B.Tech IoT Programming

Project Report

On

DESIGN AND IMPLEMENTATION OF IOT BASED SMART ACCIDENT DETECT HELMET USING VIBRATION SENSOR

by

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Abstract

The main objective of accident detection helmet is to detect accident using vibration sensor. In India, road accident contributes largely to the total deaths per year. Specially accident of two wheelers as they have minimal protection compared to other vehicles. In this also notable percentage of deaths is due to not getting med care on time or on critical hour. This helmet is an innovative modern idea which is design to enhance the rider safety using 2-wheelers (motorbike or scotty) and provide immediate assistance to injured rider. This helmet is equipped with sensors like alcohol sensor, vibration sensor, infrared sensor, pulse/heart sensor and GPS, GSM module. In the event of crash, the helmet detects it and send user's information and location of the accident to the hospital or contact saved in microcontroller (Arduino) and mobile app. Also, it will send the pulse rate of the user to the hospital and emergency contacts after he/she met with an accident to tell the seriousness of the situation and user's condition.

Important Keywords- Internet of Things**,** Smart Helmet, Arduino, GPS and GSM Technology, Vibration Sensor, Pulse Sensor, MQ3 sensor.

1. Introduction

In India, we have motorcycles and bikes as the most popular and affordable modes of personalized transportation. But unfortunately, it involves countless accidents and loss of lives. They are more vulnerable to accidents and crashes, which result in severe consequences. The increasing number of motorcycle accidents in India, demands the urgent need for an innovative solution.

The youth is particularly affected by motorcycle accidents. A report from the Indian Journal of Public Health says that nearly 25% of motorcyclists involved in accident were teenagers in Indian. According to the Ministry of Road Transport and Highways, two-wheelers account for over 37% of total road accidents in 2021 and approx. 30% of all road fatalities.

We have seen that; many lives are lost in accident due to lack of timely medical assistance, especially in the less crowed areas or during late hours when fewer people are outside. Often, after an accident, the injured person remains unnoticed for around 30 mins or more, with no one to call for help or to inform the family.

Because of these delays, the ambulance is not able to reach on time and the victim may lose their life. Research indicate that the number of accidents can be prevented if emergency services received real-time information about accidents.

The primary **motivation** behind this project is to reduce the number of deaths by providing immediate assistance to the victim. Timely assistance during the accident can reduce the risk of permanent deaths and injuries. The solution that we are proposing is to create a smart accident helmet which will help in alerting emergency services in case of accident. Helmets play an important role in protecting riders against head injuries. They absorb the impact energy, significantly reducing the likelihood of fatal injuries during accidents.

Technical Details

- **Sensors Used**:
    - **Vibration Sensor:** It will detect the vibration and according to a threshold value it can tell that an accident occurred or not.
    - **MQ-3 Gas Sensor:** It will detect whether the person has consumed alcohol or not before wearing the helmet.
    - **Pulse Sensor**: Monitors the rider's heart rate for potential emergencies.
    - **IR Sensor**: It will ensure the helmet is worn by the rider.
- **Communication**:
    - **GPS Module**: Provides real-time location data during an accident.
    - **GSM Module**: Sends emergency alerts to pre-registered contacts via SMS and email.
- **Microcontroller**: A microcontroller (Arduino) acts as the central unit, processing sensor data and managing communication protocols.

Unique Functionality of the project:

Heart Rate Monitoring:

- The helmet includes a pulse sensor which will calculate the pulse of the user after he met with an accident and continuously send the pulse rate of the user to the hospital and inform them about the urgency of the situation.
- It wil**l lead to a faster Medical Response** if the rider's pulse rate will know to medical professionals.
- Hospital can **determine it quickly whether the rider is alive or in critical condition**, which will help them in preparing the necessary medical intervention even before the rider arrives.

2. Related Works in Project

2.1 Introduction

We found many projects on smart accident detect helmet idea. But these projects we found more relevant to our project.

2.1.1 **Accident and Alcohol Detection in Bluetooth enabled Smart Helmets** et al [1]: In it the helmet can detect a possible accident, using the onboard accelerometer and pressure sensor. If the values detected exceed a threshold, it is reported as an accident. The location of the accident is sent to the emergency contacts, specified by the rider during app setup. They used alcohol sensor for alcohol detection and if the user rides the bike in that condition, his/her emergency contacts will be notified about that.

