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Design and Implementation of Protective Headgear to Reduce Human Casualties

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Abstract

Background: A smart helmet is a type of protective headgear used by the rider that makes bike driving safer than before.
Objectives: The main objective of this methodology is to build a safety system that reduces the number of two-wheeler accidents and drunken driving cases.
Methods: A belt tie sensor checks if the person is wearing the helmet or not. If the rider is not wearing a helmet, the bike remains off. The bike will start only when the rider is wearing a helmet.
Statistical Analysis: When the rider crashes and the helmet hits the ground, force sensors detect the motion and tilt of the helmet and report the occurrence of an accident.
Applications: It sends information about the corresponding location using GPS and sends a message to the registered number using GSM. The main advantage is that the proposed helmet can be used on any bike.
Improvements: It is not restricted to one user. Multiple users can use it. A panic button is provided to indicate the intensity of the accident.

Keywords: Accident, Tracking, Belt tie sensor

1. Introduction

A traffic accident is defined as any vehicle accident that occurs on public highway roads. The thought of developing this project comes to mind to do some good things for society. Many deaths are happening as the number of two-wheeler accidents increases day by day. Head protectors (helmets) have been made mandatory in Maharashtra State. Traffic collisions in India have expanded to a greater extent. According to Section 129 of the Motor Vehicles Act, 1988, it is necessary for each and every person riding a bike to wear defencing headgear adhering to the guidelines of the BIS (Bureau of Indian Standards). The WHO association has momentarily referenced the reasons for and the avoidance of traffic accidents that occurred all throughout the planet. They likewise referenced the most elevated death rate that occurred in India, and the study additionally detailed the rate at which 1.5 lakh people pass through the

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streets every year around. A smart helmet is a type of protective headgear used by the rider that makes bike driving safer than before. Nowadays, most countries are enforcing their citizens to wear helmets while riding a motorcycle and not to ride a bike when the person is under the influence of alcohol, but still, the rules are being violated. In order to overcome this problem, an "Ingenious Helmet with Bike System" is developed.

When a person meets with an accident, the helmet will fall down. Many times, a person might not get immediate medical help. Because of this, a person might die. In our idea, we are using Arduino to control entire operations. A belt tie sensor is used. If the rider does not wear a helmet properly, then our system will not turn on. A pressure and tilt sensor is used to detect the accident. A safety button is introduced to indicate that the person is safe after the accident. If this switch is pressed, then, through the GSM module, a safety message will be sent to selected contacts. During the accident, if the safety button is damaged, it means that the rider needs immediate medical help.

2. Literature Review

In [1], G. A. Chougule et al. designed a helmet in which there are mainly four features that are useful to prevent accidents and brain damage to the rider. It also detects the vicinity of the twist of fate. There are critical devices in the clever helmet. Helmet unit and motorcycle unit: in the helmet unit there is a transmitter block, and in the bike unit there is a receiver block. The transmitter transmits a signal from transmitter to receiver through an RF transmitter. There is a restriction transfer to come across whether or not the rider is sporting the helmet or not. The MQ2 sensor is used to determine whether or not the rider has taken alcohol or not while riding. A GSM and GPS machine is used to send the message to the relative whose SIM is of a wide variety in GSM. GPS gadgets are used to discover the region of coincidence. These capabilities make an easy helmet into a smart helmet. This paper presents the smart helmet that ensures that the rider cannot start the motorcycle without carrying it. This helmet makes use of a simple cable substitute for wirelessly switching on a bike, so that the motorcycle could not start without both the key and the helmet. Also, on every occasion the driver starts the ignition, the alcohol sensor measures the content of the alcohol in his breath and mechanically switches off the motorcycle if he is drunk.

In the research paper [2], Dr. B. Paulchamy et al. implemented helmets using GSM and GPS technology. Vibration sensors are located in extraordinary places on the helmet where the chance of hitting is greater and are connected to a microcontroller board. So when the rider crashes and the helmet hits the floor, those sensors sense it and offer it to the microcontroller board, which then extracts GPS statistics. When the records exceed the minimum strain limit, the GSM module routinely sends messages to ambulances or family members. This paper presents the smart helmet that ensures that the rider cannot start the motorcycle without carrying it. This helmet makes use of a simple cable substitute for wirelessly switching on a bike, so that the motorcycle could not start without both the key and the helmet. Also, on every occasion the driver starts the ignition, the alcohol sensor measures the content of the alcohol in his breath and mechanically switches off the motorcycle if he is drunk. then the controller extracts GPS statistics.

