# Smart Helmet for Motorcyclist

**S. V. Viraktamath, Vidya, Rohan Bhadavankar, Siddhartha S. Nabhapur, and Nikhil Rati**

**Abstract** Motorcycle accidents are occurring at a great phase, and the number of deaths caused by this also is at its peak. Currently, no technical innovations are being used to reduce the number of injuries and deaths caused by them. According to a study, almost half of people die as a result of a delay in receiving care after an accident. The major cause of this delay could be a lack of knowledge, traffic challenges, or other factors. This delay may be caused by inadequate information regarding the accidents, traffic problems, or other reasons. To tackle these current issues, the smart helmet is designed that provides the best solution to all of the issues mentioned above. The biker wears a smart helmet, which is a type of protective headgear that makes biking safer than before. The primary purpose of this smart helmet is to ensure the rider's safety. Advanced functions such as alcohol detection, accident identification, location monitoring, use as a hands-free device, and fall detection can be used to do this. This is not only a feature of the smart helmet but also a feature of the smart bike.

**Keywords** Arduino · Accident detection · Alcohol detection · GSM and GPS · Microcontroller

## Introduction

Two-wheelers are the foremost sold vehicles all through India. The Indian two-wheeler industry enrolled a deals volume of 13.7 million units in 2012–13, a development of 2.9% over the year FY 2011–12. As the number of bikers in our nation is expanding, the street accidents are moreover expanding day by day, due to which numerous deaths are happening. The most common kind of negligence is failure to wear a helmet, which accounts for the majority of death cases. In addition, many deaths occur as a result of the injured person's inability to receive timely medical assistance. According to Section 129 of the Motor Vehicles Act, 1988, everyone riding a two-wheeler must wear protective headgear that meets Bureau of Indian

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Benchmarks (BIS) requirements. Furthermore, intoxicated driving under the influence (DUI) may be considered a criminal offense under the Motor Vehicle Act of 1939, which stipulates that a bike rider who breaches the act would be penalized [1]. Currently, bike riders are able to easily escape from the law. Safety and security are the most crucial zones in all area of our lives. This inspires us to consider creating a framework that ensures the safety of bikers by making it mandatory to wear a helmet in accordance with government regulations, as well as inducing proper and fast medical attention in the event of an accident. The system intends to improve cyclist security and safety in the face of street accidents [2]. The development of this system has been fueled by social responsibility.

## Literature Survey

In all the related work discussed below, it is observed that the rider needs to wear the helmet compulsory; otherwise, the ignition is not turned ON and usage of an RF module for wireless communication between the transmitter (Tx) and receiver (Rx). In some cases, if the bike rider is found alcoholic, the ignition is immediately locked, and in the event of an accident, a message is sent by GSM, along with the rider's location via GPS. In [2], a simple approach is used to make helmet wearing compulsory, where without the helmet bike cannot start. In [3], two Arduinos are used: one for the Tx unit and another for the Rx unit. The force sensing resistor (FSR) detects whether or not the helmet is worn, and both accelerometer and vibration sensor for detection of an accident. In [4], FSR is used to verify whether or not the helmet is worn, BLDC fan is used to detect speed and gives a warning if speed exceeds 100 km/h, and PIC16F84a microcontroller is used. A proximity sensor is used in [5] to detect whether or not the helmet is worn. The Internet of things (IoT) is employed in [6, 7], so that the user's data can be transferred to the cloud for monitoring of activities such as helmet use, alcoholic consumption, and accident conditions. In [8], The IoT is used and the helmet works on the Raspberry Pi 3 module, which is interfaced with both the vehicle and the cloud in which the image can be accessed and sent to the receiver. The technology in [9] includes a speech module that controls the visor, turn indication, headlights, horn, and ignition system, giving the user a lot more control over the vehicle. In [10], two Arduinos are used, and in addition to other sensors, the temperature sensor is used. The solar panel is used to power up. In [11], the vibration sensor, pressure sensor, and accelerometer are used to detect an accident. The helmet is fitted with a cooling unit in [12], which uses an external power source such as solar energy to lower the temperature. An emergency alert system might be used to request assistance from cops or family members in the event of additional situations such as harassment, abduction, or molestation. In [13–15], authors have proposed a review and comparative studies of different types of helmets.

From the works discussed in this section, it is seen that some of the work carried is very simple, like limited to detection of helmet worn or not, and some are complex which involves IoT, Raspberry Pi, and many other things which may result in increase in the cost. Hence, the proposed system in this paper has most of the things required in one single unit like alcohol detection, accident detection, and helmet detection which are essential for a safe drive.

