SMART HELMET SAFETY SYSTEM

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***Abstract*—With the growing number of 2-wheel motor vehicles, the frequency of accidents is on the rise. A major portion of the fatalities occur because the person was either not wearing a helmet, and he could not be saved because of the delayed admittance to a hospital, or because he was riding while drunk. We propose mechanisms that can detect if one is wearing the helmet, and detect whether the person has over-consumed alcohol. For this purpose, we use breath-analyzer Sensor, breath-analyzer (MQ3). The helmet is equipped with an buzzer to alert the user when alcohol is detected with Engine stop. The breath analyzer senses the amount of alcohol present in the breath of a person wearing the helmet and reports if it is beyond the legal limit. This can help optimize accident detection in the future when enough data is gathered to provide reliable accuracy. This will ensure the holistic safety of the rider at all times. The project aims to reduce the number of accidents caused by drunk driving by providing an effective and reliable solution to detect alcohol consumption while driving. The system is cost-effective, user friendly, and can be easily integrated into existing helmet**

I. INTRODUCTION

In recent years, technological advancements have permeated nearly every aspect of daily life, significantly transforming traditional practices into innovative solutions. One notable development is the emergence of smart helmet safety systems, which represent a significant leap forward in personal safety for motorcyclists, cyclists, and industrial workers. These systems integrate advanced technologies such as the Internet of Things (IoT), artificial intelligence (AI), and augmented reality (AR) to enhance the functionality of traditional helmets.

Smart helmet safety systems are designed to address various safety challenges and enhance user experience by incorporating multiple sensors, communication modules, and interactive features. These helmets can monitor and analyze the wearer's environment, detect potential hazards, and provide real-time feedback, thereby reducing the risk of accidents and injuries. For motorcyclists, smart helmets offer features such as GPS navigation, voice control, and hands-free communication, allowing riders to stay connected and informed without compromising their safety. Cyclists benefit from integrated lighting systems, turn signals, and collision detection, which improve visibility and awareness on the road.

One of the most critical components of smart helmets is the array of sensors embedded within the structure. These sensors include accelerometers, gyroscopes, and magnetometers, which work together to detect sudden impacts, falls, or abnormal movements. In the event of an accident, the helmet can automatically trigger an emergency response by alerting designated contacts .

Moreover, smart helmets are increasingly incorporating augmented reality (AR) technology to provide a heads-up display (HUD) that projects essential information onto the visor. This feature allows users to access critical data, such as speed, navigation instructions, and incoming calls, without diverting their attention from their surroundings. For industrial workers, AR-enabled helmets can display work instructions, hazard alerts, and safety guidelines directly in their field of vision, thus enhancing productivity and reducing the likelihood of errors or accidents.

Another significant aspect of smart helmet safety systems is their ability to facilitate continuous health monitoring. By integrating biometric sensors, these helmets can track the wearer's heart rate, body temperature, and other vital signs. This data can be used to detect signs of fatigue, heat stress, or other health issues, prompting timely interventions and promoting overall well-being. In high-risk environments, such as construction sites or mines, this continuous monitoring can prevent accidents caused by human error or physical exhaustion.

The development of smart helmet safety systems is also driven by the need for seamless communication. Advanced helmets are equipped with Bluetooth and wireless communication technologies, enabling users to stay connected with their teams or control centers. This connectivity is particularly beneficial in scenarios where coordination and quick response are crucial, such as in emergency services or military operations. Through integrated communication systems, smart helmets can facilitate better team coordination, information sharing, and situational awareness, thus enhancing operational efficiency and safety.

Furthermore, the integration of AI in smart helmets has opened new avenues for proactive safety measures. AI algorithms can analyze data from various sensors to predict potential hazards and suggest preventive actions. For example, an AI-powered helmet can identify patterns in the wearer's movements that indicate fatigue or distraction and provide timely alerts to avoid accidents. This predictive capability not only enhances personal safety but also contributes to the overall safety culture in workplaces and on the roads.