In [3], K. Vidhya, M. Kasisel Vanathan, et al. designed the helmet, which consists of an intelligent system embedded into the helmet and the vehicle. The helmet unit ensures that the rider is wearing a helmet and is not under the influence of alcohol at some stage in the experience. It communicates with the automobile unit to turn off the ignition gadget on the bike if the above situation isn't met. Vehicle unit checks and intimates twists of fate through geometric coordinates through Short Message Service. By using geometric coordinates, the area of the juried rider may be traced using simple monitoring software. Also, this system provides robbery safety, as a helmet is also crucial, along with the key to start a motorcycle. The helmet unit ensures that the rider is wearing a helmet and is not under the influence of alcohol at some stage in the experience. It communicates with the automobile unit to turn off the ignition gadget on the bike if the above situation isn't met. Vehicle unit checks and intimates twists of fate through geometric coordinates through Short Message Service. situation isn't met. Vehicle unit checks and intimates twists of fate through geometric coordinates through Short Message Service. By using geometric coordinates, the area of the juried rider may be traced using simple monitoring software. Also, this system provides robbery safety, as a helmet is also crucial, along with the key to start a motorcycle.

In [4], Prajitha Prasad A et al. designed a helmet in which the flex sensor checks if the person wearing the helmet is wearing it or not. Alcohol sensors locate the alcoholic content in riders' breath. If the rider isn't wearing a helmet or if there may be any alcohol-containing material found in the rider's breath, the motorcycle remains off. The bike will not start until the rider wears the helmet and if there is no alcohol content material present. When the rider crashes and the helmet hits the floor, sensors come across the movement and tilt of the helmet and report the occurrence of an accident. It sends records of the corresponding region to family contributors of the rider and emergency contact varieties. Index Terms: Biker's Protection, Accident Detection, Smart Helmet, Alcohol Detection So, while the coincidence takes place, it'll send a message using GSM to the registered numbers with their contemporary area by GPS module. It can be used to obtain a name at the same time as driving. The distinct application of the challenge is falling detection; if the bike rider falls from the motorcycle, it will send the message automatically.

In [5], Mr. Salunke et al. designed a smart helmet with advanced features like alcohol detection, accident identification, location tracking, use as a hands-free device, solar power, and fall detection. It's compulsory to wear a helmet; without a helmet, ignition transfer can't be turned on. A RF module is a Wi-Fi link that is able to communicate between transmitter and receiver. If the rider gets drunk, it receives a mechanical ignition transfer lock and sends a message routinely to their check-in variety with their present-day place. So, while the coincidence takes place, it'll send a message using GSM to the registered numbers with their contemporary area by GPS module. It can be used to obtain a name at the same time as driving. The distinct application of the challenge is falling detection; if the bike rider falls from the motorcycle, it will send the message automatically. The exploration additionally assists with knowledge of the smart head masking framework, which has advanced over time and, as of now, by way of growing innovation like the Internet of Things (IoT). This likewise addresses the canny engine-wheeler head overlaying framework that's utilised to educate the rider about huge vans and buses for dodging crashes.

In [6], Amgoth Kishore et al. proposed the shrewd head covering framework that is utilised to forestall the mishaps in engine two-wheelers and to recognise the two-wheeler mishaps on schedule for the health of individuals. Additionally, the notable head covering framework dissected in this paper is used in the digging industry for protecting the excavators from risky activities in the mine and for warning the diggers from hazardous fuel emanations inside it. The exploration additionally assists with knowledge of the smart head masking framework, which has advanced over time and, as of now, by way of growing innovation like the Internet of Things (IoT). This likewise addresses the canny engine-wheeler head overlaying framework that's utilised to educate the rider about huge vans and buses for dodging crashes. This likewise addresses the canny engine-wheeler head overlaying framework that's utilised to educate the rider about huge vans and buses for dodging crashes. The notable head covering framework dissected in this paper is used in the digging industry for protecting the excavators from risky activities in the mine and for warning the diggers from hazardous fuel emanations inside it.

