Smart Helmet System by Using Mq-3 Sensor & Ir Sensor

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***Abstract*—The Smart Helmet with an Alcohol Sensor is designed to enhance road safety by preventing intoxicated individuals from riding motorcycles. This helmet integrates an alcohol sensor,an IR sensor, a DC motor, a battery, a relay, and IoT technology. The alcohol sensor detects the presence of alcohol in the rider's breath. If alcohol is detected beyond a predefined limit, the relay disconnects the ignition system, preventing the bike from starting. The IoT module enables real-time monitoring and alerts authorities or emergency contacts in case of intoxication. The DC motor and battery power the system, ensuring reliable operation. This innovative helmet aims to reduce accidents caused by drunk driving by enforcing safety measures at the source. Its integration with IoT further enhances its effectiveness by providing remote monitoring and data logging. This smart helmet serves as a proactive solution to road safety, offering a practical and technological approach to minimizing alcohol-related accidents.**

1. INTRODUCTION

Road accidents due to drunk driving are a significant concern worldwide. To address this issue, a smart helmet with an alcohol sensor is designed, incorporating IoT technology, a DC motor, a battery and a relay system. This innovative helmet ensures that a rider under the influence of alcohol cannot start the vehicle, thereby enhancing road safety.

The smart helmet is equipped with an MQ-3 alcohol sensor, which detects the presence of alcohol in the rider's breath. If the alcohol level exceeds a predefined threshold, the system sends a signal to the relay, cutting off the power supply to the vehicle's ignition system, thus preventing the rider from starting the bike. Additionally, the IoT module (such as Node MCU or ESP8266) can be integrated to send real-time alerts to a registered mobile number or cloud-based system, ensuring immediate action.

The IR Sensor is a device which is used to detect the presence of the helmet wear by the rider or not. It is placed in the helmet front side right above before the riders' face. It transmits Infrared waves which sense the object before it and receive the signal, which connects to the relay. If the rider doesn't wear the helmet the signal transmits to the receiver which is connected to the relay and cut off the ignition which means the does not start or move until the rider wears the helmet.

A DC motor is used to simulate the ignition mechanism, demonstrating how the vehicle's engine functions in response to sensor inputs. The helmet is powered by a battery, ensuring portability and convenience. The system operates wirelessly, requiring the rider to wear the helmet for the vehicle to function, promoting helmet usage.
This smart helmet significantly enhances road safety by combining sensor technology, IoT connectivity, and automation. It prevents drunk and drive encourages helmet use, and can be further enhanced with GPS tracking and accident detection features. This technology serves as a vital step toward reducing road accidents and saving lives.

2. OBJECTIVES

The objectives of this study is,

- To utilize industrial by-products such as fly ash, Ground Granulated Blast Furnace Slag (GGBS), and Manufactured Sand (M-sand) in the production of geopolymer bricks, thereby promoting waste valorization and environmental sustainability.
- To determine the optimal mix ratio of raw materials that yields the best performance in terms of workability, compressive strength, and durability.

- To analyze the physical and mechanical properties of the geopolymer bricks, including compressive strength, water absorption, and efflorescence test.

3. METHODOLOGY

The development of the smart helmet followed a structured methodology involving the following stages:

Problem Identification: Studied accident data to identify the correlation between drunk driving and non-usage of helmets.

1. Component Selection: Selected appropriate sensors (MQ-3 and IR), microcontrollers (NodeMCU), and actuators (relay and buzzer).
2. Circuit Design: Designed transmitter and receiver modules with ESP-NOW communication.
3. Programming: Developed firmware for both transmitter and receiver using Arduino IDE.
4. Hardware Integration: Mounted the transmitter inside the helmet and receiver on the vehicle.
5. Testing: Conducted multiple test cases simulating different conditions like helmet worn/not worn, alcohol present/absent.
6. Validation: Measured performance in terms of responsiveness, accuracy, and reliability.

This methodology ensured systematic development, resulting in a robust safety solution.

4. SYSTEM COMPONENTS

The smart helmet consists of two modules: transmitter (helmet) and receiver (vehicle).

4.1 MQ-3 Alcohol sensor

An alcohol sensor is a device designed to detect the presence of alcohol vapor in the air or on a person's breath. These sensors are commonly used in various applications, including breathalyzer tests for law enforcement, automotive safety systems, and personal breathalyzers for individuals concerned about their blood alcohol content (BAC).