2.1.2 **The project** et al [2] provides a cheap, effective accident detection and notification system to address the aforementioned problems. Though integrating sensors with a high-end microcontroller provides rapid accident detection, they are limited in terms of processing and notification capabilities. The TI CC3200 [14] is a Wi-Fi enabled controller, which is used to connect to a data network for accessing cloud services. This expands the computational and storage capabilities of the system. The system on the helmet communicates with the cloud-based incidence response and notification system via a RESTful architecture over HTTP using JSON.

2.1.3 **IoT Based Smart Helmet and Accident Identification System** et al [3]: They use IR sensors, gas sensors, and load sensors for preventing an accident. The 3-axis accelerometer is used for detecting any accident. When any accidents occur, the accident location sends to the nearest hospital and police center.

2.1.4 **The project** et al [4]: In the Smart Helmet project, the helmet is equipped with various sensors, including an accelerometer, gyroscope. The system uses MPU6050 sensor to detect rider's heads movement and abnormal movements. If an accident is detected, it immediately sends an alert to emergency contact and nearby hospital.

2.1.5 **The Smart Helmet using IoT for Alcohol Detection and Location Detection System** et al [5] presents a system that includes an alcohol detection sensor (MQ-3) and an infrared (IR) sensor. These sensors ensure the rider is wearing the helmet and has not consumed alcohol

before the ignition starts. If alcohol is detected or the helmet is not worn, the ignition is blocked. The system uses GPS to access location of the rider and send it to the contacts.

2.1.6 In **Design & Implementation of IoT Based Smart Helmet for Road Accident Detection** et al [6], an IoT-based smart helmet is designed for road accident detection using various sensors. The Sharp IR sensor to detect if the rider is wearing helmet or not, and an MQ-3 gas sensor to identify alcohol consumption. If the rider is drunk, the system prevents the motorcycle from starting. Additionally, a vibration sensor (SW420) detects accidents, and GPS and GSM technologies send the accident location to the rider's emergency contacts and nearby hospitals

2.1.7 **In SMART HELMET** et al [7], the helmet system ensures that the rider wears the helmet before starting the bike using an IR sensor. An alcohol detection sensor checks if the rider is under the influence of alcohol. The system also uses an RF transmitter and receiver for communication between the helmet and the bike. Additionally, a temperature sensor monitors the engine to prevent overheating, while accident detection modules send location alerts in case of a crash. Signboard detection through RF modules provides early warnings to riders.

2.1.8 **In Implementation and Analysis of Smart Helmet** et al [8] various sensors are integrated to ensure rider safety. The helmet includes an alcohol sensor (MQ-6) to detect alcohol consumption, a fog sensor (LDR) to enhance visibility in low-light conditions, and an accelerometer for accident detection. Additionally, an RF module ensures communication between the helmet and the bike, ensuring the bike can only start if the rider is wearing the helmet. In case of an accident, a GSM module is employed to automatically send alerts to emergency contacts and nearby hospitals.

Author	**Link of publish edwork (Resear ch**	**Year**	**Features**	**Modules/ Sensors/Used**