In [7], the author, Sreenithy Chandran et al., discussed the sensors, Wi-Fi-enabled processors, and cloud computing infrastructures that are utilised for building the system. The twist of fate detection device communicates the accelerometer values to the processor, which constantly monitors for erratic versions. When the coincidence occurs, the related information is sent to the emergency contacts by way of a cloud-based service provider. The vehicle's vicinity is received via the global positioning system. The machine guarantees a reliable and short delivery of information referring to the accident in real time and is appropriately named Konnect. Then detecting if the rider has consumed alcohol or not, if these two conditions are satisfied, then only the motor will ignite or else it will not ignite. In the event that an accident occurs, our system is capable of detecting the accident and its approximate location. The led strip indication in the helmet unit is to reduce the percentage of accidents during nighttime. The vehicle's vicinity is received via the global positioning system.

In [8], P. Dharani et al. designed a system that is capable of detecting whether the rider is wearing a helmet or not. Then detecting if the rider has consumed alcohol or not, if these two conditions are satisfied, then only the motor will ignite or else it will not ignite. In the event that an accident occurs, our system is capable of detecting the accident and its approximate location. The led strip indication in the helmet unit is to reduce the percentage of accidents during nighttime. The twist of fate detection device communicates the accelerometer values to the processor, which constantly monitors for erratic versions. When a coincidence occurs, the related information is sent to the emergency contacts by way of a cloud-based service provider. The vehicle's vicinity is received via the global positioning system. The machine guarantees a reliable and short delivery of information referring to the accident in real time and is appropriately named Konnect. Then detecting if the rider has consumed alcohol or not, if these two conditions are satisfied, then only the motor will ignite or else it will not ignite. The led strip indication in the helmet unit is to reduce the percentage of accidents during nighttime.

In [9], Sayan Tapadar et al. proposed mechanisms that can detect if one is wearing the helmet, detect accidents, and detect whether the person has over-consumed alcohol. For this purpose, we use onboard sensors: a flex sensor, an effect sensor, an accelerometer (ADXL355), and a breath analyzer (MQ3). The accelerometer measures the exchange in tilt in the X, Y and Z axes, respectively, and sends the information to a server through an internet software programming interface (API). The breath analyzer senses the amount of alcohol in the breath of the person carrying the helmet and reports if it is past the felony restriction. The server additionally makes use of the information gathered from the accelerometer and the stress sensors to teach a help vector system (SVM). This can help optimise coincidence detection in the future when enough statistics are gathered to offer dependable accuracy. The helmet can hook up with any cell phone through Bluetooth to communicate with the web API, using the phone's internet connection. This will ensure the holistic protection of the rider.

In [10], Priya Parameshwari designed a system that checks the two conditions before turning on the engine of the bike. This machine consists of an alcohol sensor and a helmet sensor. A transfer is used to detect whether the biker is wearing a helmet. An alcohol sensor is used to detect when the biker is drunk, and the output is fed to the MCU. Both the switch and the alcohol sensor are outfitted in the helmet. If any of the two situations are violated, the engine will not turn on. The alcohol sensor MQ3 is used right here for detecting the alcohol awareness gift inside the motive force’s breath. The sensor presents an analogue resistive output based totally on the alcohol's attention. The MCU takes or reads information from the sensors and controls all the functions of the entire system by manipulating this data. The alcohol sensor is hooked up to the MCU through an interfacing circuit, and the helmet sensing transfer is at once linked to the MCU. The MCU gets information from these sensors, and it offers virtual information corresponding to the output of the sensors to the encoder simplest if the two conditions are satisfied. An alcohol sensor is used to detect when the biker is drunk, and the output is fed to the MCU. Both the switch and the alcohol sensor are outfitted in the helmet. If any of the two situations are violated, the engine will not turn on.

