International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 10 Issue 08, August-2021

Smart Helmet with Quick Ambulance Response System

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***Abstract*— A smart helmet is used as protective headgear for the rider. The smart helmet is providing safety to the rider. This can be developed by using the method of alcohol detection, accident identification, location tracking, and fall detection which are uses as a hands-free device. It also makes a two-wheeler as a feature of smart bike. The rider must wear the helmet otherwise bikes will not start. An RF Module is used as a wireless link for communication between transmitter (helmet unit) and receiver (bike unit).If the rider is drunk the ignition gets automatically locked, and sends information to a contact number with the current location. In case of an accident, it will send a message through google firebase server along with location with the help of GPS module. Most important utility of this method is that fall detection and it will send a message when the rider falls down from the bike.**

Keywords—Accident Detection; Smart helmet; IoT; FSR; Gyro sensor; GPS; Alcohol Sensor; QR Code; Haar-like feature; MOG2;

I. INTRODUCTION

A. Background of Project

In recent times helmets have been made compulsory in All States. In India, traffic accidents are increased day by day. From the Motor Vehicles Act, 1988, Section 129, we know that when a person rides a two-wheeler they should wear protective headgear which must be following the Bureau of Indian Standards. Also, from the Motor Vehicle act 1939, we know that it is a criminal offence and the rider will get punishment if a drunken driving under the influence (DUI). But at present the bike rider forgot or intentionally does not follow the rules and regulation and if identified, they can easily overcome the situation from the law. This problem motivates us to design this technique.

B. Statement of the Problem

During the study for the project, we got acknowledged to various scenarios, where, bike accident is occurred in remote places and rider cannot capable to communicate with ambulance or family Increases the possibility of death of the person in case of late medical response. In past years road death increased to 1.49 lakh. Out of that, 25% crashes occurred with two-wheeler. Those who died, over 50% did not wear helmet. 1.5% bike crashes occurred due to drunken bike riding. Also, there have significance factor that people got helpless when they are facing such type of accident condition. So, by this project we are aimed to reduce the accident death by providing them health support.

C. Aims and Objective of the Project

The main object of this project is to make a protection system in a helmet for the safety of bike rider. Other specific objectives are:

i. Estimating cost of the proposed system.
ii. Designing a controller circuit to interface among transmitter, receiver, GPS Module and different sensors.
iii. Implement a smart system in which the engine starts only when helmet is worn.
iv. Programing for detecting accident.
v. Programming for sending message with current location to nearby ambulance and family member automatically.

II. PROPOSED SYSTEM

The first step is to identify whether the helmet is worn or not and to check whether the rider is drunken or not. If helmet is worn and the rider is not in drunken condition then ignition will start otherwise it remains off. For this, Force Sensing Sensor (FSR) sensor and alcohol sensor are used. When the above condition is satisfied then only ignition can be started. The main issue is accident and late medical help. When accident is occurred, the rider cannot get any medical help immediately which lead to death of the person. Every second people die due to delay in medical help or in the case where the place of accident is unmanned. The system sends the news of accident immediately to the ambulance service database and to preregistered mobile numbers with proper location using GPS. The ambulance database assigns nearest available ambulance to rescue the victims. In fall detection, we place Accelerometer and Gyro Sensor in the bike unit. By this proposed method we can detect the accidents.

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
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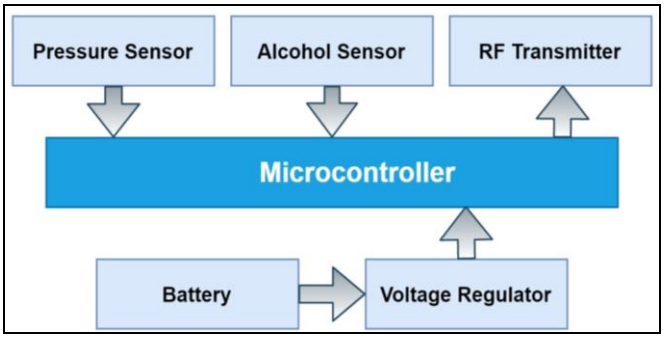