Smart helmet safety systems represent a remarkable convergence of technology and safety, offering comprehensive solutions to protect and empower users in diverse environments. By integrating sensors, communication modules, and advanced analytics, these helmets provide real-time monitoring, instant alerts, and critical information that can significantly reduce the risk of accidents and improve user experience. As technology continues to evolve, smart helmets are poised to become an indispensable tool in enhancing personal safety and advancing the broader goals of health and safety in various sectors This will integrate the systems in Artificial intelligence to make the proactive safety measures and predict the potential hazards before handedly and can identify the patterns in the wearer’s movements that indicate fatigue or distraction and provide timely alerts to avoid accidents.

While the primary focus of smart helmet safety systems is on enhancing safety, user comfort and ergonomics are also crucial considerations. Modern smart helmets are designed with lightweight materials and ergonomic shapes to ensure they do not cause discomfort during prolonged use. Ventilation systems, adjustable padding, and customizable fits are incorporated to cater to individual preferences and ensure maximum comfort.

As the adoption of smart helmets grows, so too does the need for regulatory and standardization efforts to ensure their safety and reliability. Regulatory bodies are beginning to establish standards for the performance, durability, and interoperability of smart helmets. These standards are crucial for ensuring that smart helmets provide consistent and reliable protection and that they can be safely used in various environments. Standardization also facilitates the development of compatible accessories and systems, further enhancing the functionality and appeal of smart helmets.

II. LITERATURE SURVEY

In[1] “Alcohol Detection Using Smart Helmet System,” Sudharsana Vijayan, Vineed T. Govind, Merin Mathews, Simna Surendran, and Muhammed Sabah present a smart helmet designed to enhance road safety by detecting the presence of alcohol in a rider's breath. Published in the International Journal of Emerging Technology in Computer Science & Electronics (IJETCSE) in April 2014, the study outlines a system that integrates an alcohol sensor within the helmet, which can prevent the vehicle from starting if the rider's breath alcohol concentration exceeds a predefined limit. This innovation aims to reduce accidents caused by drunk driving, thereby promoting safer road practices.

In[2] “Online Driving Style Recognition using Fuzzy Logic,” Dominik Dörr, David Grabengiesser, and Frank Gauterin present a method for identifying driving styles in real-time using fuzzy logic. Presented at the IEEE 17th International Conference on Intelligent Transportation Systems (ITSC) in October 2014 in Qingdao, China, the study proposes a system that analyzes various driving parameters to classify driving behavior dynamically. This approach aims to improve traffic safety and efficiency by providing adaptive feedback based on the recognized driving style, ultimately contributing to smarter and safer transportation systems.

In[3] “Vehicular Ad Hoc Networks (VANETs): Current State, Challenges, Potentials and Way Forward,” Elias C. Eze, Sijing Zhang, and Enjie Liu review the status and future prospects of VANETs. Published in 2014 by the Centre for Wireless Research at the University of Bedfordshire, the study discusses the technological advancements, current challenges, and potential applications of VANETs in improving traffic management and safety. The authors highlight the need for addressing issues such as security, scalability, and standardization to fully realize the benefits of VANETs in creating efficient and intelligent transportation systems.

In[4] “Smart Helmet using GSM & GPS Technology for Accident detection and reporting system” by Manjesh N and Prof. Sudarshan Raj present a smart helmet designed to detect accidents and report them using GSM and GPS technologies. Published in the International Journal of Electrical and Electronics Research in the October-December 2014 issue, the study outlines a system where the helmet detects collisions and automatically sends the location and accident alert to predefined contacts. This innovation aims to enhance rider safety by ensuring timely emergency responses and reducing the consequences of accidents.