3. Methodology

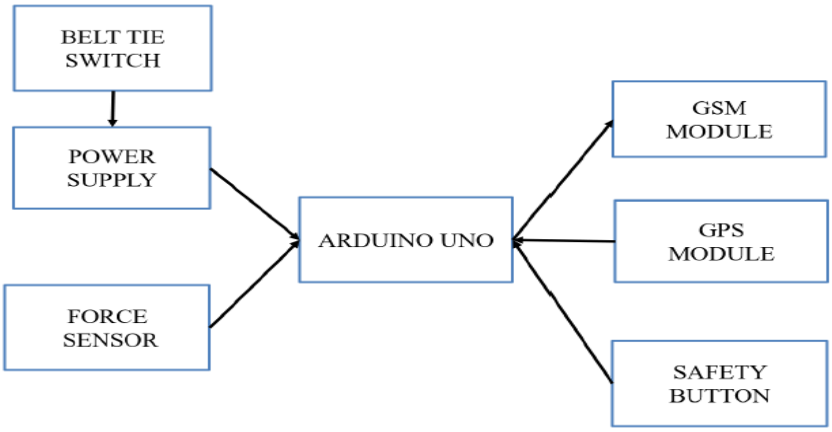

Figure 1. Block Diagram

In the above figure, we start from the belt tie switch. If the belt tie switch is connected, only the power supply will turn on the UNO. In this, we are using a pressure sensor to find out whether an accident occurred or not. If the accident occurred, then GPS will find out the longitude and latitude points, and that data is sent to the selected contact numbers. The safety button is used to send another message if the rider is safe.

Belt Tie Switch: The belt tie switch serves as the power supply initialization mechanism for the system. When the rider wears the helmet and fastens the strap, the switch is closed, completing the circuit and providing power to the system. This ensures that the system is activated only when the helmet is worn.

Arduino: The Arduino microcontroller acts as the brain of the smart helmet system. It receives inputs from various sensors and controls the system's behaviour based on the programmed logic. It processes the data from the sensors, performs calculations, and triggers appropriate actions or events accordingly.

GPS (Global Positioning System): The GPS module is used to determine the precise location of the helmet wearer. It receives signals from multiple satellites and uses the timing of these signals to calculate the wearer's latitude, longitude, and altitude. The Arduino collects this location data from the GPS module.

GSM (Global System for Mobile Communications): The GSM module enables communication over mobile networks. In the smart helmet system, it is used to transmit the wearer's location information to selected contacts. The Arduino communicates with the GSM module to send SMS messages or make phone calls to the predetermined contacts, providing them with the wearer's location details.
Force Sensor: The force sensor is used to detect accidents or significant impacts. It measures the force or pressure applied to the helmet. When the force exceeds a predefined threshold, the force sensor triggers an event or sends a signal to the Arduino, indicating a potential

accident. This event can then initiate further actions, such as activating emergency response measures or notifying the selected contacts.

Safety Button: The safety button is a manual switch that allows the rider to interact with the system after an accident has occurred. If the rider presses the safety button within 2 minutes of the accident, it indicates their safety and triggers the "Safe Message Transmission" process. The Arduino monitors the state of the safety button and takes appropriate actions based on its status.

When the force sensor detects an accident or significant impact, it triggers the "Accident Detected" event. This event notifies the Arduino that an emergency situation has occurred, prompting the system to initiate the necessary response actions. If the rider presses the safety button within 2 minutes of the accident, indicating their safety, the Arduino triggers the "Safe Message Transmission" process. This involves using the GSM module to send a message or notification to the selected contacts, informing them that the rider is safe. The content of the message can be customised based on the system requirements, such as a predefined text or an automated notification indicating the rider's well-being. In summary, the smart helmet system uses a combination of sensors, a microcontroller, GPS, a GSM module, a force sensor, and a safety button to enhance rider safety. It detects accidents, provides accurate location information to selected contacts, and allows the rider to indicate their safety by pressing the safety button within a specific time frame.

Flow Chart:

The belt tie switch serves as the power supply initialization mechanism for the system. When the rider wears the helmet and fastens the strap, the switch is closed, completing the circuit and providing power to the system. This ensures that the system is activated only when the helmet is worn.

The Arduino microcontroller acts as the brain of the smart helmet system. It receives inputs from various sensors and controls the system's behaviour based on the programmed logic. It processes the data from the sensors, performs calculations, and triggers appropriate actions or events accordingly. The GPS module is used to determine the precise location of the helmet wearer. It receives signals from multiple satellites and uses the timing of these signals to calculate the wearer's latitude, longitude, and altitude. The Arduino collects this location data from the GPS module.

The GSM module enables communication over mobile networks. In the smart helmet system, it is used to transmit the wearer's location information to selected contacts. The Arduino communicates with the GSM module to send SMS messages or make phone calls to the predetermined contacts, providing them with the wearer's location details. The force sensor is used to detect accidents or significant impacts. It measures the force or pressure applied to the helmet. When the force exceeds a predefined threshold, the force sensor triggers an event or sends a signal to the Arduino, indicating a potential accident. This event can then initiate further actions, such as activating emergency response measures or notifying the selected contacts. The safety button is a manual switch that allows the rider to interact with the system after an accident has occurred. If the rider presses the safety button within 2 minutes of the accident, it indicates their safety and triggers the "Safe Message Transmission" process. The Arduino monitors the state of the safety button and takes appropriate actions based on its status.