Figure 1: Helmet Unit Block Diagram

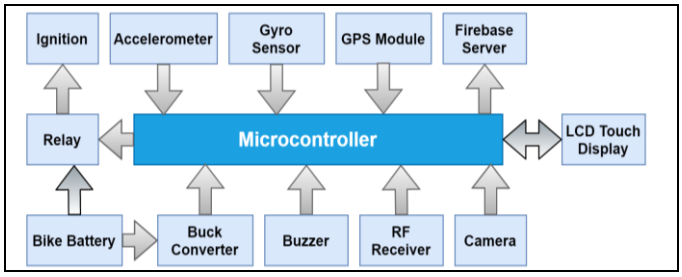

Figure 2: Bike Unit Block Diagram

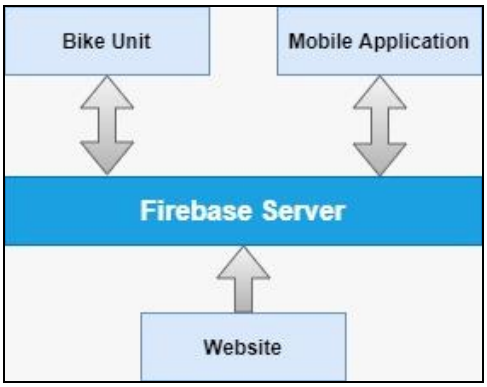

Figure 3: Server Block Design

Besides, another big problem is that, rider cannot see blind spot in highway. Due to this reason, so many accidents occur.

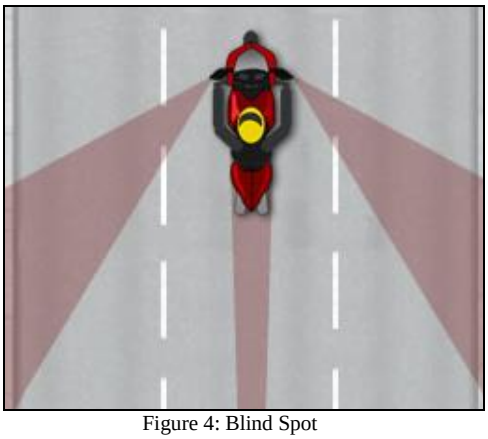

Figure 4: Blind Spot

To solve this problem, a rear-view camera is installed on the bike. The system will recognize the vehicles coming from behind of the rider by image processing.