## Technical Studies

### *Microcontroller*

A microcontroller board based on the ATmega328 is the core component of the helmet's hardware part. It has 28 pins. ATmega328 microcontroller is the main component of Arduino UNO. As soon as the microcontroller is powered, the peripherals such as GPIO and TIMER are initialized. This microcontroller is mainly used to detect the RFID whether it is similar to what is required or not, which helps in avoiding theft. ATmega32 is used in vehicle unit. It has $32 \times 8$ general working purpose registers, 32 K bytes of flash program memory, 2 K bytes of internal SRAM, 1024 bytes EEPROM. It has 32 pins (4ports $\times$ 8pins) configurable as digital I/O pins. It has 3 inbuilt timer/counters, two 8 bits (timer0 and timer2) and one 16 bits (timer1). Also, it has 3 external interrupts. Operating voltage is in range of +4.5 to +5.5 V and has an 8 MHz calibrated internal oscillator.

### *Alcohol Sensor*

In the MQ sensor series, the MQ3 sensor is one of the most extensively utilized alcohol sensors. It is a sensor that detects the presence of alcohol gas in the air and outputs an analogue voltage reading. It can detect alcohol concentrations as low as 25 parts per million and as high as 500 parts per million (ppm). In this model, alcohol sensor is present near the front end of the helmet unit for sensing the presence of alcohol content in the riders' breath. These sensors are highly sensitive to alcohol and less sensitive to benzine. With a sensing range of 0.04 mg/L to 4 mg/L, it is perfect for breathalyzers. The voltage range of the MQ-3 sensor is 2.5–5.0 V.

### *RF Encoder and Decoder*

A pair of encoder and decoder boards composes the module. The HT12E IC can only be used in combination with the HT12D IC. These two ICs work together to produce an encoder and decoder pair. 12-bit encoders/decoders are capable of sending and receiving 12-bit data. An 8-bit data address will be shared by the encoder and decoder

IC pair. These ICs are frequently seen in radio frequency (RF) pairs. They both use a voltage range of 2.4–5 V to operate.

## *LCD*

LCD is an electronic display module, which is a commonly used component in most of the embedded applications. In this model, a 16 * 2 LCD is used, which can display 16 alphanumerical characters on the two rows. Each of the characters is made up of $5 \times 8$ pixels. This can operate at a voltage range of 4.7–5.3 V.

## *GSM Module*

A GSM or GPRS module is a circuit that connects a computer or mobile device to a GSM or GPRS network. A GSM modem might be a separate device having a serial, USB, or Bluetooth interface, or it can be a mobile phone with GSM modem capabilities. Its dimensions are $24 \times 24 \times 3$mm.

## *GPS Module*

The NEO6MV2 GPS module makes it possible to receive GPS signals. This allows the model to establish its actual location on earth by supplying the longitude and latitude of its position, as well as the speed and direction of its movement and the number of satellites visible. A serial Tx/Rx connection is used for communication (just two I/O are required). NEO6 modules are suited for battery-operated mobile devices with severe cost and space requirements because of their tiny architecture, power, and memory options.

## *Vibration Sensor*

A structure's vibration or acceleration of motion is detected and measured using vibration sensor modules. They have a piezoelectric transducer that transforms mechanical force from vibration or movement into an electrical current.

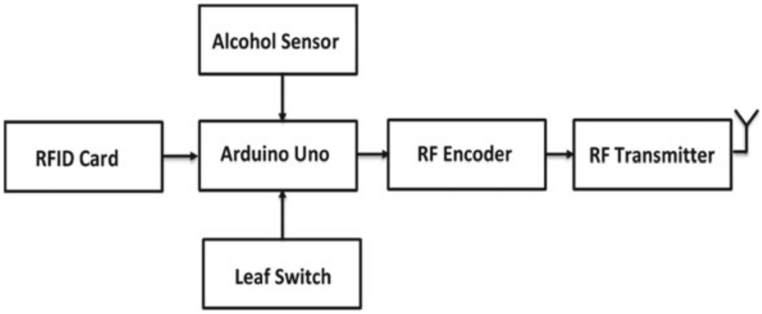


**Fig. 1** Helmet unit

### *Leaf Switch*

A leaf switch is a switch that is installed in a helmet model to detect whether or not the wearer is wearing one. The microcontroller gets a signal indicating whether or not the user is wearing a helmet when the switch is pressed.

## Methodology

### *Block Diagram*

The entire system of smart helmet is mainly divided into two units: vehicle unit and helmet unit. The below block diagram represents the clear idea of each unit. Figure 1 shows the helmet unit where it consists of alcohol sensor to detect the alcohol content in the rider's breath, a leaf switch to detect the helmet, and RF encoder to encode the data and it is transmitted using RF transmitter; the whole helmet is protected with RFID card reader against theft.