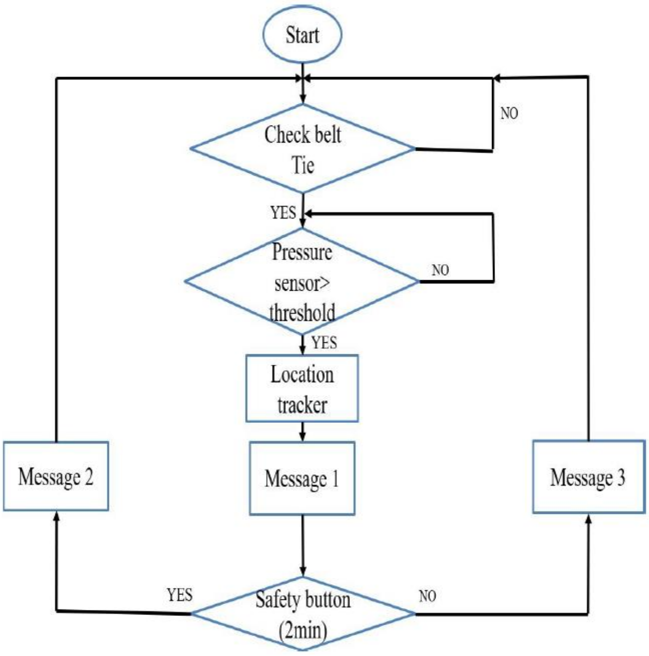

Figure 1. Flow Chart

4. Implementation and Testing

The GSM module enables communication over mobile networks. In the smart helmet system, it is used to transmit the wearer's location information to selected contacts. The Arduino communicates with the GSM module to send SMS messages or make phone calls to the predetermined contacts, providing them with the wearer's location details.

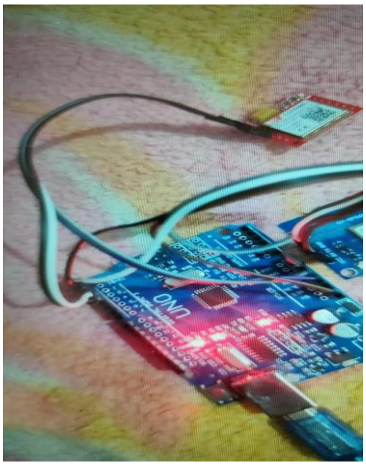

Figure 3(a): Implementation of GSM

Figure 3(b): Implementation of GPS

The GPS module is used to determine the precise location of the helmet wearer. It receives signals from multiple satellites and uses the timing of these signals to calculate the wearer's latitude, longitude, and altitude. The Arduino collects this location data from the GPS module.

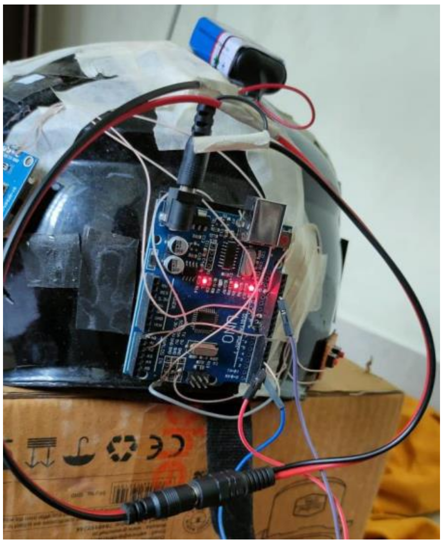

Figure 4(a): When Belt tie switch is connected

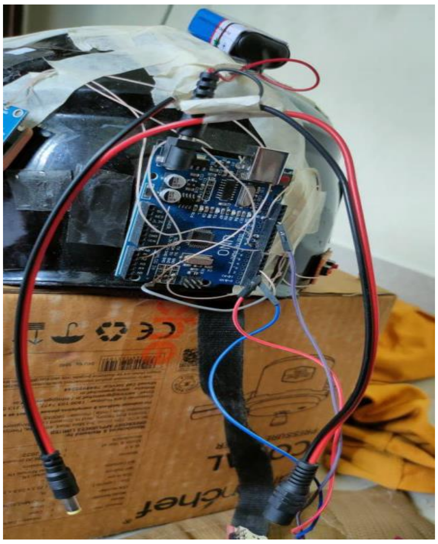

Figure 4(b): When Belt tie switch is not connected

The belt tie switch serves as the power supply initialization mechanism for the system. When the rider wears the helmet and fastens the strap, the switch is closed, completing the circuit and providing power to the system. This ensures that the system is activated only when the helmet is worn.