In[5] “A Low Power Intelligent Helmet System,” Albert Daimary, Meghna Goswami, and Ratul Kumar Baruah present a helmet designed to enhance safety while conserving power. Published in 2017 by the Department of Electronics & Communication Engineering at Tezpur University, Assam, India, the study details a system that integrates various sensors to monitor environmental conditions and the wearer's status. This low-power intelligent helmet aims to provide real-time safety alerts and data transmission while optimizing energy consumption, making it practical for prolonged use in diverse conditions.

In[6] “Biometric Automobile Ignition Locking System,” R. M. Vithlani, Sagar Shingala, and Dr. H. N. Pandya present a secure vehicle ignition system that utilizes biometric authentication. Published in the International Journal of Electronics and Communication Engineering and Technology (IJECET) in 2016, the study details a system that requires biometric data, such as fingerprints, to start the vehicle, thereby enhancing security by ensuring that only authorized users can operate the vehicle. This biometric approach aims to prevent theft and unauthorized access, significantly improving the safety and security of automobiles.

In[7] “Two-Factor Authentication Based Automobile Keyless Entry System,” O. Akinsanmi, A. D. Usman, A. Abdulraheem, G. D. Obikoya, and B. G. Bajoga present a secure keyless entry system for vehicles that employs two-factor authentication. Published in the International Journal of Engineering and Applied Sciences (IJEAS) in 2015, the study describes a system that combines something the user knows (a PIN or password) with something the user possesses (a key fob or mobile device) to enhance security. This approach aims to provide a robust defense against unauthorized access, improving the overall safety of automotive keyless entry systems.

In[8] “Smart Protection of Vehicle using Multi Factor Authentication (MFA) Technique,” S. Aliyu, Umar Abdullahi, Majeedat Pomam, Mustapha Hafiz, Adeiza Sanusi, and Sodiq Akanmu explore the implementation of a multi-factor authentication system to enhance vehicle security. Presented at the 3rd International Engineering Conference (IEC) in 2019, the study outlines a security system that combines multiple authentication factors, such as passwords, biometric data, and smart cards, to ensure only authorized users can access and operate the vehicle. This approach significantly strengthens vehicle protection against unauthorized access and theft by adding multiple layers of security.

In[9] “Predictive Prevention of Loss of Vehicle Control for Roadway Departure Avoidance,” Mohammad Ali, Paolo Falcone, Claes Olsson, and Jonas Sjoberg propose a predictive system aimed at preventing loss of vehicle control and roadway departure accidents. Published in 2013, the study focuses on developing algorithms that anticipate potential loss of control events based on vehicle dynamics and driver behavior. By providing real-time warnings or interventions, this system aims to mitigate the risk of accidents and enhance road safety, particularly on highways and winding roads where loss of vehicle control is more prevalent.

In[10]“Comparing Car Drivers’ and Motorcyclists’ Opinions about Junction Crashes,” Chloe J. Robbins, Harriet A. Allen, and Peter Chapman analyze perspectives on junction crashes from both car drivers and motorcyclists. Published in Accident Analysis & Prevention, the study investigates the opinions, experiences, and perceived causes of junction-related accidents among these two road user groups. By comparing their viewpoints, the research aims to identify potential differences in understanding and awareness, with the ultimate goal of informing targeted interventions to reduce the incidence of junction crashes and improve road safety for all.

In[11] "Smart Helmet with Sensors for Accident Prevention," M. K. A. Mohd Rasli, N. K. Madzhi, and J. Johari present a novel helmet design showcased at the 2013 International Conference on Electrical, Electronics and System Engineering. The smart helmet integrates various sensors to detect potential accident scenarios, such as sudden impacts or falls. By providing real-time alerts to the wearer or relevant authorities, the system aims to prevent accidents and improve overall safety for users, making it a significant advancement in personal protective gear for various activities.

