Design and Implementation of Intelligent Head Protective Gear for Accident Detection and Notification

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Abstract. The main aim of the paper is to safeguard the rider with a smart helmet without which the rider cannot start the bike. So the bike can be started only by using both key and smart helmet. This smart helmet technology consists of alcohol detection, accident detection, alert system and women’s safety. If accident occurs, the information will be send to the emergency contacts by using a GPS and GSM technology. Also, the bike’s location is tracked by employing GPS (Global Positioning System) and provide information to contacts by using GSM (Global System of Mobile) technology. Similarly, when the rider has consumed alcohol, the controller will automatically shut downs the bike’s ignition system and will not allow the rider to ride the bike. An emergency alert system could be used in case of emergencies like provocation and molestation. The women have to hold the button of helmet and whenever she clicks the button of the helmet, its ends alert messages to family members or nearby police stations. Another important feature is that, when the rider’s helmet strikes the floor, vibration sensor senses the possibility of hitting and gives information to regulator. When the numbers surpasses smallest stress limit, GSM module alerts ambulance or family members along with location using GPS module. This smart and intelligent helmet is implemented and tested to enhance the protection of riders.

Keywords: Accident, Global Positioning system, Global System of mobile, Sensor, Smart Helmet

Introduction
Security and Safety is one of the fundamental necessities of our daily lives. In many countries, the most compulsion for two wheelers is to wear the helmet but they do not wear the helmet because of uncomfortable temperature generated inside it. As many of the bike riders failed to wear the helmet it causes more number of death.
According to an Indian survey [1], there are around 6,00,000 road accidents and around 5,00,000 people were injured in road accidents. Ignorance of traffic rules, no proper driving knowledge, fast riding, drink and drive and so on are the major reasons that will lead to accidents and cause death of people [2]. The compulsion of wearing headgear is to avoid accidents. If the rider wear the headgear and an accident occurs, there may be chance that bike rider can able to escape from his death [3].

1. Block Diagram of Intelligent Head gear

The smart helmet is made up of various units such as, helmet unit, bike unit, women safety unit which are controlled using separate control algorithm [4-5]. The operation of different units and its functions are explicated concisely in the subsequent sections.

1.1 Helmet Module

Figure 1 represents the operation of a helmet unit. The vibration sensor, alcohol sensor, emergency button, microcontroller, and camera are available in the Helmet module. If the rider consumes alcohol, the ignition mechanism of the bike will not start the vehicle with the use of an alcohol sensor. When the helmet hit the ground, vibration sensor sense the probability of hitting and if it is higher than the particular value then the information about location will sent to emergency contacts by using GPS and GSM technology. The bike’s location is tracked by use of GPS and sends information to contacts by using GSM. In case of any emergency, the GSM module sends information to ambulance or family members with location using GPS module. An emergency alert system could be used for Women safety and protection. Whenever the women’s are in trouble they want to hold the emergency button of helmet and whenever they clicks the button in the helmet, ESP camera will be ON and also the message is send to the nearby police station and family members through GPS.

![Figure 1: A Block diagram of Helmet module](image)

1.2 Bike Module

Figure 2 represents the operation of a bike unit. The Bike Unit, consists of Global Positioning System (GPS), Global System for Mobile (GSM), RF Receiver, Relay Driver and DC motor. RF receiver will receive the output of the helmet module. If the vibration sensor value exceeds the limit, the location information will be sent to emergency contacts by using a GPS and GSM technology. The bike’s location is tracked by use of GPS and sends information to contacts by GSM. An emergency alert system could be used in case emergencies. The women need to hold the helmet emergency button and once they clicks the button in the helmet, the ESP camera will be ON and will send information via GPS.
2. Methodology used in Proposed System

2.1 Existing System

There are around 600,000 road accidents, and 500,000 people were injured in road accidents, according to an Indian survey. Ignorance of traffic laws, lack of proper driving experience, the fast riding of two-wheelers, drunk driving, and so on is the key causes that will cause accidents and people to die. The compulsion of wearing of helmet is to avoid accidents [6]. If the rider has consumed alcohol, bike’s ignition system will not start the vehicle by using alcohol sensor. As soon as the head gear hits the ground, vibration sensor senses that probability of hitting is more [7-8]. Then, the information will be sent to emergency contacts by using a GPS and GSM technology. The bike’s location is tracked by use of GPS and sends information to contacts by use of GSM. In many countries, the most compulsion for two wheeler is to wear the helmet for bike rider but they do not wear the helmet because of uncomfortable temperature generated inside it. To provide chill air for the bike rider’s captured by solar cells that are mounted on uppermost of the helmet using thermoelectric cooling [9]. The rider will get an indication when the speed limit exceeds. If the speed of the motor is greater than 100 km/h, the LED will blow flash. Most incidents can occur while driving, by attending the call. Using hands while driving, we can avoid talking via mobiles by providing the Bluetooth device inside the helmet. Bluetooth module is built inside the helmet so that we can continue the call without removing the helmet [10].