Figure 5: Blind Spot visibility

III. DESIGN OF THE PROJECT

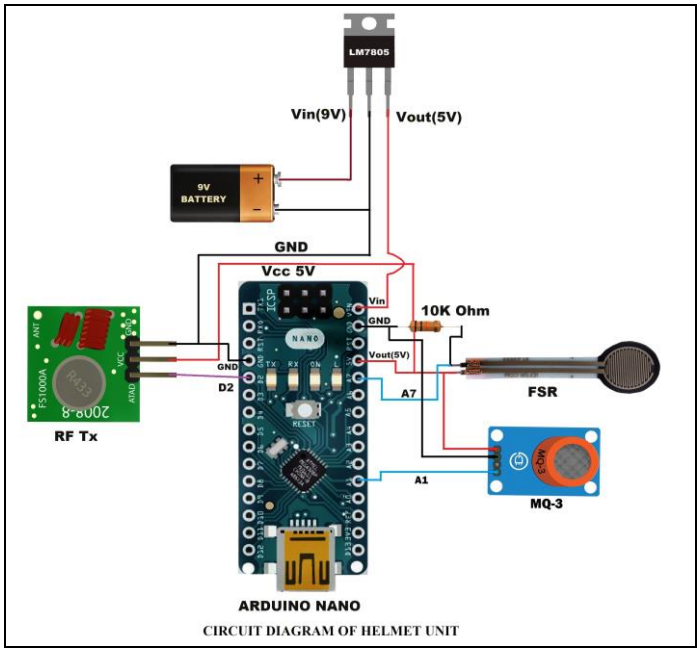

Figure 6: Helmet Unit Interfacing

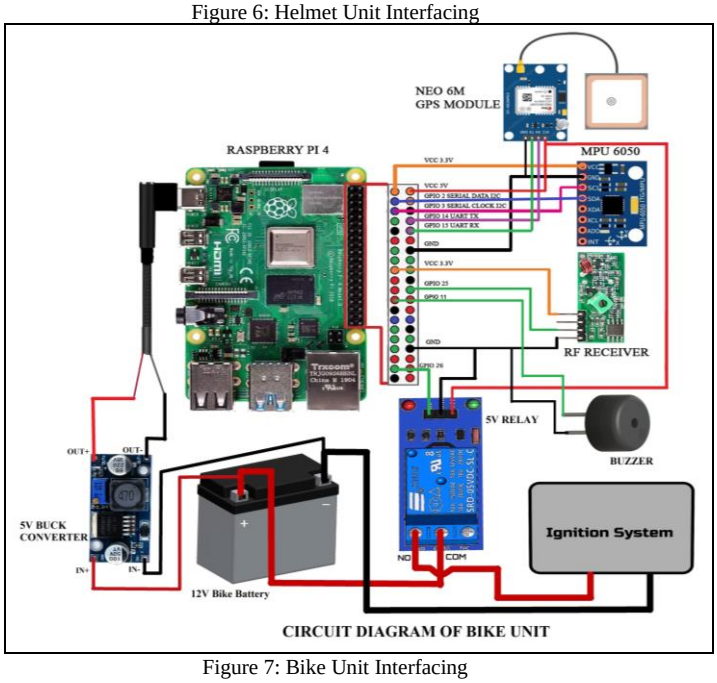

Figure 7: Bike Unit Interfacing

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IV. REGISTRATION

A. *Rider Registration*

This QR code can be created using any online websites. If we scan this QR code we go to our website with Device ID.
Url: https://fir-test-c8a84.web.app/?id=Device_03
In the above Url https://fir-test-c8a84.web.app/ is website address and id=Device_03 is the query params. For every Device we can create different QR code by changing the device id in query params.
i.e.
Device_01=>https://fir-test-c8a84.web.app/?id=Device_01
Device_02=>https://fir-test-c8a84.web.app/?id=Device_02

Figure 8: Device Registration QR Code

The Rider has to scan the QR Code then the web page open. The rider has to fill up all the personal details and emergency contact number. Then the rider submits the form and the database are updated. Now the module is completed to use.

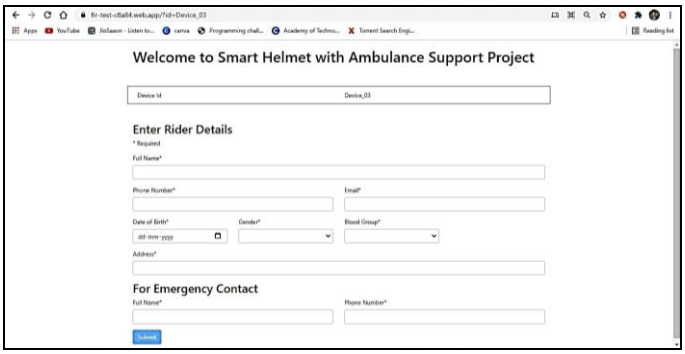

Figure 9: Website Rider Registration Form

B. *Ambulance Driver Authentication*

In Our Smart Helmet and Quick Response System the Ambulance App plays a major role. When an Accident occurs the smart box in the bike send the location to server and the location is marked in the app. So, the Ambulance Driver Easily navigate to the location as soon as possible.

We use Email based user authentication. Every user has to register using email and password. All the passwords are stored as encrypted string.

New user after giving the email ID and password should click **REGISTRATION** and then account will be created.

Figure 10: App Icon

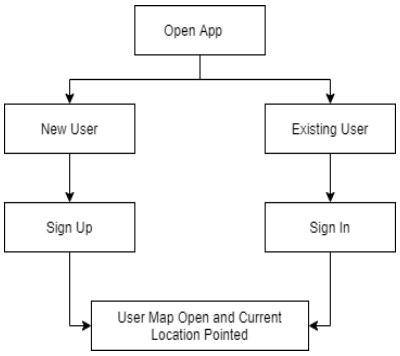

Figure 11: Ambulance Driver Authentication Flow

Figure 12: App Sign in and signup Screen

C. *Ambulance Details*

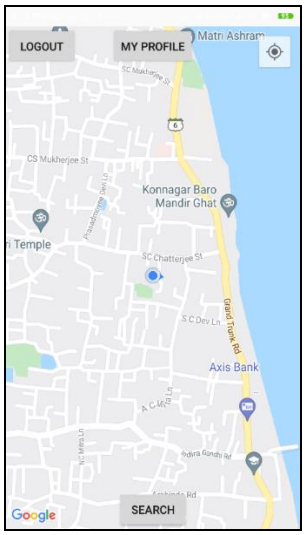

Figure 13: Map with driver current location

Figure 14: Driver My Profile Form

In **My Profile** Section user has to submit his ambulance and personal information.

V. WORKING PRINCIPLE

The system is divided into three different parts which work together. These three parts are:

A. Helmet Unit.
B. Bike Unit.
C. Mobile Application.

The all three parts are discussed below:

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Vol. 10 Issue 08, August-2021