In[12] "Smart Helmet," N. Nataraja, K. S. Mamatha, Keshavamurthy, and Shivashankar present an innovative helmet design showcased at the 2018 IEEE International Conference on Recent Trends in Electronics, Information & Communication Technology. The smart helmet incorporates advanced technologies such as sensors, communication modules, and real-time monitoring systems to enhance user safety and experience. By integrating features like accident detection, GPS tracking, and communication capabilities, the helmet aims to mitigate risks and improve response times in emergency situations, contributing to overall road safety.

In[14]This study basically discussed about increasing efficiency of PV panels in dessert regions. The author explained that by using part of the power output of the solar panel two degrees of freedom orientation can be achieved. If we consider the symmetry of the system, the kinematics of the system can be controlled using astronomic calculation.

In[15] "Smart Helmet with Accident Avoidance System," L. Kanimozhi, R. Sambasivam, M. Pragathi, and M. Ranjith introduce an innovative helmet design featured in the Cikitusi Journal for Multidisciplinary Research. The smart helmet integrates an accident avoidance system utilizing advanced sensors and real-time monitoring capabilities. By detecting potential hazards and providing timely alerts to the wearer, the system aims to prevent accidents and enhance overall safety for users, representing a significant advancement in protective headgear technology for various applications.

ARCHITECTURE

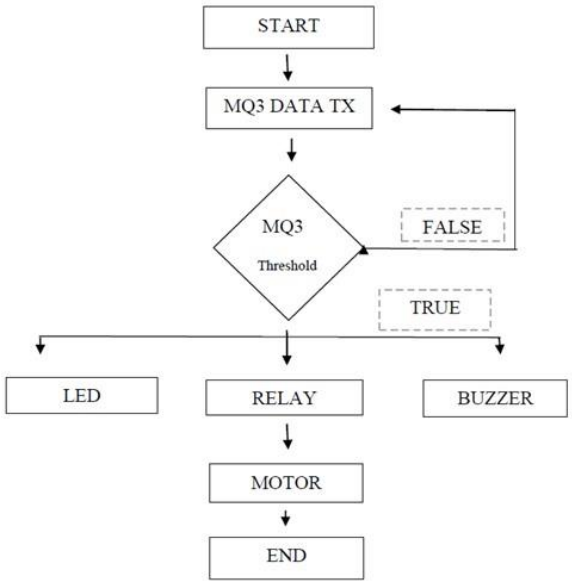


Fig 1 :
Architecture

A. Arduino board

The Arduino board is a versatile and widely used open-source electronics platform that empowers individuals, from beginners to experienced developers, to create interactive projects. Featuring a microcontroller and a user-friendly development environment, Arduino enables users to easily program and control various sensors, actuators, and other electronic components. Its flexibility and accessibility make it ideal for prototyping and experimenting in fields such as robotics, home automation, IoT (Internet of Things), and education. With a vibrant community and extensive online resources, Arduino fosters innovation and creativity, allowing enthusiasts to bring theirideas to life with minimal barriers to entry.

B. Jumper Wires

Both ends have a male pin connector designed to plug into sockets or holes.They are commonly used to create temporary connections on breadboards, for prototyping electronic circuits without soldering. They can also be used to connect components with male header pins. Male-to-malejumper wires are reusable and allow for easy changes to be made to a circuit during the prototyping stage. They also come in various lengths and colors for easy identification of different connections.

*C. MQ3 Sensor**

The MQ-3 sensor is a type of gas sensor specifically designed to detect alcohol vapor in the air. It operates based on the principle of conductivity changes in the presence of alcohol molecules. When alcohol vapor comes into contact with the sensor's surface, it alters the sensor's resistance, which can be measured to determine the concentration of alcohol in the air. The MQ-3 sensor is commonly used in various applications, including breathalyzer devices, automotive safety systems, and smart alcohol detection systems such as those integrated into smart helmets for preventing drunk driving accidents.