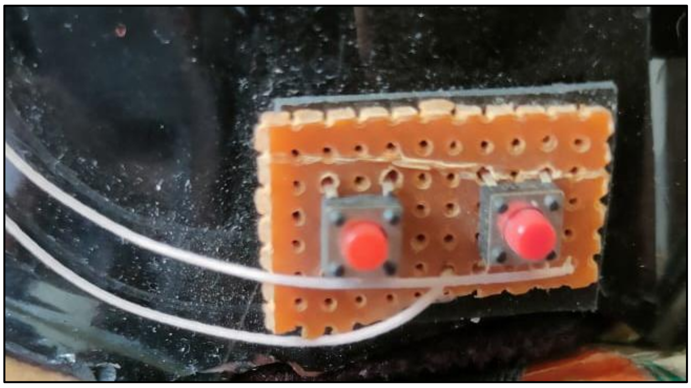

Figure 5: Safety Button

The safety button is a manual switch that allows the rider to interact with the system after an accident has occurred. If the rider presses the safety button within 2 minutes of the accident, it indicates their safety and triggers the "Safe Message Transmission" process. The Arduino monitors the state of the safety button and takes appropriate actions based on its status.

5. Result and Discussion

When an accident occurs, the impact force sensor registers the force exerted on it and provides a corresponding reading. The magnitude of the reading can indicate the severity or intensity of the impact. By analysing the force reading, it becomes possible to assess the level of damage, evaluate safety implications, trigger appropriate responses or alarms, and potentially provide valuable data for accident investigation or analysis.

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It's important to note that the specific threshold or range of force readings considered indicative of an accident will depend on the intended application and the calibration of the force sensor. Manufacturers often provide specifications and guidelines to determine what force levels are considered significant for accident detection or analysis based on the capabilities and intended use of the sensor.

Figure 6: Accident Notification

When an accident occurs, the smart helmet system can send a message or notification to predetermined contacts or emergency services to inform them about the incident. This message serves as an alert, providing important information about the accident. The message begins with an indication that an accident has occurred. It may include phrases such as "Warning" or "Emergency Notification" to grab the attention of the recipient and convey the urgency of the situation.

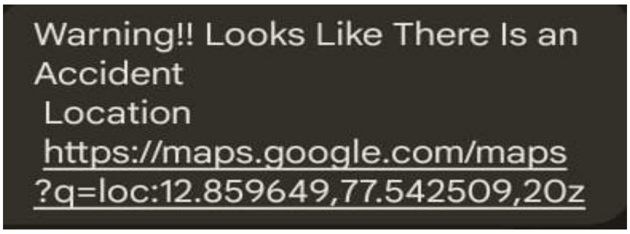

Figure 7: Accident Notification with Location

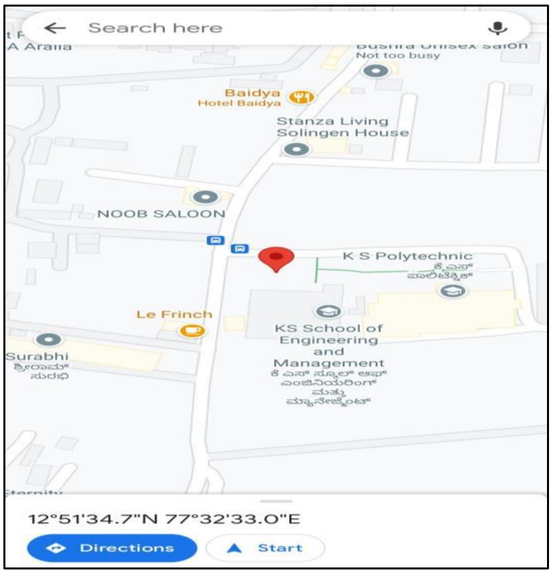

Figure 8: Sample Accident Location

When an accident occurs, the smart helmet system can send a message or notification to predetermined contacts or emergency services to inform them about the incident. This message serves as an alert, providing important information about the accident and the rider's location. The message includes GPS-derived location data for the accident. This includes the

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latitude, longitude, and potentially the altitude coordinates of the rider's position at the time of the accident. These coordinates enable responders to quickly locate the accident site and provide aid or support.