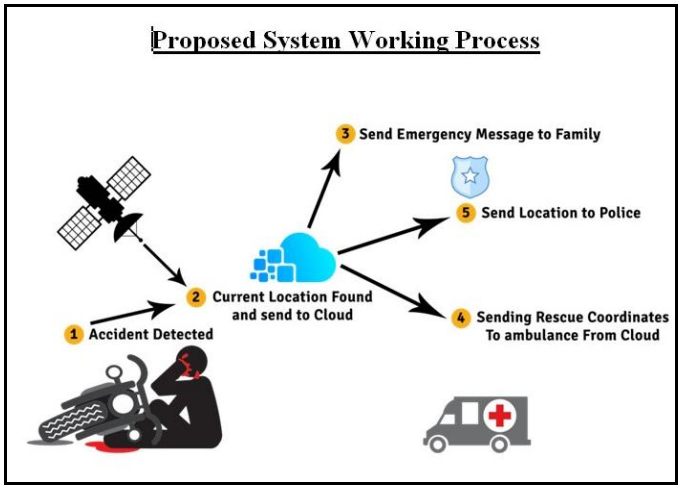

Figure 15: Working Process

A. Helmet Unit:

1. At first the Helmet Unit initializes all the ports and establishes the connections with the Bike Unit.

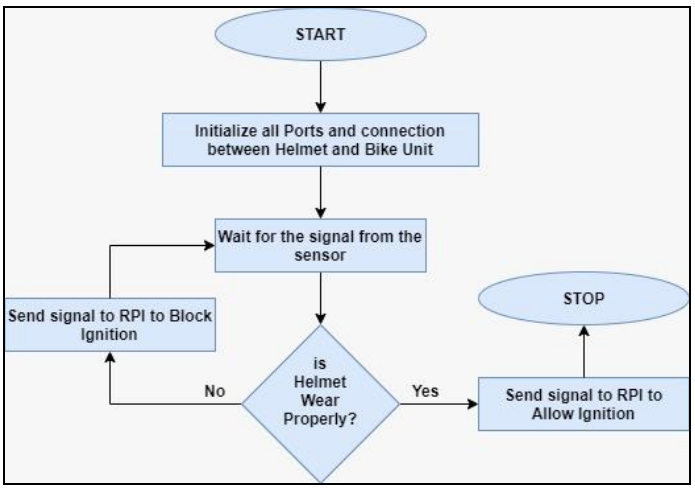

Figure 16: Helmet Unit Flow Chart

2. Then the smart helmet checks the reading of FSR sensor to ensure that the rider wears the helmet properly.
3. If the condition is not appropriate i.e., the rider does not wear helmet, then the helmet unit sent the Negative signal to the bike unit by RF transmitter to not allow the rider to start the bike engine by locking the flasher relay.

B. Bike Unit:

1. At first the Bike Unit initializes all the ports and establishes the connections with the Helmet Unit.
2. The rider should connect the system with internet to enable the Emergency Ambulance Service by connecting the bike unit with Google Firebase Server.
3. Then microcontroller analyses the received signal received by RF Receiver and make sure that the rider wears helmet properly.
4. Then the system allows the rider to start the engine by unblocking the flasher relay.
5. After starting the engine, the microcontroller always analyses the received real-time signal sent by helmet unit to make sure that the rider wears helmet properly at the time of riding.
6. If the rider met any accident, then bike unit will sense the condition through the Gyro sensor and Accelerometer reading.
7. After that, the bike unit will ask the rider that does he need any help**?** through buzzer signal and also it will visible in screen.

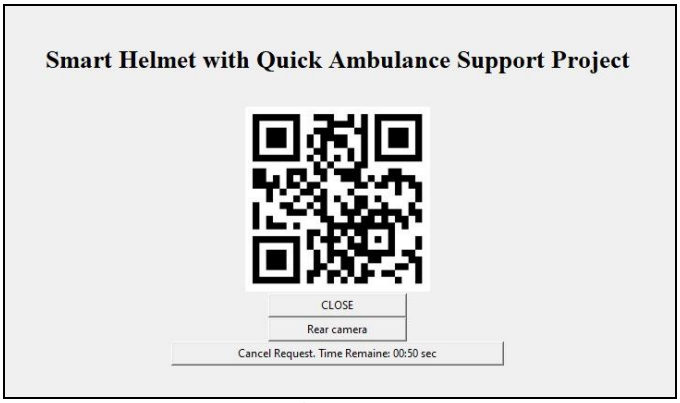

Figure 18: Confirmation Request

8. The rider should response in the screen within 1minIf rider will unable to give reply within 1 minute, then bike unit send the data to the server and the system will start searching the nearest available ambulance to help him automatically. The nearest ambulance will receive the notification along with the present location of the rider.
9. The system will also send SMS to preregistered mobile numbers of family members.