D. DC MOTOR

A DC motor, short for Direct Current motor, is an electric motor that converts electrical energy into mechanical energy. It operates using the principle of electromagnetism, where a current-carrying conductor within a magnetic field experiences a force. DC motors consist of a stationary part called the stator and a rotating part called the rotor. When electric current flows through the motor's coils, it generates a magnetic field that interacts with the permanent magnets or magnetic field of the stator, causing the rotor to rotate. DC motors are widely used in various applications, including automotive systems, industrial machinery, robotics, and household appliances, due to their simplicity, reliability, and controllability.

E. Signal Transmitter and Receiver

A signal transmitter and receiver are components of a communication system that work together to send and receive information wirelessly. The transmitter converts the information into a suitable form for transmission, such as electromagnetic waves or optical signals, and emits it into the surrounding medium. The receiver then detects the transmitted signals, extracts the information, and converts it back into its original format for interpretation by the user or another device. These components are essential in various communication technologies, including radio, television, wireless internet, and telecommunications systems. They enable the exchange of data over long distances without the need for physical connections, facilitating efficient and convenient communication.

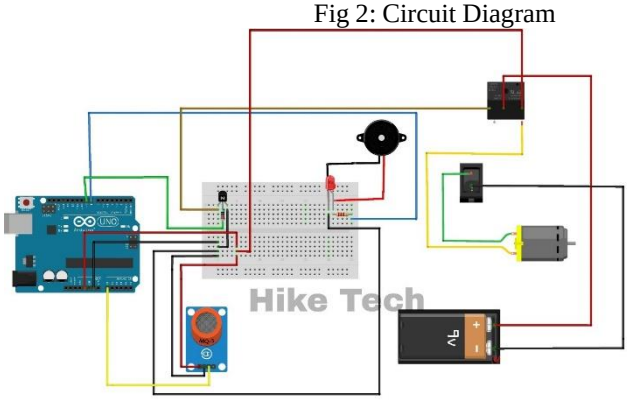
F. 12V Relay

A 12V relay is an electromechanical switch that operates using a 12-volt direct current (DC) power supply. It consists of a coil, which when energized with a 12V DC voltage, generates a magnetic field that attracts a movable armature or switch contact. This action causes the switch contacts to close or open, depending on the relay type and configuration. 12V relays are commonly used in automotive applications, home automation systems, electronic circuits, and industrial control systems to control higher voltage or current circuits using a low-voltage control signal. They offer versatility, reliability, and compatibility with a wide range of electrical devices and systems.

III. Circuit Explanation

The circuit diagram of a smart helmet safety system encompasses a carefully designed integration of electronic components aimed at enhancing user safety and providing real-time monitoring and feedback. At its core is a microcontroller, serving as the system's brain, which processes data from an array of sensors strategically placed within the helmet. These sensors may include accelerometers, gyroscopes, GPS modules, and gas sensors like the MQ3, which collectively monitor the wearer's environment for potential hazards such as sudden impacts, changes in direction, or hazardous gases. The microcontroller processes this sensor data and triggers appropriate actions, such as activating alerting mechanisms or transmitting emergency signals via wireless communication modules like Bluetooth or Wi-Fi.

Fig 2: Circuit Diagram



Additionally, the circuit diagram includes power supply components to ensure a stable power source, control interfaces for user interaction, and alerting mechanisms like buzzers or LEDs to provide immediate feedback to the wearer. Through this integration, the smart helmet safety system offers comprehensive protection, alerting the wearer to potential dangers in real-time and facilitating communication with external devices or monitoring stations. Overall, the circuit diagram reflects a sophisticated yet user-friendly design aimed at enhancing safety and situational awareness for motorcyclists, cyclists, or industrial workers in various environments.

Motion detection ensures speed are only on when needed, minimizing accidents. Improved visibility in low-light conditions can deter crime and increase pedestrian safety. Reduces accidents evolutions associated with traditional grid-powered processes this sensor data and triggers appropriate actions, such as activating alerting mechanisms or transmitting emergency signals via wireless communication modules and overall illumination

Fig 3: Project Implementation

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Assessment of battery performance in different speed and its ability to meet nighttime detection of alcohol of persons efficiency in way of using their vechicles in the day to day life..