Fig 4.1: MQ-3 Alcohol Sensor

4.2 IR Sensor

IR sensor is an electronic device that emits the light in order to sense some object of the surroundings. An IR sensor can measure the heat of an object as well as detects the motion. Usually, in the infrared spectrum**,** all the objects radiate some form of thermal radiation. These types of radiations are invisible to our eyes, but infrared sensor can detect these radiations.

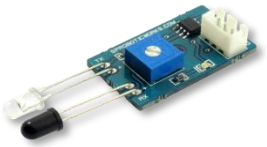

Fig 4.2: IR Sensor

4.3 NodeMCU (ESP8266)

The NodeMCU (***N***ode *M*icro ***C***ontroller ***U***nit) is an open-source software and hardware development environment built around an inexpensive System-on-a-Chip called the ESP8266. The ESP8266, designed and manufactured by Espressif Systems, contains the crucial elements of a computer: CPU, RAM, networking (WiFi), and even a modern operating system and SDK. That makes it an excellent choice for Internet of Things projects of all kinds.

Fig 4.3: NodeMCU (ESP8266)

4.4 Relay Module

A relay is an electrically operated switch. Current flowing through the coil of the relay creates a magnetic field which attracts a lever and changes the switch contacts. The coil current can be on or off so relays have two switch positions and they are double throw switches. Relays allow one circuit to switch a second circuit which can be completely separate from the first There is no electrical connection inside the relay between the two circuits

Fig 4.4: Relay module

4.5 DC Motor

A DC motor is any of a class of rotary electrical machines that converts direct current electrical energy into mechanical energy. The most common

types rely on the forces produced by magnetic fields. Different number of stator and armature fields as well as how they are connected provides different inherent speed/torque regulation characteristics. The speed of a DC motor can be controlled by changing the voltage applied to the armature. The introduction of variable resistance in the armature circuit or field circuit allowed speed control.

Fig 4.5: DC Motor

4.6 Battery

A battery is a device that converts chemical energy directly to electrical energy. It consists of a number of voltaic cells; each voltaic cell consists of two half cells connected in series by a conductive electrolyte containing anions and cation. One half cell includes electrolyte and the electrode to which anions migrate, i.e., the anode or negative electrode; the other half-cell includes electrolyte and the electrode to which cation migrate, i.e., the cathode or positive electrode.. The electrodes do not touch each other but they are electrically connected by the electrolyte. Some cells use two half-cells with different electrolytes

Fig 4.6: Battery

4.7 Helmet

A vehicle riding helmet, often referred to as a biker helmet or motorcycle helmet, is a type of protective headgear designed to safeguard the rider's head and neck during accidents or falls while operating a two-wheeled vehicle. These helmets typically have a hard shell made of materials like fiberglass or plastic, with an impact-absorbing inner layer, and may include features like visors, ventilation, and other safety features.

Fig 4.7: Helmet

5. WORKING PRINCIPLE

If the IR sensor confirms helmet wear and MQ-3 sensor does not detect alcohol, the system sends a signal to the receiver unit to enable ignition. Otherwise, ignition is disabled and a buzzer alert is activated.

Detailed Working Principle

The smart helmet system is designed to operate in a real-time environment and works through a sequence of logical events:

1. Helmet Wear Detection: The IR sensor embedded in the helmet emits infrared rays that are reflected by the rider's head or skin. When the helmet is worn properly, the reflected rays are detected by the IR receiver, indicating helmet usage.
2. Alcohol Detection: The MQ-3 sensor monitors the presence of ethanol in the rider's breath. If alcohol vapors are detected above a certain threshold, it sends a signal to the NodeMCU indicating intoxication.
3. Data Transmission: NodeMCU processes both sensor readings and transmits them wirelessly to the receiver unit installed on the vehicle using the ESP-NOW protocol.
4. Ignition Control: The receiver unit activates or disables the relay based on input, allowing or preventing the ignition of the vehicle.
5. IoT Alerts: When connected with IoT (Blynk), the system can send notifications to mobile devices upon alcohol detection or helmet absence.
6. User Feedback: Status updates are displayed via an LCD screen for user interaction.