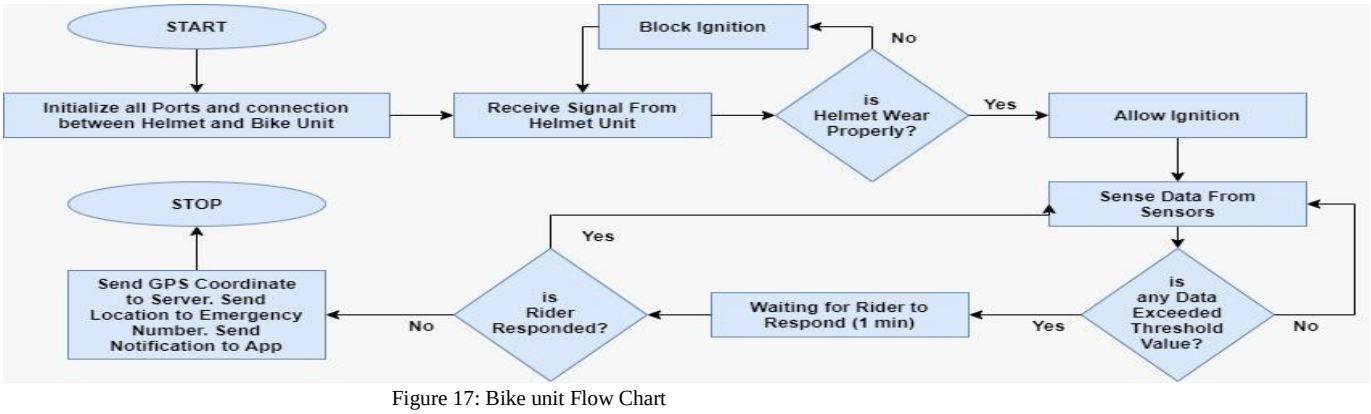

Figure 17: Bike unit Flow Chart

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10. After getting confirmation from the rider, all the ambulances will get the notification in the App with exact location. The nearest ambulance will go for pickup.

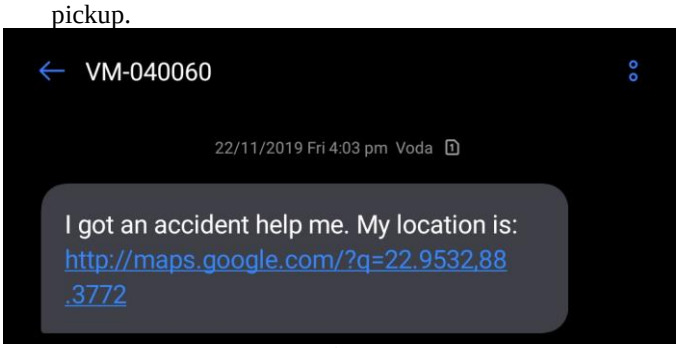

Figure 19: Help message for Emergency Number

11. When the user clicks the link, it will open in google map.

C. *Mobile Application:*

Searching Algorithm:

Device = Accident Victim Smart Box

Step 1: Start

Step 2: Find User Last Location.

Step 3: Search Database for Device Locations (Latitude, Longitude).

Step 4: Set Radius r = 1 Km.

Step 5: Search inside r Km Radius of User's Last Location.

Step 6: Check Any Device Found. If Device Found Go to Step 8.

Step 7: If Not Device Found. Increment Radius r = r+1. Go To Step 5.

Step 8: Update Database connect the Device Location with the user id.

Step 9: Update the Google map and show the pickup location.

Step 10: Stop.

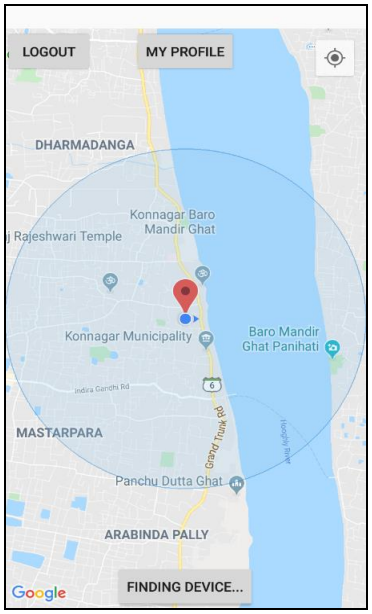

Figure 20: Searching For Device

Cancel Search:

If the user Exit the app or Click Finding Device or Cancel Button It is automatically Stop Searching.

Accident Location Found:

After Finding the Device Location. User Can click on the navigation button it will open the goggle map app with the shortest path.