CONCLUSION AND FUTURE ENHANCEMENT

Smart helmet safety systems represent a significant advancement in personal safety technology, offering a comprehensive solution to mitigate risks and enhance user protection in various environments. These systems integrate advanced sensors, communication modules, and real-time monitoring capabilities to detect potential hazards.

There are several promising avenues for future enhancement of smart helmet safety systems. One area of focus is improving sensor accuracy and reliability to enhance hazard detection and reduce false alarms. Additionally, advancements in artificial intelligence and machine learning could enable smarter and more adaptive safety features, such as predictive accident prevention or personalized alerting based on user behavior patterns. Integration with emerging technologies like augmented reality (AR) could provide users with enhanced situational awareness and real-time guidance, further enhancing safety.

REFERENCES

[1]. Sudharsana Vijayan, Vineed T Govind, Merin Mathews, SimnaSurendran, Muhammed Sabah,“ALCOHOL DETECTION USING SMART HELMET SYSTEM”,- International Journal of Emerging Technology in Computer Science & Electronics (IJETCSE) ISSN:0976-1353 volume 8 issue 1 – APRIL 2014.

[2]. Dominik Dorr ¨ 1 , David Grabengiesser2 and Frank Gauterin1 2014,"Online Driving Style Recognition using Fuzzy Logic"- IEEE 17th International Conference on Intelligent Transportation Systems (ITSC) October 8-11, 2014. Qingdao, China.

[3]. Elias C. Eze, Sijing Zhang and Enjie Liu, "Vehicular Ad Hoc Networks (VANETs): Current State, Challenges, Potentials and Way Forward" - Centre for Wireless Research, Institute for Research in Applicable Computing (IRAC), Department of Computer Science and Technology, University of Bedfordshire, Luton, LU1 3JU, England,2014

[4]. Manjesh N,Prof. Sudarshan Raj ,"SMART HELMET USING GSM & GPS TECHNOLOGY FOR ACCIDENT DETECTION AND REPORTING SYSTEM"- International Journal of Electrical and Electronics Research ISSN 2348-6988 Vol. 2, Issue 4, pp: (122-127), Month: October - December 2014, Research Publish Journals.

[5]. Albert Daimary, Meghna Goswami and Ratul Kumar Baruah ."A Low Power Intelligent Helmet System,2017". Department of Electronics & Communication Engineering Tezpur University Tezpur, Assam, India .

[6] O Akinsanmi, A D Usman, A Abdulraheem, G D Obikoya and B G Bajoga 2015 "Two-Factor Authentication Based Automobile Keyless Entry System", International Journal of Engineering and Applied Sciences (IJEAS) ISSN: 2394-3661, 2, Issue-8.

[7] R M Vithlani, Sagar Shingala, Dr. H N Pandya 2016 "Biometric automobile ignition locking system", International Journal of Electronics and Communication Engineering and Technology (IJECET) 7, Issue 5, pp. 28–37.

[8] S Aliyu, Umar Abdullahi, Majeedat Pomam, Mustapha Hafiz, Adeiza Sanusi, and Sodiq Akanmu 2019 "Smart Protection of Vehicle using Multi Factor Authentication (MFA) Technique", 3 rd International Engineering Conference IEC pp 701 - 710.

[9] Mohammad Ali, Paolo falcone, Claes Olsson and Jonas Sjoberg. 2013. "Predictive prevention of Loss of Vehicle Control for Roadway Departure Avo

[10] Chloe J. Robbins, Harriet A. Allen, Peter Chapman, 2018. "Comparing car drivers' and motorcyclists' opinions about junction crashes", Accident Analysis & Prevention, 117, pp 304- 317