulations, thereby reducing the likelihood of accidents and improving road-sharing dynamics with other vehicles and pedestrians.
6. Adaptability and Future Potential: As IoT technology continues to evolve, smart helmets can be further enhanced with features such as augmented reality (AR) displays for navigation prompts, voice command interfaces for hands-free operation, and integration with biometric sensors for health monitoring. These advancements promise to enhance further safety, convenience, and usability for bikers in diverse biking environments.
7. Environmental and Health Benefits: Encouraging more people to bike safely, IoT-based smart helmets support sustainable transportation initiatives. Biking reduces carbon emissions and promotes physical activity, contributing to improved air quality and public health outcomes in urban areas. IoT-based smart helmets for bikes signify a significant advancement in biking safety and experience. They leverage cutting-edge technology to provide real-time monitoring, communication capabilities, data-driven insights, and user-centered design features that enhance safety, convenience, and overall enjoyment for bikers while promoting sustainable and healthy lifestyles.

## IV. METHODOLOGY

Developing an IoT-based smart helmet for bikers involves a structured methodology that integrates advanced technologies to enhance safety, communication, and convenience.Clearly defining the needs and goals of the smart helmet is the first stage. This includes identifying essential safety features such as accident detection, emergency alerts, and environmental monitoring. Communication capabilities such as hands-free calling, GPS navigation, and interactivity with smartphones are also crucial aspects to consider. Additionally, user-friendly features like music playback and voice commands should be outlined to ensure a comprehensive design. Next, the integration of sensors plays a pivotal role in the smart helmet's functionality. Sensors like accelerometers and gyroscopes are employed for accident detection by monitoring sudden impacts or falls. Environmental sensors can measure temperature, humidity, and pollution levels, providing real- time data to the rider.The creation of the IoT-based smart helmet for preventing accidents and detecting alcohol comprises multiple crucial

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phases, ranging from hardware design to software integration.The following are proposed methodology and working model.

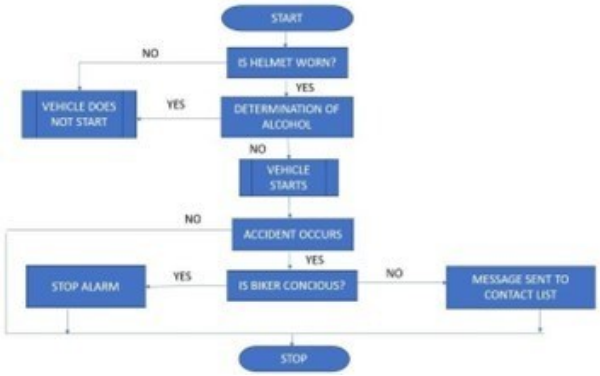


Fig. 1. Flowchart of working kit

A. Proposed Methodology

The are five parts to the project:

i. Helmet Authentication- This checks to see if the rider is wearing a helmet.
ii. Alcohol Detection- This uses a MQ3 Gas Sensor to make sure the rider hasn't had any alcohol.
iii. Response System- This feature uses the GPS, GSM module in the helmet to notify the rider's family of the accident in the event of one.
iv. Safety Zone Indication- An ultrasonic sensor is used to notify the cyclist if a car approaches too closely.
v. Fall Detection- An accelerometer is used to detect vibrations caused by static objects, and in the event of an accident, the rider's family is notified.

B. Working Model

- To check the helmet, a switch is used.
- An alcohol sensor, the MQ3 Gas sensor, is used to measure the alcohol concentration.
- A vehicle's descent is detected using an accelerometer.
- Arduino Nano is used as a controlling unit, it reads the values from the accelerometer, and when Arduino serves any abnormal values, it reads the current location from the GPS module, and sends it to the given mobile through SMS by using the GSM module.

## V. EQUIPMENT USED

The various equipment used for the proposed system are as follows

i. Arduino UNO: An open-source, programmable microcontroller board that is inexpensive, versatile, and simple to use, the Arduino UNO may be incorporated into a range of electronic projects. This board can be used to interface with Arduino shields, other Arduino boards, The AVR microprocessor Atmega328, six analog input pins, and fourteen digital I/O pins—six of which are used for PWM output—are all features of the Arduino UNO. This board has a USB interface, meaning that it can be programmed using the Arduino IDE (In- tegrated Development Environment) software and connected to a computer via a USB cable. The unit's working voltage is 5V, which means that the microcontroller on the board and the circuitry that powers it run at 5V. The recommended input voltage ranges are 7V to 12V, while the input voltage varies from 6V to 20V.

ii. DC Motor: A DC motor is an electronic motor that generates mechanical force by means of direct current (DC). The most popular kinds rely on magnetic forces generated by coil currents. Almost all varieties of DC motors contain an internal mechanism—electromechanical or electronic—that allows the motor's portion of the current to be periodically reversed. Since DC motors could be run on the direct-current lighting power distribution networks already in place, they were the first type of motors to be employed extensively. This board contains a USB interface i.e. USB cable is used to connect the board to the computer and Arduino IDE (Integrated Development Environment) software is used to program the board.