Figure 2 indicates the vehicle unit where all the inputs from the different sensors are applied to the microcontroller. The microcontroller processes all the inputs from the sensor and takes the required actions. The microcontroller is the main head of the unit. The data received by the helmet unit will be processed and gives the output; the GSM and GPS are used to send the SMS to the family members whenever the rider met with an accident with live location.

### *Flowchart and Working*

In this section, the design methodology of the system is indicated in flow diagram. The sensors used here sense all the parameters, check all the conditions, and give

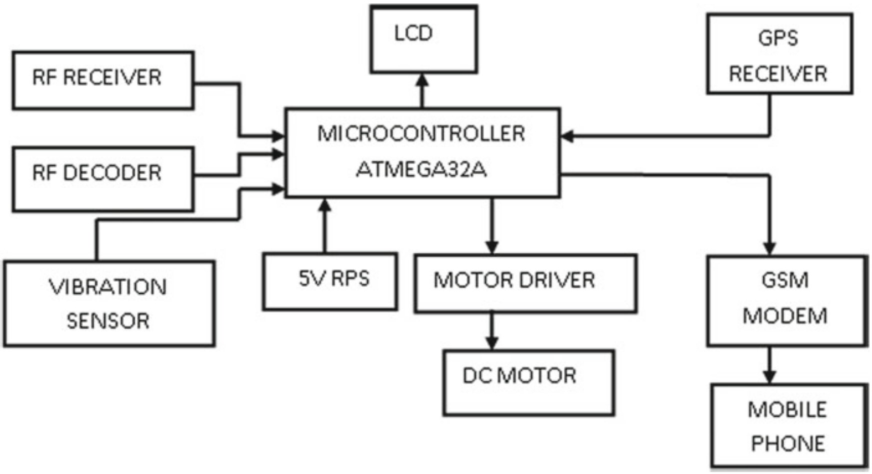


**Fig. 2** Vehicle unit

the output. If the necessary conditions are not met, it checks again all the parameters and gives required result. As soon as the microcontroller is powered, the peripherals such as GPIO and TIMER are initialized. The first step in the flowchart involves the initialization of all the ports and then setting the RF communication between the bike and the helmet unit. The RF decoder and the vibration sensor are monitored by the microcontroller. The next step involves the arrival of the signal from the leaf switch where it checks whether the helmet is worn or not and the alcohol sensor placed at the front end of the helmet senses the alcohol content in the riders' breath, and if it is between the range of 25 and 500 ppm, it sends the signal as the rider is drunken. The ignition will be locked until the rider wears the helmet, and if the rider is drunk, a message will be displayed on the LCD. If both the signals are valid, the user will be able to access the vehicle. The vibration sensor present in the vehicle unit senses the vibration, if any accidents occurred. In case of any accidents occurred, a message is sent to a mobile number of the authorized person with the location. Figure 3 shows the flow of the system.

## Results

The smart helmet system is successfully tested, and the results obtained are analyzed. After the testing, it can be integrated into a helmet. Figure 4 gives the schematics of the vehicle unit, and Fig. 5 shows the helmet unit. The driver is not allowed to start a bike if he is not wearing a helmet, also displays the message as "PLEASE WEAR THE HELMET," and the message is also sent to the given number. If the accident is detected or rider has consumed alcohol, it is displayed in LCD as shown in Figs. 6