	Paper/ Patent)			
Sayan Tapadar, Arnab Kumar Saha, Dr. Himadri Nath Saha. Shinjini Ray, Robin Karlose	[1]	2018	• Detect accident by using accelerometers and pressure sensors. • If rider had consumed alcohol, then it alerts emergency contacts	Flex sensor, Impact sensor, IR sensor, GSM module
Sreenithy Chandran, Sneha Chandrasekar, N Edna Elizabeth	[2]	2020	• The accident detection system communicates the accelerometer values to the processor which continuously monitors for erratic variations.	IR sensor, MQ-3 sensor, GPS module
Md. Atiqur Rahman, S.M Ahsanuzzaman, Toufiq Ahmed, Abid Ahsan, Ishman Rahman	[3]	2020	• All 3 sensors used prevents the accident and 3-axis accelerometer detect accident. • It also sends the accident location to nearby hospitals and police	IR sensors, gas sensors, load sensors, GPS module
Dr. M. Kiran Kumar1, *Aniruddha* Balbudhe, *CH Sai* Karthikeya	[4]	2023	• Use accelerometer and gyroscope to detect head and abnormal movements. • Send the accident alert to emergency contacts and hospitals.	MPU6050 sensor
Gurpreet Singh Chhabra, Monika Verma, Khushi Gupta, Abhinandan Kondekar, Dr. Siddhartha Choubey, Dr. Abha Choubey	[5]	2022	• The sensors used block the ignition of vehicle if condition is unsafe. • GPS module sends the location of accident.	alcohol detection sensor (MQ-3), IR sensor, GPS module
Mohammad Ehsanul Alim, Marzieh Naghdi Dorabati, Sarosh Ahmad, Ihab Hassoun	[6]	2020	• IR sensor detects the helmet usage and MQ-3 sensor checks for alcohol. • Accident is detected by vibration sensor and alert is also send.	IR sensor, MQ-3 gas sensor, vibration sensor (SW420), GPS and GSM module
Nataraja N, Mamatha K S,Dr. Keshavamurthy ,Dr. Shivashankar	[7]	2018	• Uses RF transmitter/receiver for bike communication. • Accident alert system with temperature monitoring and signboard detection by RF modules	IR sensor, temperature sensor, RF modules
Rashmi Vashisth, Sanchit Gupta, Aditya Jain, Sarthak Gupta, Sahil, Prashant Rana	[8]	2017	• Fog sensor is used for visibility. • RF module ensures bike-helmet communication.	Alcohol sensor (MQ-6), fog sensor (LDR), RF module, GSM module

2.2 Drawbacks in these existing projects

2.2.1 None of them used a pulse sensor to calculate the pulse of the user when he or she has met with an accident. Also, they are not reporting the pulse too.

2.2.2 Due to alcohol sensor not having 100% accuracy it can cause user problem. If he or she does

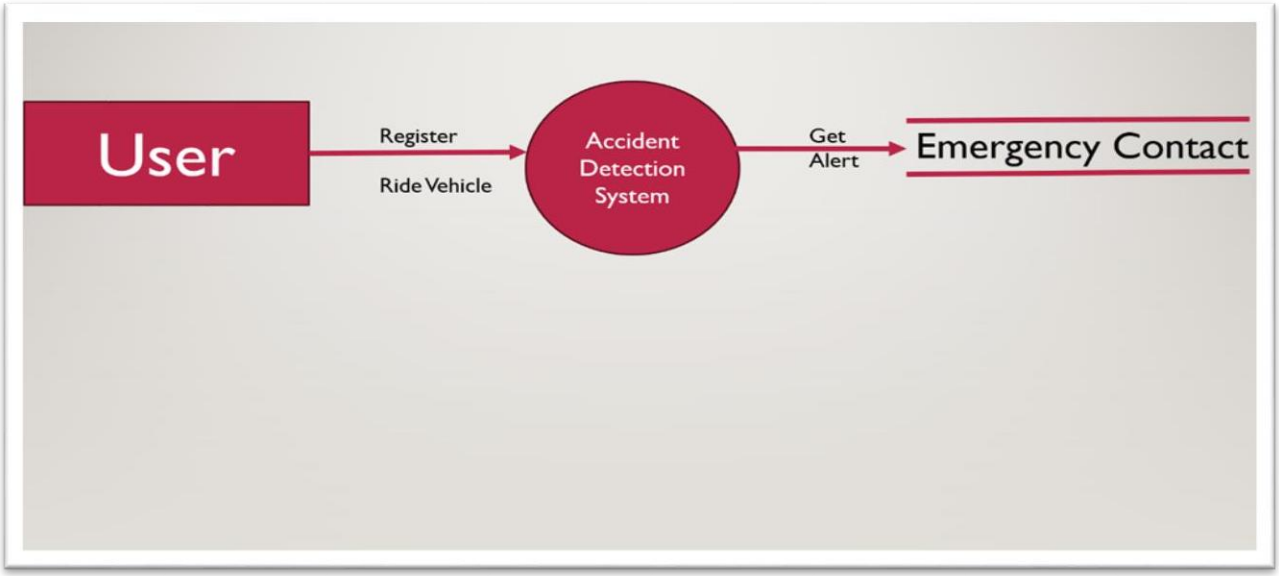
not have consumed any alcohol and the alcohol sensor gave false readings the motorbike will not start as given in (2.1.2) design as mentioned.

2.2.3 In case the user's helmet gets any issue with it he/she cannot use their vehicle either as it is connected to the helmet of the user. So, integrating helmet with the user has its own disadvantages.