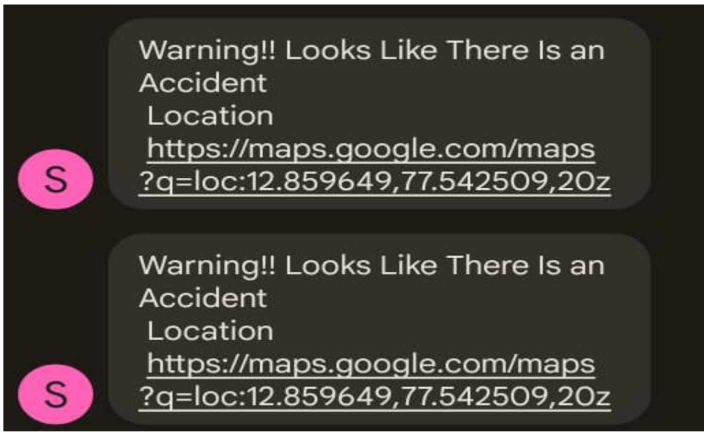

Figure 9: Alert Notification

In the event that the rider does not press the safety button within 2 minutes of the accident, the smart helmet system can send an additional message to the predetermined contact numbers. This message serves as a notification that the rider has not confirmed their safety within the specified timeframe, indicating a potential need for assistance or further attention. The message begins with an alert indicating that an accident has occurred and the rider's safety status has not been confirmed within the allocated time. The message includes the GPS-derived location data of the accident, similar to the initial accident message. The message may include a request for assistance or further action from the recipients. This can prompt them to take appropriate measures to ensure the rider's well-being. The method of message transmission remains the same as in the initial accident message, typically utilising the GSM module to send SMS messages to the predetermined contact numbers.

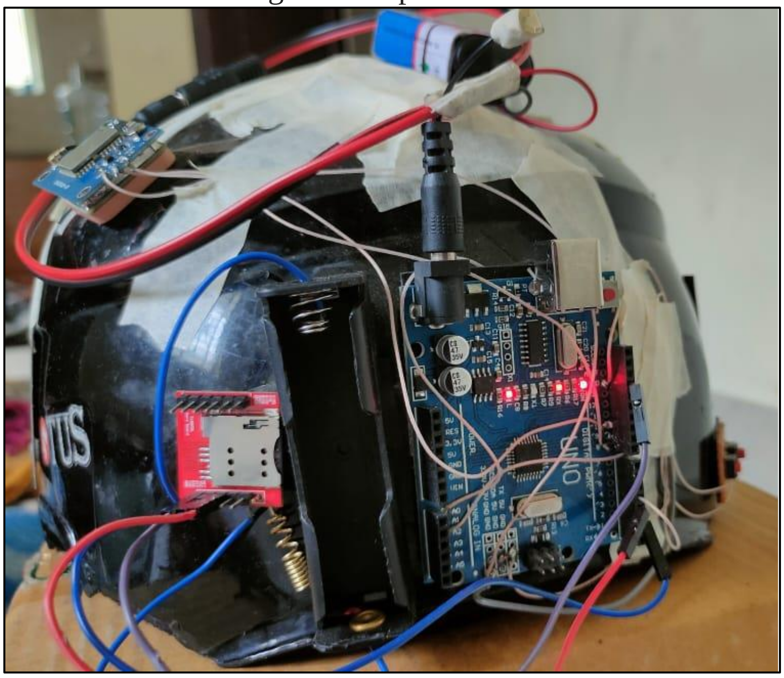

Figure 10: Final Model Proposed System

6. Conclusion

A person must act on time when another individual is wounded; otherwise, a valuable life might be lost. We need to know how precious people's lives are and what importance first aid carries in saving these valuable lives. The system efficiently ensures that the rider is wearing the helmet throughout the ride and detects accidents. By implementing this, a safe two-wheeler ride is possible, which will prevent head injuries during the accident. The proposed approach makes it mandatory to use this protective guard in order to drive a two-wheeler vehicle and therefore reduces the risks of brain injuries and deaths in accidents. This technology can further be implemented by using small cameras to record the driver's activity. It can be used for passing messages from one vehicle to another by using a wireless transmitter. It can also be implemented in cars by replacing the helmet with a seatbelt.

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