2.2 Drawback of Existing System

The following are described drawbacks [11-12] of smart helmet for accident detection and alcohol detection.

1. If there is no traffic checking, riders do not wear the helmet in regions.
2. Rider will be affected by polluted and hot air.
3. No comfortable and safe driving for women in night times.
4. Rider’s location can’t find in emergency situations because of lockage of network[13-15].

Proposed System

This system contains Wi-Fi module, alcohol sensor, vibration sensor, emergency switch, Arduino and so on. This smart helmet technology consists of alcohol detection accident detection women’s protection and sends notification. If accident occurs, the information will be sent to emergency links by using a GPS and GSM technology.

Figure 2: Block diagram for bike module
The bike’s location is followed by GPS and sends information to contacts by use of GSM (Global System of Mobile). Similarly when the rider has consumed alcohol; the controller will automatically shut down the bike’s ignition system and not allowing the rider to ride the bike. The women’s wants to hold the button of helmet and whenever she clicks the button of helmet, it sends alert messages to family members or nearby police stations. When the rider’s helmet hit the ground, vibration sensor. When the data exceeds minimum stress limit, GSM module sends information to ambulance or family members with location using GPS module.

3. Circuit Diagram of Intelligent Headgear

The circuit diagram consists of bike unit, helmet unit and power supply unit as shown in Figure 3. The power supply unit consist of 7805 IC which acts as a voltage regulator to supply a regulated voltage of 9V. Actually there are two supply unit’s, one unit is used to supply the ATMEGA328P microcontroller and the unit is used to supply the ESP8266 module which acts as a Wi-Fi module. The helmet unit consists of alcohol sensor, limit switch, ESP camera and a RF transmitter. A dedicated sensor is used to detect whether the rider is drunken or not. If the rider drunk alcohol more than a limited range the bike won’t start. This helps a lot to maintain the drunk and drive free environment. The limit switch shown here is fixed in the helmet, which ensures whether the wearing of helmet. If the rider flops to wear the helmet the bike won’t even start. This can helps to prevent the serious head injuries during accident. Both the alcohol sensor and the limit switch are connected to the RF transmitter. The RF transmitter in turn sends the signal to the RF transmitter which is fitted in the bike. This module plays a major role in the start of the bike. Because the signal was not received by the receiver the bike won’t start.

ESP camera module is used for the women’s safety purpose. When the women is subjected to any harassment or any issues, the camera gives the live streaming of the incident to the nearby police station, which helps the cops to identify the accused easily. In this module a SD card slot is also available to record the video of live streaming. The bike unit consists of vibration sensor, SOS switch, ATMEGA328P, ESP8266, RF receiver, LCD display and a relay unit. The vibration sensor used here is for accident detection. If a rider subjected to any accident, he may die due to late medication.

![Figure 3: Circuit Diagram of Intelligent Helmet](image-url)
This system provides message about the accident to the nearby trauma care center or ambulance driver. So that he can receive fast medication as soon as possible. In the vibration sensor a limit is set; during the course of accident the vibration sensor limit is verified whether it exceeds the fixed range. If it is high then, the signal is send to ATMEGA328P about. So, microcontroller confirms it as accident and sends a message to the nearby police station or neighbors about the accident location. An SOS switch is provided to the rider. This is especially for women’s safety. During any abnormal activities when riding the women has to push the switch. If she does so the alert message along with the live location is send to the neighbors and the cops.