Logic for helmet detection using IR sensor

If IR Signal = Present → Helmet is Worn → Proceed to Alcohol Detection

Else → Block Ignition → "Wear Helmet" Alert

Logic for alcohol detection using MQ-3 sensor

If Alcohol Level ≤ Threshold → Allow Ignition

Else → Block Ignition → "Alcohol Detected" Alert

6. CIRCUIT CHART

Transmitter setup to be placed in the helmet:

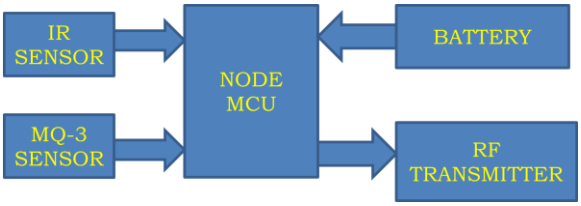

Fig 6.1: Transmitter setup to be placed in the helmet

Receiver setup to be placed in vehicle:

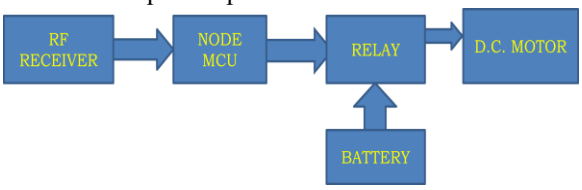

Fig 6.2: Receiver setup to be placed in vehicle

7. FRAME WORKS

This frame has been designed for the two-wheeler vehicle prototype model for the experimental use to execute the result for this project.

7.1 MATERIALS USED

7.1.1 METAL FRAME

The metal frame is generally made of mild steel bars for machining, suitable for lightly stressed components including studs, bolts, gears and shafts. It can be case-hardened to improve wear resistance

Fig 7.1: Metal frame

7.1.2 SHEET METAL

Sheet metal is metal formed by an industrial process into thin, flat pieces. It is one of the fundamental forms used in metalworking and it can be cut and bent into a variety of shapes. Countless everyday objects are fabricated from sheet metal. Thicknesses can vary significantly; extremely thin thicknesses are considered foil or leaf, and pieces thicker than 6 mm (0.25 in) are considered plate

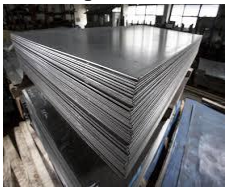

Fig 7.2 sheet metal

7.1.3 METAL STRIP

Metal strip can be designed and manipulated through a large number of processes which are grouped into categories. They are joining and assembly processes, deformation processes, material removal processes, heat treating processes, and finishing processes.

Fig 7.3 Metal strip

7.2. PROCEDURE

7.2.1 MANUFACTURING PROCESS

Manufacturing processes are the steps through which raw materials are transformed into a final product. The manufacturing process begins with the creation of the materials from which the design is made. These materials are then modified through manufacturing processes to become the required part. Manufacturing processes can include treating (such as heat treating or coating), machining, or reshaping the material. The manufacturing process also includes tests and checks for quality assurance during or after the manufacturing, and planning the production process prior to manufacturing.

7.2.2. SAWING

Cold saws are saws that make use of a circular saw blade to cut through various types of metal, including sheet metal. The name of the saw has to do with the action that takes place during the cutting process, which manages to keep both the metal and the blade from becoming too hot. A cold saw is powered with electricity and is usually a stationary type of saw machine rather than a portable type of saw. The circular saw blades used with a cold saw are often constructed of high speed steel. Steel blades of these types are of resistant to wear even under daily usage. The end result is that it is possible to complete a number of cutting projects before there is a need to replace the blade. High speed steel blades are especially useful when the saws are used for cutting through thicker sections of metal.

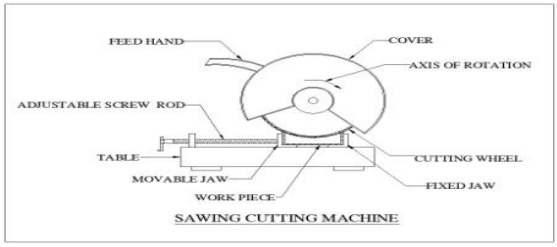

Fig 7.4: Sawing

7.2.3. WELDING

Welding is a process for joining similar metals. Welding joins metals by melting and fusing **1,** the base metals being joined and **2,** the filler metal applied. Welding employs pinpointed, localized heat input. Most welding involves ferrous-based metals such as steel and stainless steel. Weld joints are usually stronger than or as strong as the base metals being joined.Welding is used for making permanent joints. It is used in the manufacture of automobile bodies, aircraft frames, railway wagons, machine frames, structural works, tanks, furniture, boilers, general repair work and ship building.