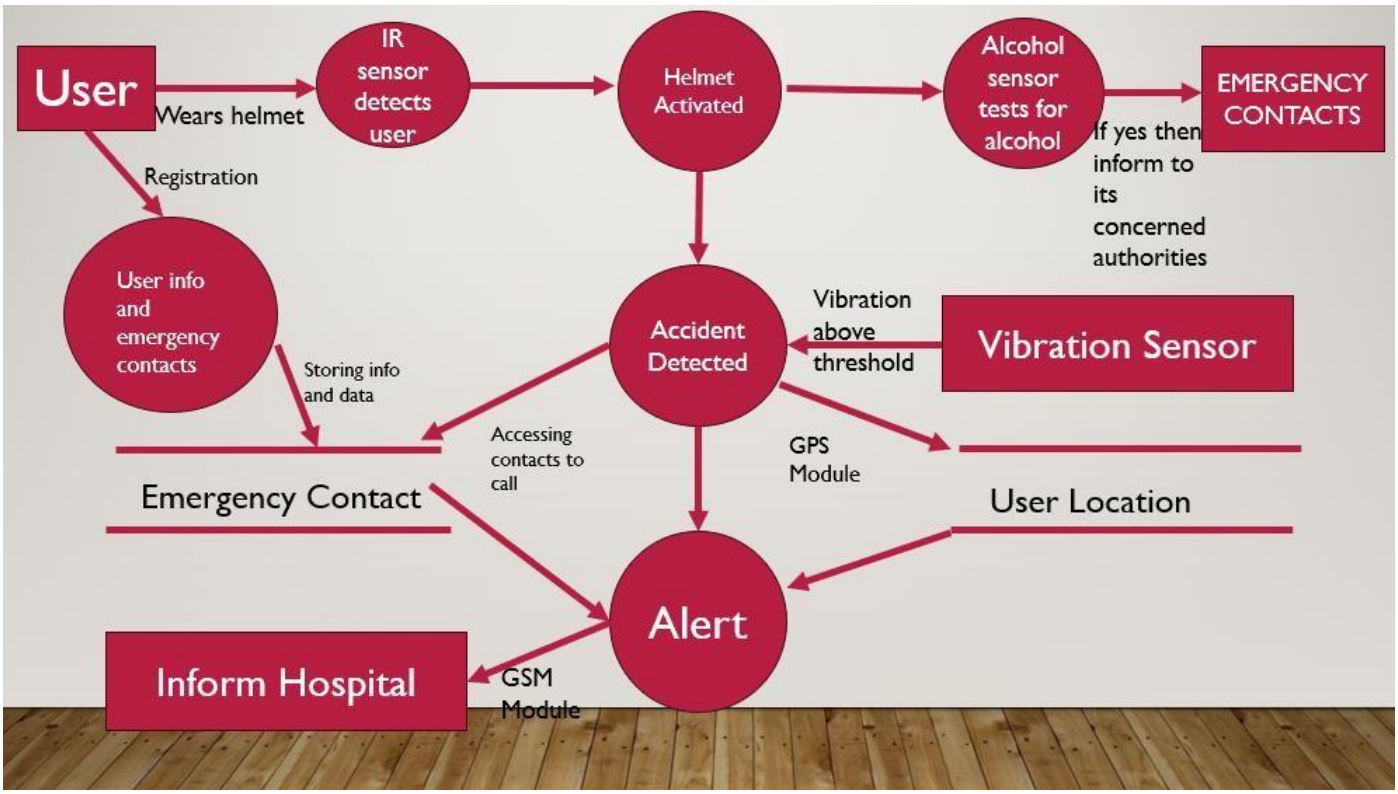
3. Project

The helmet system contains multiple components like alcohol sensor, gps module, gsm module, vibration sensor, pulse senor, etc. The helmet starts after detecting the rider using infrared sensor and continuously track the location of user using gps module and when an accident happens, it will be detected using a vibration sensor, and a message will be sent to the hospital after the accident.