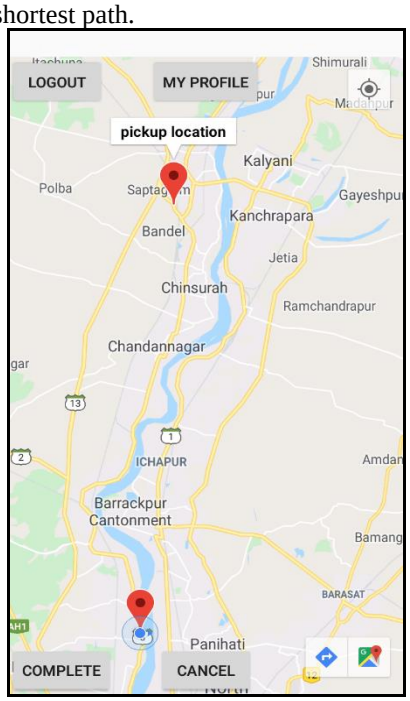

Figure 21: Device Location Found

Complete Pickup:

When the ambulances picks up the victim and send to the nearest hospital the user clicked the complete button to update the database. Then the user can search again for new Device.

VI. BLIND SPOT DETECTION

In the proposed system, it detects the phase by calculating the Haar-like feature of each portion of the image and a window of the target size which is moved over the image. Now it compared with threshold value obtained by learning feature that separate between object and non-objects. Calculation of the speed is the most advantage of this proposed method. Since integral image is use, it generates the value of sum of a subset of rectangular shape in the grid very efficiently and quickly. Then it calculates the Haar-like feature in constant time.

The Figure 22 shows a single frame of a sample video. The image contains pedestrians as objects. Figure 23 is a snapshot of the output after using MOG2 Background Subtraction. The Gray section under a vehicle represents the shadow of the vehicle.

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Figure 22: Simple Frame of a Video

Figure 23: Result after Background Subtraction

Next, we create the XML files of the various objects (target object) to be detected i.e., one XML file each for bus, car, two-wheeler. The steps involved in detecting the vehicles from the video is shown below-

Step 1: Collection of Positive and Negative Image Set
Step 2: Training the Haar Classifier
Step 3: Creating XML file of the trained Haar Classifier
Step 4: Import the XML file in the project and detect vehicles from the video.
Step 5: Display in LCD Display.

Figure 24: Detection of Vehicle 1

Figure 25: Detection of Vehicle 2

VII. Result & Discussion

An embedded system designed for Smart Helmet and Quick Ambulance Response System and its components are shown in figure 6 & 7 the embedded device is placed in particular area for testing purpose.

A. Helmet Unit

1. FSR Sensor

The FSR sensor detects the pressure and analyze it to make sure the rider wears the helmet. If the threshold limit is crossed the corresponding controlling action will be taken (like issuing Negative message to the bike unit). Reading description given below-

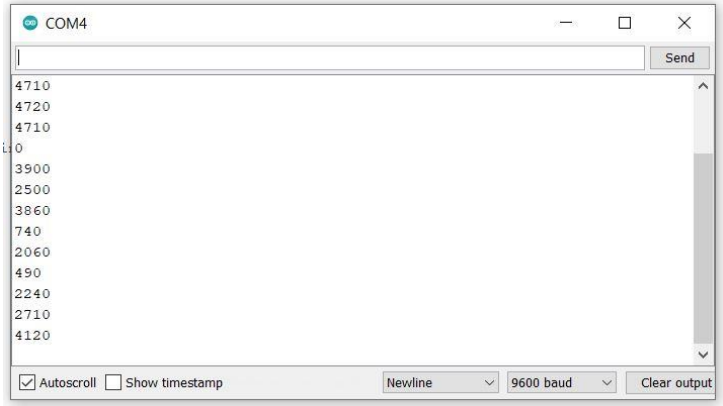

Figure 26: Analog Reading of FSR Sensor

TABLE I
Analog Reading of FSR Sensor

Reading Value	Status
0-1000	No pressure or Low Pressure on FSR
1000-2000	Moderate pressure
<2000	High Pressure

2. MQ-3 Alcohol Sensor

MQ3 is very commonly used sensors in the MQ sensor group. It is a Metal Oxide Semiconductor (MOS) type of sensor. Metal oxide sensors are known as Chemiresistors, because sensing is based on the change of resistance of the sensing material when exposed to alcohol. So by placing it in a simple voltage divider network, alcohol concentrations can be detected. Reading description given below -

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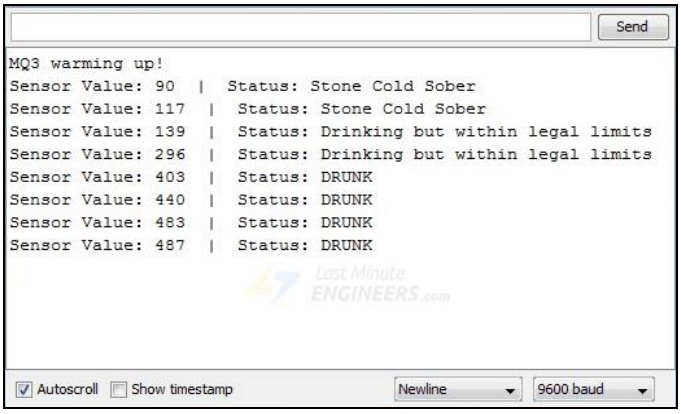