4. Implementation of Intelligent Headgear

4.1 Alcohol Sensor

Figure 4 shows an alcohol sensor detects the attentiveness of alcohol gas in the air and an analog voltage is an output reading. MQ-3 gas sensor is used to detect the presence of alcohol in the breath of a person. It is placed in the chin portion of the helmet so that it is nearer to the mouth of the rider. The surface of the sensor is sensitive to alcoholic concentrations. It detects the presence of alcohol from the rider’s breath. Based on the concentration of alcohol, the resistive output can be obtained. Generally the unlawful intake of alcohol in the course of using is 0.08mg/L as according to the authorities act. Except for demonstration purpose, we will be predisposed to software the drink restriction as 0.04 mg/L. The alcohol sensor outfitted in the chin piece of the helmet identifies the alcohol in our breath and sends the signal to the controller. If the alcohol concentration level exceeds the approved limit, then the MCU gives the order to the RF transmitter to transmit the signal. The RF receiver receives signal and pass the message sent by the helmet unit to the MCU which is situated in the bike unit. The MCU in turn prevents the bike from the ignition. If the bike’s engine is already running then the MCU unit stops the bike’s engine and prevents him from the accident.

![Figure 4: Implementation of Alcohol Sensor](image)

4.2 Vibration Sensor
Figure 5 shows the vibration sensor. The primary motive is to alert the Ambulance, Police, and neighbors about the location of the incident, and to take crucial measures to rule the situation. The basic part used is the vibration sensor, detecting the accident and transmitting the signal to Arduino. Vibration sensor simply operates on the piezoelectric effect principle. Piezoelectric Effect is the ability of some materials, such as quartz, topaz, tourmaline, to produce electric charge in response to mechanical stress applied. The term Piezoelectric derives from the Greek word piezein, which means pressing or squeezing, and piezo, which is Greek for drive. As stated above, piezoelectricity is the ability of a material to obtain energy if a strain is applied to it along with pressing, bending or twisting. When placed below strain, the piezoelectric crystal generates a polarization, $P$, equal to the strain that produced it.

4.3 Transmitter Section of the Intelligent Head Gear

The first step in this device is to put the helmet on to make the micro switches feel the head pressure and the transmitter inserted in the helmet itself transmits the signal to the receiver end. Figure 6 shows the transmitter section of intelligent head gear.

Figure 6: Transmitter Section of Intelligent Head Gear

4.4 Receiver Section of the Bike

The signal being transmitted by using the transmitter segment will obtain here and as a consequence relay will operate that allows you to switch ON/OFF the ignition of the bike. Figure 7 shows the receiver section of intelligent head gear.
5. Women’s Protection

This section consists of SOS Switch and ESP32-CAM module. These components were mainly implemented to safeguard the women who are all travelling at night times. In case of any emergency situations like harassment or any other in-disciplinary activities, the affected women can press the SOS Switch which is connected to ESP8266 module in the bike unit. A camera is also connected at the front portion of the helmet named ESP32-CAM Module. Both ESP Modules are programmed through the Arduino software. Then an app is designed through the Thunkable Platform for location tracking which should be installed in the user’s mobile and should enable the start option before starting the riding. Figure 8 represents the ESP32 Camera streaming adjustments for women’s protection in smart helmet.
The ESP8266 module is programmed in the way that an alert message with the content “DANGER IN LATITUDE, LONGITUDE and IP ADDRESS OF LIVE VIDEO STREAM” will be sent to affected women’s relatives and nearby police stations through SMS from affected women. Figure 9 represents the live video streaming for women’s protection in smart helmet. Actually the live location will be identified by affected women’s mobile itself by enabling the location option in their mobile. By clicking the latitude and longitude details which were sent through the SMS person at the other end can be able to see the live location of the affected women by using google maps. Then by clicking out the IP address which were sent in the SMS, person at the other end can be able to see the live stream of what happening in that location through enabling the hotspot in their mobile.

6. Conclusion
In this paper, intelligent head protective gear has been implemented with Accident detection and notification system which gives an effective solution to reduce the number of accidents occurred due to the increased use of two wheelers. According to an Indian survey, many accidents occurred by two wheeler. With the implementation of the project, the number of accidents will be reduced by wearing intelligent head gear. This system consists of alcohol detection, Accident detection, notification and women’s protection. Alcohol detection consists of alcohol sensor which senses the content of alcohol in the blood. If rider has consumed alcohol, ignition system does not start. If the rider hit the ground, vibration sensor sense and give information to controller. This controller will give information to family members or ambulance through GSM with location by using GPS. When women subjected to any harassment or any problem, ESP camera turns ON and sends information through GSM. Safety, reducing road accidents, experiencing comfortable riding at night times for women, proper intimation to emergency contacts or ambulance where accident
occurs and pollution free environment because of no drunk and drive are the main advantages of the Smart Helmet for safety, accident detection and notification. Thus, the proposed smart helmet has been implemented and tested for various operating modes.

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