Conceptual Diagram

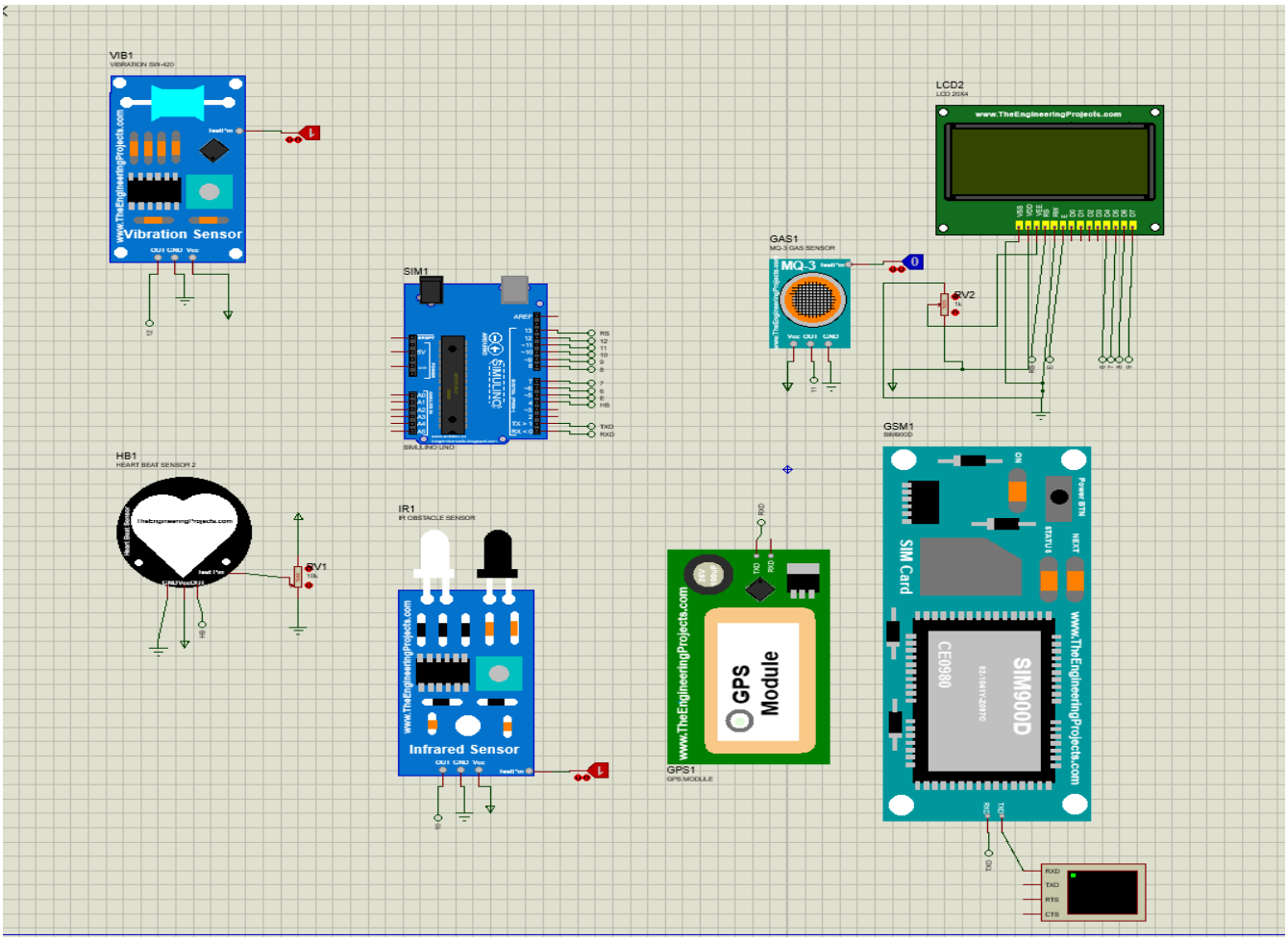


Level 0



Level 2

Circuit Diagram:



Process Flow:

Registration: The rider first register himself along with his personal details like name, mobile number, address, emergency contacts, etc. in the system so that the system can use this information at the time of accident**.**

Helmet Activation: The helmet start working when the rider wears it then the infrared sensor senses the rider's head. Helmet will first detect the alcohol using alcohol sensor.

Alcohol Detection: After activation of helmet first it will detect the alcohol using alcohol sensor and if the rider is drunk it will notify the server and this information is provided to the emergency contacts and the concerned authorities.

Accident Detection: When the rider meets an accident then the vibration sensor will detect it and then it will notify the server about the accident.

GPS Tracking: The GPS module connected with microcontroller (Arduino) track the rider location and will update the user location on the server.