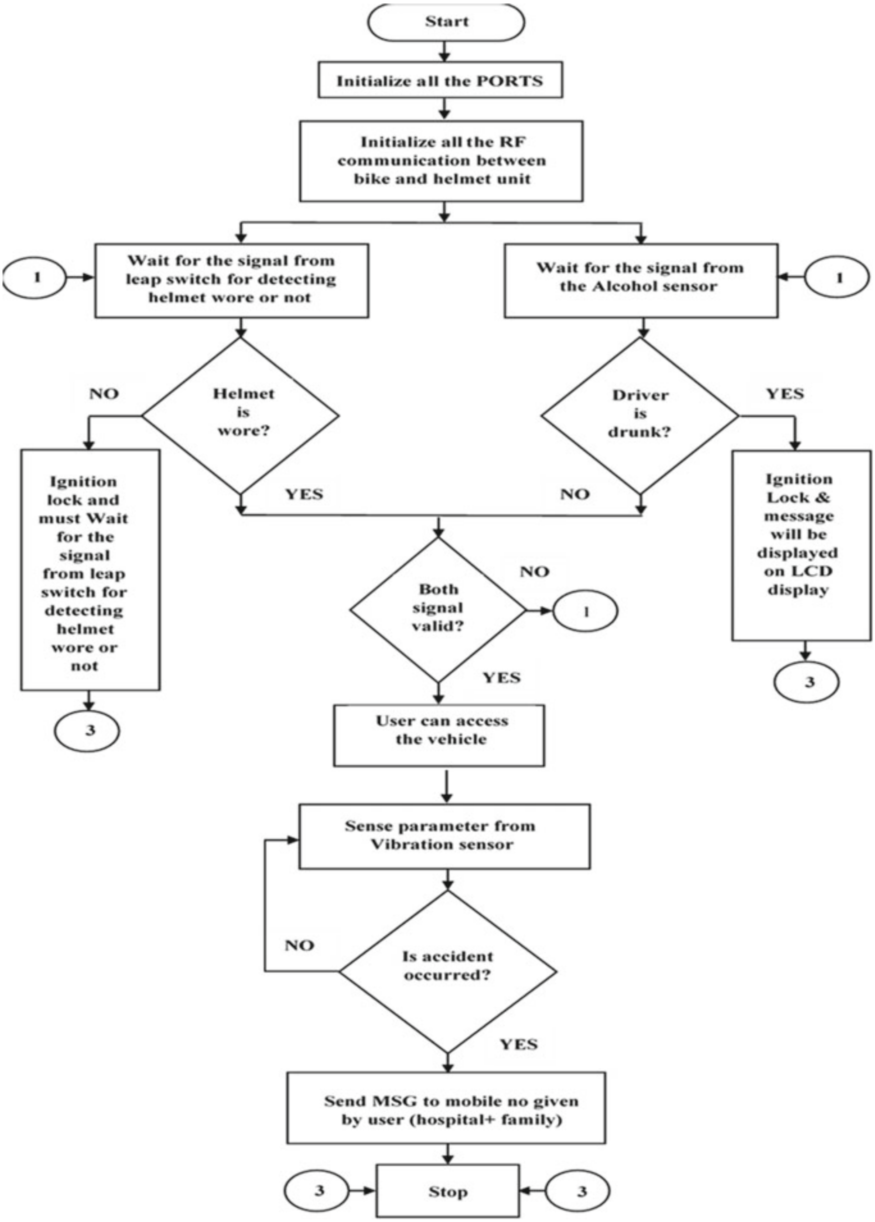


**Fig. 3** Flowchart of the model

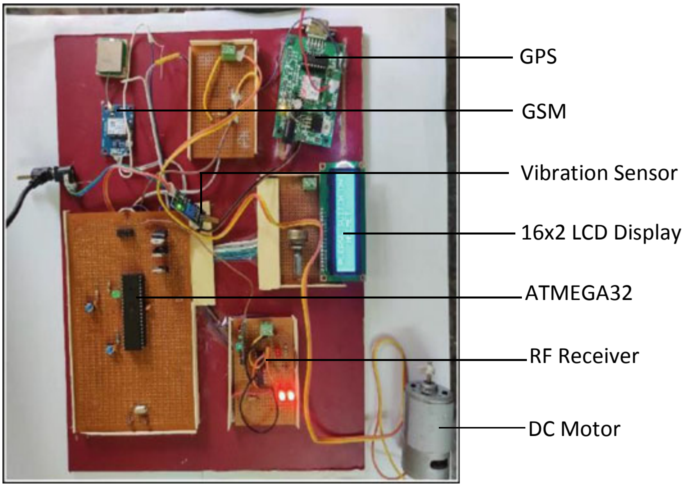


**Fig. 4** Vehicle unit

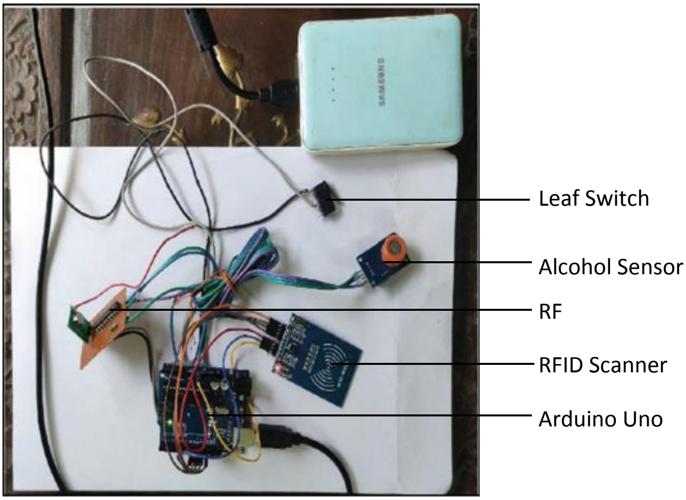


**Fig. 5** Helmet unit

and 7. When the rider meets with an accident, the vibration sensor in vehicle unit detects it and a message is sent with the help of GSM to the designated cell number and also the location of accident spot which is obtained from GPS. This is depicted in Figs. 8 and 9.