iii. GSM Module: A GSM module is an apparatus that facilitates GSM network communication between electronic devices. As a digital cellular communications standard, GSM offers a wireless communication platform for mobile devices to connect with one another.A specialized gadget called a GSM module makes it possible for a device to send and receive data via the GSM network. One crucial element of contemporary communication systems is the GSM network. It is a standard that mobile devices utilize to connect wirelessly to one another. iv.MQ3 Alcohol Sensor: This Grove module can detect CO, LPG, Benzine, Hexane, CH4, and alcohol. Due to its high sensitivity and fast response time, measurements can be taken
as soon as possible.

v. Switch: A switch is an electronic component that can disconnect or connect the conducting path in an electrical circuit, interrupting the electric current or diverting it from one conductor to another.

vi. GPS: The US government owns this satellite-based radio system, which was formerly known as Navistar GPS. It is one of the global navigation satellite systems (GNSS) that can give a GPS receiver location and time data anywhere on or near the planet as long as four or more GPS satellites can be seen clearly from one another.

vii. LCD Display: The term "LCD 16x2" refers to an electronic device that shows messages and data. As implied by the name, it has 16 Columns and 2 Rows, allowing it to display 32 characters (16×2=32) overall. Each character is created using 5×8 (40) Pixel Dots. Thus, the total number of pixels in this LCD can be determined as 32 x 40, if not 1280. viii.Vibration Sensor: A vibration sensor is a measuring device. As the name implies it senses the vibration or to- and-fro movement of any equipment or system at the location where it is applied. It measures the amplitude and frequency of vibration of the system under study.

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The most widespread ap- plication of vibration sensors is found to measure the vibration of rotating equipment and machines like pumps, compressors, steam turbines, and connected lines. These measured outputs are then studied to detect any imbalance or issues in the asset or equipment under investigation to predict the condition of the system. Vibration sensors are very important components of a vibration-measuring tool.

ix.SIM: A SIM card is a tiny cellular module that enables phone conversations, SMS sending and receiving, and GPRS transmission. This module's tiny size, low cost, and support for quadband frequencies make it the ideal choice for any project requiring long-range connectivity. Power module connects, boots up, finds a cellular network, and automatically logs in.

A. Software Required

Arduino IDE: Code can be written, assembled, and uploaded to the Arduino UNO using the Arduino IDE. It comes with a variety of libraries for interacting with sensors and modules, as well as an intuitive interface for creating Arduino sketches.

## VI. RESULT AND DISCUSSION

The design, implementation, and user feedback of an In- ternet of Things (IoT) smart helmet for bikers are presented. When assessing safety features, the helmet reliably and ef- ficiently used vibration sensors to identify accidents and instantly send emergency alerts to pre-designated contacts.The images below show the working kit for the Internet of Things- based intelligent helmet system, as well as various case scenarios and operating messages. By requiring the wearer to wear a helmet and verifying that they haven't consumed more alcohol than is permitted, the Smart helmet's design ensures the rider's safety. The suggested technology will prohibit the rider from starting the bike in the event that any of these primary safety regulations are broken.

Fig. 2. Working Kit

Fig. 3. LCD Display of GPS

Fig. 4. LCD Display

By providing the police station with an SMS including the biker's location, the technology also aids in the effective management of accident aftermath. In the event of an acci- dent, this guarantees that the victims receive appropriate and timely medical assistance.The integration of GPS navigation was deemed beneficial, providing clear route guidance and real-time traffic updates, contributing significantly to riders' convenience and journey planning.


Fig. 5.


Fig. 6. Messages sent to registered mobile number

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## VII. CONCLUSION

In conclusion, the development and deployment of an IoT based smart helmets for bikers represent a significant advancement in enhancing safety, communication, and con- venience on the road. By integrating advanced sensors like accelerometers and gyroscopes, the helmet effectively detects

accidents and triggers timely emergency alerts, potentially mitigating severe outcomes. User feedback has underscored the helmet's practicality in real-world scenarios, highlighting its robust GPS navigation for route guidance and hands-free communication capabilities that simplify interactions while riding. Despite initial challenges in optimizing power management for prolonged battery life, ongoing improvements in technology offer promising avenues for enhancing endurance and usability. Looking forward, future iterations could explore additional features such as collision avoidance systems or biometric sensors to further make safety measures. Ultimately, the IoT-based smart helmet addresses current safety concerns and sets a foundation for continued innovation in wearable technology, promising a safer and more connected experience for bikers worldwide. Driving while intoxicated is discouraged by stopping intoxicated riders from operating a vehicle. Find- ing an accident as soon as it happens might expedite the arrival of the medical team and potentially save a life. Accidents can be avoided by alerting the rider if they are going too fast or tilting their bike. In order to prevent accidents, the initiative makes sure that riders are seated properly and issues warnings when there is a risk. The bike's speed and tilt may be tracked in real time along three axes thanks to the effective operation of the IoT module. This supports the monitoring and preventive actions taken by concerned authorities on riders.

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