Figure 27: Analog Reading of MQ-3 Sensor

TABLE II
Analog Reading of MQ-3 Sensor

Reading Value	Status
< 120	is sober
120 - 400	is drinking – but within legal limits
> 400	is drunk

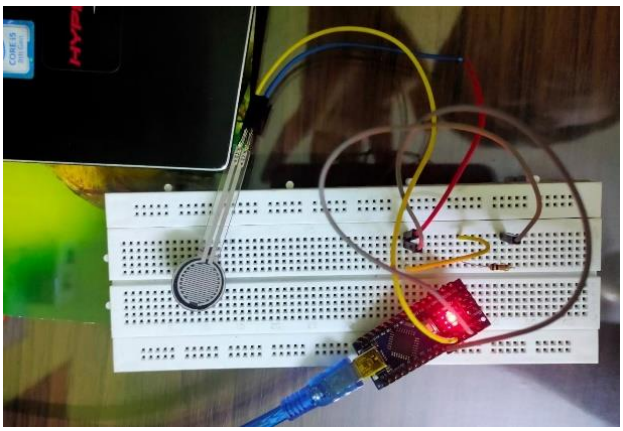

Figure 28: Taking Reading of FSR Sensor

Figure 29: Actual Image 1

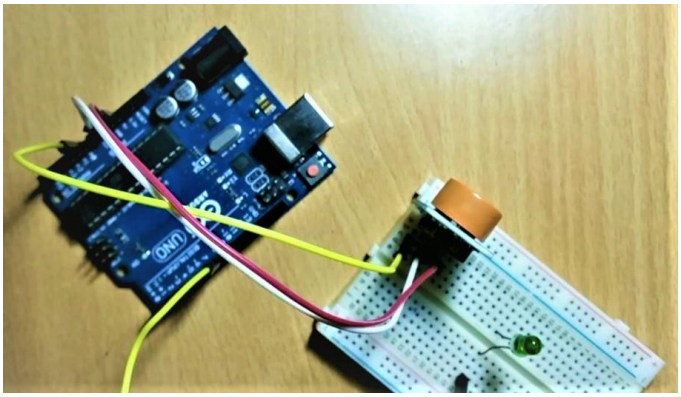

Figure 30: Taking Reading of MQ-3 Sensor

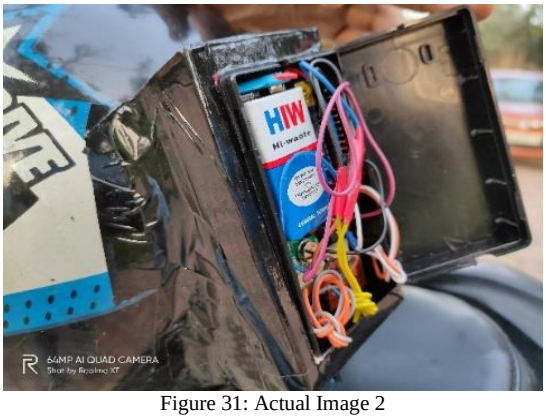

Figure 31: Actual Image 2

Figure 32: Actual Image 3

B. Bike Unit

Bike Unit has different components. At first, we have tested those components individually. The results which we have got are given below. After that, we have made the required embedded system using all the components together.

1. MPU-6050 Acceleration and Gyro Sensor

In this system we connect a Raspberry Pi with a module MPU6050. This interface is used to read and print the value of Accelerometer and Gyroscope sensor. Python and C language can be used to interface the Raspberry Pi with MPU6050 module. The reading value from the module MPU6050 will be displayed on the terminal.

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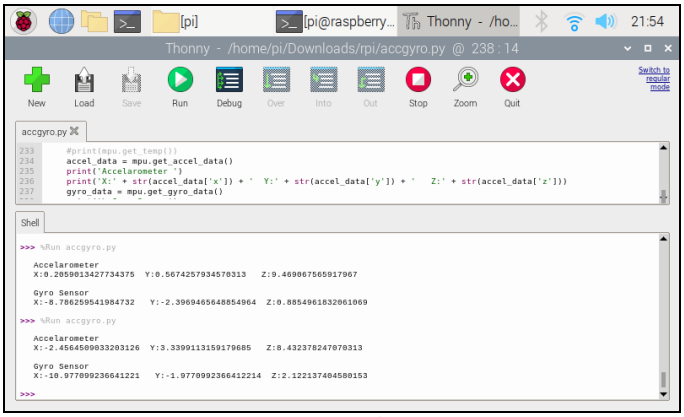