**Fig. 6** Accident detection


**Fig. 7** Alcohol detection

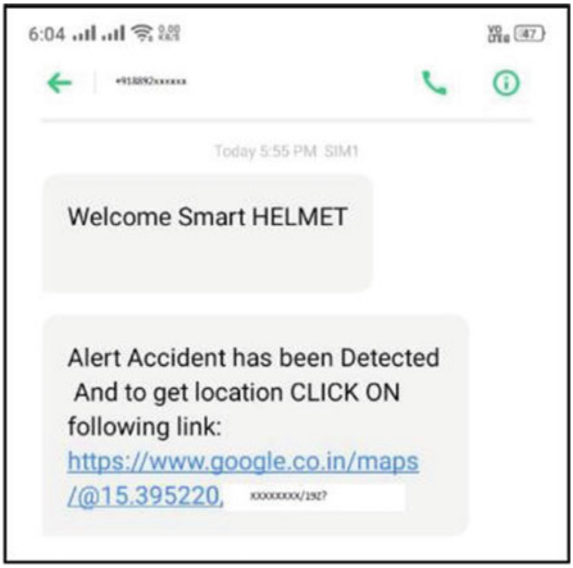


**Fig. 8** Message received on registered mobile number when accident detected

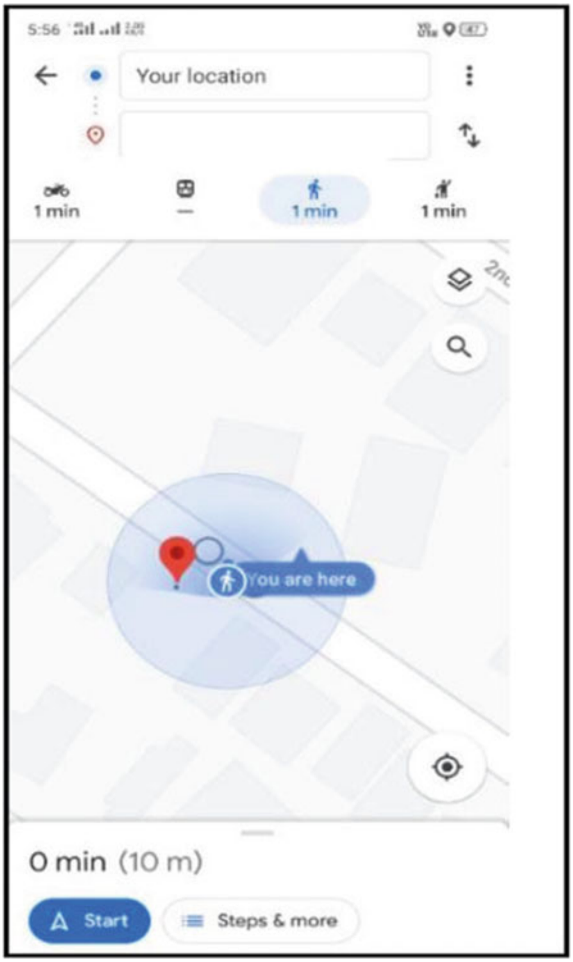


**Fig. 9** Location of the accident

## Future Scope

- The use of various bioelectric sensors on a helmet, which can track diverse actions, can improve this safety system technology.
- The entire approach can be adopted in cars simply substituting a seat belt for the helmet.
- A small camera can also be placed in the helmet for recording the activities of the driver. It also gives a message about the passing vehicles.
- A solar panel can also be inserted at the helmet top, by which the helmet unit gets a power supply. This power can be used for charging the mobiles.
- The model as a whole can be employed in a real-time safety system.

## Conclusion

The smart helmet acts as a rider's protective headgear that helps to reduce the number of people dying from road accidents. If not treated as soon as possible, a person may die. Violations of traffic laws can also be reduced. The suggested system of smart helmet stipulates that the user must wear a helmet when riding the bike, without which the bike will not start. The alcohol sensor detects alcohol in the breath of the rider. The bike will not start if found to be alcoholic. Finally, in the event of an accident, a message containing the accident location is sent to a family member or any registered number via GSM. This aids in the provision of timely assistance to the rider and the prevention of casualties.

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