Pulse Monitoring: After detecting the impact by vibration sensor, Pulse sensor continuously monitor the heartbeat/health of the rider.

Sending Message: The GSM module send the message of the accident to the nearest hospital and to the concerned authorities (emergency contacts, police, etc.). The message contains the user information, location of the rider and his pulse condition. The pulse condition will tell the hospital about the user

health and will tell them the urgency of the situation.

Experimental Setup

4.1. Implementation Details: Implementing a **Smart Accident-Avoiding Helmet** involves integrating several technologies such as sensors, communication modules, and microcontrollers to enhance rider safety. The system aims to prevent accidents by detecting potential hazards, monitoring the rider's condition, and ensuring the helmet is worn properly. Below are the details of every sensor, model, library used in the project and their functional descriptions.

Table 1: Implementation Details

Sr. No.	**Sensors**	**Model**	**Library**	**Description**
1.	Vibration Sensor	MPX4115	VibrationSensorTEP	Designed to detect vibrations or shocks in a system and generate a response when movement exceeds a set threshold value.
2.	Pulse Sensor	Heartbeat Sensor V2.0	HeartBeatSensor TEP	designed to measure the heart rate of an individual. It can detect the pulse of the finger or earlobe and convert it into an analog signal for further processing.
3.	Alcohol Sensor	Gas Sensor MQ3	GasSensorsTEP	used for detecting alcohol and ethanol vapor concentrations in the air. The MQ-3 specifically detects alcohol, making it suitable for breathalyzers, gas leak detection, and similar applications.
4.	GSM Module	SIM 900D	GSMLibraryTEP	**GSM module** (Global System for Mobile Communication) used to enable cellular communication for various applications like **IoT** (Internet of Things), remote monitoring, and mobile data transfer or connect to the internet through **GPRS** (General Packet Radio Service).
5.	GPS Module	GPS Module v1.0	GpsTEP	**GPS** (Global Positioning System) is a satellite-based navigation system that provides location and time information anywhere on Earth, regardless of weather conditions, time of day, or geographic location.
6.	IR Sensor		InfraredSensorsTEP	An **Infrared (IR) Sensor** is an electronic device that detects infrared (IR) radiation emitted by objects. It can sense the presence, proximity, or motion of objects by analyzing the heat emitted in the form of IR radiation, which is invisible to the human eye but detectable by the sensor.

4.2. Experimental Results

Sr. No.	TEST SCENARIO	INPUT	OUTPUT
1.	Helmet Activation	Rider will wear the helmet	Infrared sensor detects that rider has worn the helmet. It will start the system.
2.	Alcohol Detection	Rider wears helmet	If rider had consumed alcohol before wearing helmet, then it will notify that user/rider
3.	Accident Detection	Rider met with an accident	With the help of the vibration sensor, we will detect whether the user has met with an accident or not. So, in case of accident vibration sensor will tell he met with an accident to the server.
4.	GPS location	User accident point	GPS will locate the user location where he met with the accident.
5.	Pulse Sensor	There can be rapid increase or decrease in the pulse of the person.	It will calculate the pulse of the rider.
6.	Sending messages	Alerts and location of the rider to be sent to the hospital and the emergency contacts.	It will help to send message and alerts to the hospital and emergency contacts about the rider's accident and location of the accident. Also, it will tell the pulse rate of the person to determine the emergency of the situation.

Total time take for accident detection and sending message is 9154ms or 9.1sec.

6. Conclusion and Future Work

6.1 We can use a solar panel which can store energy in the helmet. It can also include working on solar energy when it is available and switch to battery when needed.

6.2 Helmet can also include a charging port where the person can use helmet's battery to charge his/her device.

6.3 We can also add sensors to check whether the user's drowsiness and if he is feeling sleepy it will raise an alarm or buzzer and awake him. It will call his emergency contacts and also to the user so that he/she can rest somewhere after the advice of his close ones and the people from the company.

Accident detect helmet is a modern system which can save multiple lives which get lost due to not getting treatment on time and provide a more secured bike riding. Many riders lost their lives due to drunk and drove. So, alcohol sensor will check this issue. It also contains a pulse sensor which will regularly monitor rider's condition after the accident. GPS module is preset to track the rider location after his/her accident and get help immediately. This helmet not only enhances the 2-wheeler safety but also serves as a milestone for future advancements.

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