Figure 33: Reading of MPU6050

Following value will be shown in output window:

Gx = Gyro X-axis data in degree / seconds
Gy = Gyro Y-axis data in degree / seconds
Gz = Gyro Z-axis data in degree/seconds
Ax = Accelerometer X-axis data in g
Ay = Accelerometer Y-axis data in g
Az = Accelerometer Z-axis data in g

2. NEO-6m GPS module

When switch on the power supply, the GPS module takes few time to get ready for the different configuration as for a hot, warm, or cold start.

When GPS module is wake up and if receiver can see the GPS satellites then it starts to attain its location and a LED will start blinking on the module. It gives us value of **Longitude** and **Latitude**.

Figure 34: Reading of NEO-6M

Figure 35: Actual Image 4

Figure 36: Actual Image 5

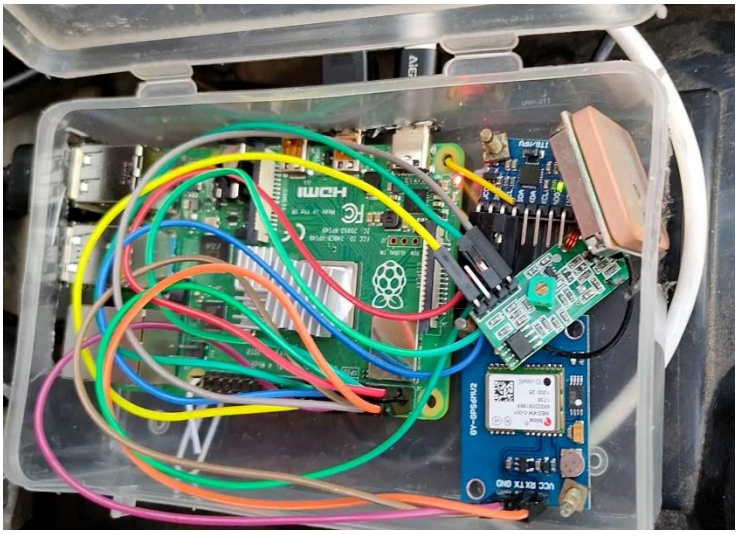

Figure 37: Actual Image 6

VIII. FUTURE WORK AND CONCLUSION

A. *Future Work*

1. We can use a Solar panel in the helmet to power the smart helmet by itself and it will also eco-friendly.
2. We can implement the whole circuit into small VLSI chip that can be embedded into the helmet and bike unit.
3. We can create some machine learning model to reduce the false accident detection.
4. We can improve the vehicle detection model to reduce the processing time load on microcontroller.
5. This safety system technology can further be used into four-wheeler also by replacing helmet with seatbelt.
6. To reduce our project cost we did not use GSM module. But using GSM module we can send the message to the ambulance and preregistered mobile no. of the rider without internet where the internet connectivity is not available.

B. *Conclusion*

The two-wheeler safety system developed with Smart Helmet with Quick Ambulance Response System is reliable and aims to help in the prevention, detection and reporting of accidents, hence reducing the probability of the accident.

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Additionally, it offers several advantages over the existing methods of accident detection and notification using SMS and mobile application. Our proposed system provides a primary technique for prevention of the accidents and confirms a safety in two-wheelers for a greater extent. The severities of the two-wheeler accidents are increased because of the absence of helmet. By designing this system, a two-wheeler journey is possible with safety. It can reduce the head injuries if accidents are occurred. A GPS is used in this system to get the rider location. Our system will send a message with GPS coordinates to the predefined numbers that are programmed using microcontroller in case of any accident. The Mobile application will help the driver to go to the location by finding the shortest and fastest route. At present this image processing requires high power CPU. Reliability on Raspberry pi 4 for this image processing is not very high. To run the image processing in higher FPS, we need powerful CPU and minimum 4GB RAM. Hence the cost is very high. In future we can improve the vehicle detection model to reduce the processing time load on the microcontroller by improving the algorithm and also we can develop a dedicated embedded system for this purpose.

ACKNOWLEDGEMENT

We like to share our sincere gratitude to all those who help us in completion of this project. During the work we faced many challenges due to our lack of knowledge and experience but these people helped us to get over from all the difficulties and they help to give in a proper shaped of our idea in final compilation. In the end we would like to thank the management of Academy Of Technology for providing us such an opportunity to learn from these experiences. We are also thankful to our whole class and most of all to our parents who have inspired us to face all the challenges and overcome all the hurdles in life.

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