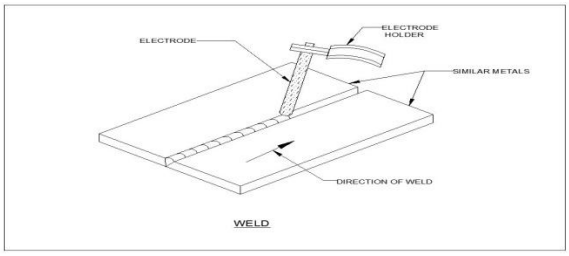

Fig 7.5: Welding

7.2.4. OPERATION

Several welding processes are based on heating with an electric arc, only a few are considered here, starting with the oldest, simple arc welding, also known as shielded metal arc welding (SMAW) or stick welding. In this process an electrical machine (which may be DC or AC, but nowadays is usually AC) supplies current to an electrode holder which carries an electrode which is normally coated with a mixture of chemicals or flux. An earth cable connects the work piece to the welding machine to provide a return path for the current. The weld is initiated by tapping ('striking') the tip of the electrode against the work piece which initiates an electric arc. The high temperature generated (about 6000^{o}C) almost instantly produces a molten pool and the end of the electrode continuously melts into this pool and forms the joint.The operator needs to control the gap between the electrode tip and the work piece while moving the electrode along the joint.

7.2.5. DRILLNG

Drilling is a cutting process that uses a drill bit to cut or enlarge a hole of circular cross-section in solid materials. The drill bit is a rotary cutting tool, often multipoint. The bit is pressed against the work piece and rotated at rates from hundreds to thousands of revolutions per minute. This forces the cutting edge against the work piece, cutting off chips (sward) from the hole as it is drilled.

8. ADVANTAGES AND APPLICATIONS

8.1 ADVANTAGES

- Prevents Drunk Driving – The MQ-3 alcohol sensor detects alcohol levels, preventing the vehicle from starting if the rider is intoxicated.
- Enhances Road Safety – Reduces accidents caused by drunk driving, ensuring safer roads.
- Encourages Helmet Usage – The system ensures the vehicle only starts when the helmet is worn.
- IoT-Based Monitoring – Sends real-time alerts to authorities or family members in case of violations.
- Automatic Ignition Control – The relay and DC motor mechanism restrict ignition when alcohol is detected.
- Portable & Efficient – Powered by a battery, making it reliable and easy to use.

8.2 APPLICATION

- Road Safety Enforcement – Prevents drunk driving by restricting vehicle ignition.
- Personal Safety – Ensures only sober riders can operate the vehicle
- Fleet Management – Used in commercial transport to monitor driver sobriety.
- IoT-Based Monitoring – Sends alerts to authorities or family members.

9. CONCLUSION

The development and implementation of the smart helmet system have proven to be an effective step toward enhancing two-wheeler rider safety. By incorporating both alcohol detection and helmet-

wearing verification, the system provides a dual-layer safety mechanism.

- This significantly reduces the possibility of driving under the influence and ensures compliance with helmet usage laws. The integration of IoT for remote alerts and real-time monitoring further strengthens the functionality and adaptability of the system in modern smart transportation.
- The smart helmet system responds swiftly to sensor inputs and reliably prevents ignition if the rider is unfit to drive. It shows strong potential for widespread adoption in both urban and rural settings, where motorcycle usage is high and traffic law violations are common. This project not only demonstrates technological feasibility but also aligns with national road safety initiatives.
- Future enhancements can include GPS tracking for accident alerts, GSM-based communication for remote location updates, and integration with government traffic databases for automated violation logging.
- With appropriate funding and commercial support, this system could be scaled into a product capable of saving lives and improving road discipline across the globe.
- The system uses a non-intrusive and reliable method for detecting alcohol levels among the riders and can send alerts in case of high alcohol content.
- The system is cost-effective, easy to implement, and can be integrated with other smart features such as GPS tracking and collision detection, making it a highly desirable solution for motorcycle safety. In the future, the smart helmet alcohol detection system can be improved by incorporating advanced sensors and machine learning algorithms for more accurate and reliable results.
- Additionally, the system can be integrated with other smart features such as voice assistants and augmented reality displays to enhance the overall riding experience. Furthermore, the system can be expanded to include other forms of transportation such as cars, trucks, and buses, making it a comprehensive solution for preventing drunk and drive and promoting safe transportation.
- With further development and implementation, the alcohol detection system based on a smart helmet has the potential to significantly reduce the number of accidents caused by drunk and drive and save many lives.

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