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Internet of Things Enabled Smart Helmet

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***Abstract*: At present, India is the largest market for two-wheelers (China being second) in the world. However, this leads to increasing road accidents and thereby increasing the death rate. Over speeding and not wearing a helmet are the main reasons for injuries. Therefore, helmets must be used while riding a motorcycle. Most of the deaths occur within the first few minutes of impact. Thus, in this crucial phase of time, if victims get the proper medical help, mortality rates can be reduced. Smart helmets make the journey of riders safer and more comfortable. The smart helmet provides complete safety measures which include accident detection and SOS notification immediately after impact and uploading accident clip to the cloud, getting warnings of nearby vehicles which are approaching from the rear. Smart helmet promotes the usage of the helmet by attracting the user by its features like connectivity with a phone, sharing clips of a journey with friends and family, weather updates as well as GPS directions via voice.**

Index terms- Road Accidents, Medical Help, Safe Journey, Smart Helmet, Safety Measures, Accident Detection, SOS

I. INTRODUCTION

Using the Internet of Things (IoT), smart helmet makes the journey of rider safer and more comfortable. It provides complete safety measures which include the important feature of detecting the accident and informing the user's friends and family (or specified emergency contact) about the impact along with user's current location so that user can get the immediate medical help and death can be avoided. Other important features are uploading accident clip to the cloud which can be used as evidence in a police case, getting voice warnings about the vehicles approaching closer to the rider's vehicle from the rear side so that user can take appropriate action. Smart helmet promotes the use of helmet by attracting the users by its features like connectivity with a phone to receive incoming calls on the go, sharing clips of a journey with friends and family using IoT, getting weather updates as well as GPS directions via voice instructions. The purpose of this project is to make the journey of riders safer and more comfortable by making the helmet smart by using trending technology like IoT and creating a plethora of features which are not available currently in the market.

II. LITERATURE REVIEW

A. Ajay, G. Vishnu proposed a work on the system for intelligent helmet. This system detects the accident and notifies it through the GPS and GSM system. For accident detection pressure sensors are used. The GPS is used to track the current location. This location is sent to the emergency contacts through GPS. GPS is also used for navigation system which provides the direction of location. This is done by connecting google maps and the voice readout which is exhibited through speakers in helmet so the google voice will give the person the easy and the most possible route to reach the location. So, the features like location tracking and accident notification are very useful [1].

Karthik P, Muthu Kumar proposed a system in which a different way of accident detection and notification is used. It consists of two parts helmet part and vehicle part. And they both are interacting with each other using radio frequencies. Piezoelectric sensor is used for accident detection. According to the output the signal is sent from helmet side to the vehicle side and then appropriate actions will be taken. For emergency message, GSM module is used [2].

Sreenithy Chandran, Sneha Chandrasekar, Edna Elizabeth N proposed the work on smart helmet which makes use of Wi-Fi enabled processor and IoT. It provides the features of accident identification and notification by making use of accelerometer sensor and cloud computing. It needs the good internet connection for the system to work properly. This system has a provision to avoid the wrong triggering of accident. This is done by putting a timer of few seconds within which the message sending can be prompted [3].

Muthiah M1, Aswin Natesh V2 proposed work to create a prototype model that would help riders improve their vision and road safety. Intelligent control of the headlights using the servomotors used here becomes active when conditions such as the correct tension of the helmet belt are fulfilled, which, in turn, satisfies the next appearance in the receiver circuit, which causes the motorcycle to start working. Thus, the driver may not be allowed to ride without a suitable helmet. Additional features provided by this system improving user safety, for example, built-in sleep sensors, monitoring drivers and sirens, reducing the risk of falling asleep [4].

Rashmi Vashisth, Sanchit Gupta presented the work on smart helmets consisting of two modules, one on the helmet and other on bike, each of which is synchronized to ensure that the rider wears a helmet. The helmet provides features such as automatically deducting the required amount from the user's virtual wallet, wirelessly preventing the rider from stopping and paying, using alcohol sensors to prevent drunk and driving scenarios, detecting and notifying an accident, detect over speeding [5].

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III. PROPOSED WORK

In this project use of the IoT technology which makes the system smart system. The block diagram of proposed system is shown in Fig. 1. Here Master or main processor is Wi-Fi enabled processor. All the slaves that is sensors and other modules like accelerometer, proximity sensor, mic, speakers, camera, etc. are connected to the master and master is connected to the cloud storage. Master collects data from sensors and sends it to cloud storage. That data is analysed and send back to the controller to for actuation. That data can be remotely accessed or monitored using IoT cloud web portal. Data can be analysed by master and proper actions can be taken.

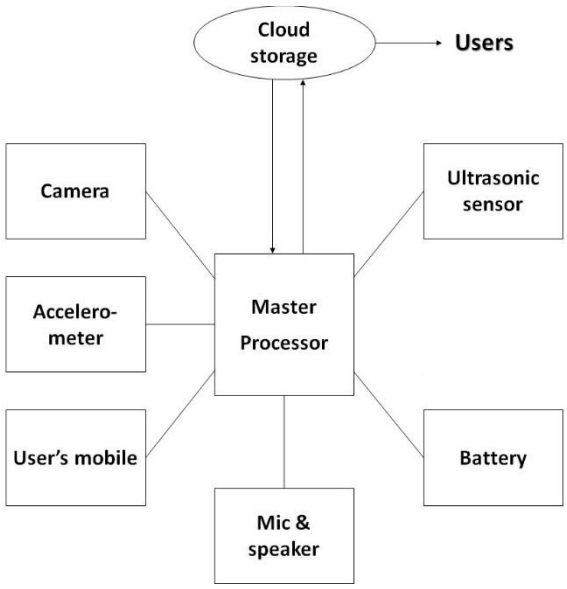

Fig. 1. Proposed system block diagram

IV.IMPLEMENTATION SCHEME

Following are the features provided by smart helmet:

- Take a photo and/ or video clip of accident and upload on the cloud.
- Send SOS message to the pre-set emergency contacts in case of accidents.
- Track the location of user and status from the android app (as per permission preferences).
- Get weather information at the current location of user every hour.
- Voice warnings about the vehicles approaching closer from the rear side
- Connection with mobile (for incoming calls and music with connected speakers)

The feature wise modules are explained as below:

A. Capturing photos and videos and uploading on free cloud storage

In this module an image and/ or video is captured and uploaded on a free cloud storage like dropbox. The videos are shot after every 5 minutes and stored in the internal memory. When accident event is triggered the clip is sent to the dropbox which can be used in case of an investigation. For this a camera has been interfaced with Raspberry Pi and Raspberry Pi to gas been connected to the mobile's internet to upload the video. The working of this module is explained in the Fig. 2.

The work flow is shown in Fig. 3. It contains the required installations and procedures to be followed for successful image capturing and uploading.

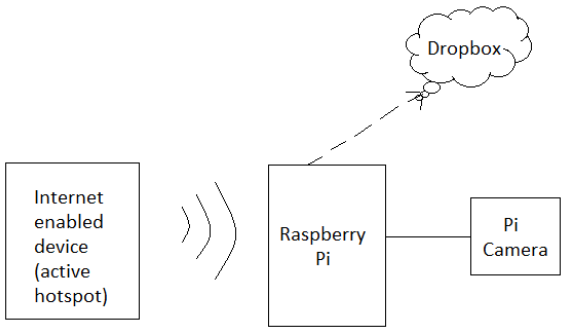

Fig. 2. Block diagram

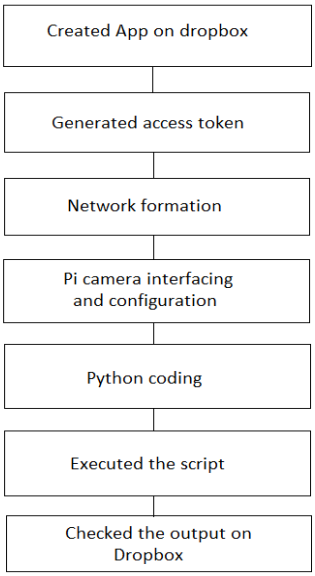

Fig. 3. Work flowchart

The following procedure can be followed to form the network connection:-

- Connect Raspberry Pi through ethernet cable to the laptop.
- Using ipconfig command get ip assigned to the ethernet port.
- Using "Wireshark" software get the IP address of the Raspberry pi.
- Load the ssh file using echo>F:\ssh
- Login into pi in the putty software using the IP detected in Wireshark.
- To connect to the WiFi add the network credentials in the in the wpa-supplicant.conf file. (Use command sudo nano /etc/wpa_supplicant/wpa_supplicant.conf)
- Then reboot the pi.
- Check for new ip assigned to the pi when connected to wifi using ifconfig command.

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After doing these required connections and following the procedure, the images are captured and uploaded successfully as shown in Fig. 4 and Fig. 5.

B. Accident detection and notification

In this module, an accident is detected by using an accelerometer module. An I2C protocol has been used. The steps that we followed are as follows:

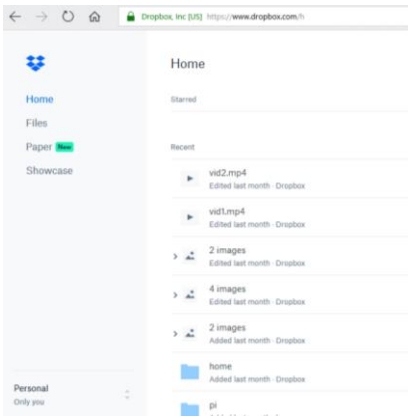

Fig. 4. Output (Images uploaded)

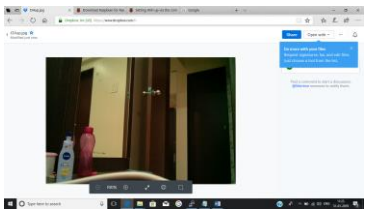

Fig. 5. Output (Image captured and uploaded)

a. Interfacing the accelerometer
b. Enabling the I2C using sudo raspi-config command.
c. Installing essential package and set it up.
d. Using command sudo i2cdetect -y 1 to check the physical connection
e. Coding (In this code, we are detecting free fall event)

The webpage is created which continuously checks the value sent by accelerometer. When a free fall event is detected by the accelerometer it sends the "true value" to the webpage and an accident is detected. The "SOS" message is sent to the registered emergency contacts through an Android application.

The results can be observed at the receiver end as shown in Fig. 6. The accident message is sent to the registered emergency contact number which contains the link for the user's current location which can be accessed through google maps.

C. Getting weather and location updates

The current location is fetched from the user's mobile through Android application and will be sent to the processor and the location co-ordinates are used to get the weather information. A weather API is used to get the weather information. This API specializes in weather forecasting and visualization. A spoken summary of weather is directed through the speakers for the convenience of user at stipulated time. The screenshot of android application with location page is given in Fig. 7.

In fig 7, the address of the location is displayed along with latitude and longitude parameters which will be used further for getting weather information.

D. Getting voice warnings about the vehicles approaching from rear side

Ultrasonic sensor is used to get the information about the vehicles in the rear which are approaching closer than the particular limit set for the sensor. The output is as shown in Fig. 8. When the positive output is triggered by the sensor, user gets a voice notification through speakers about the vehicle approaching from the rear side is in the close vicinity of the rider.

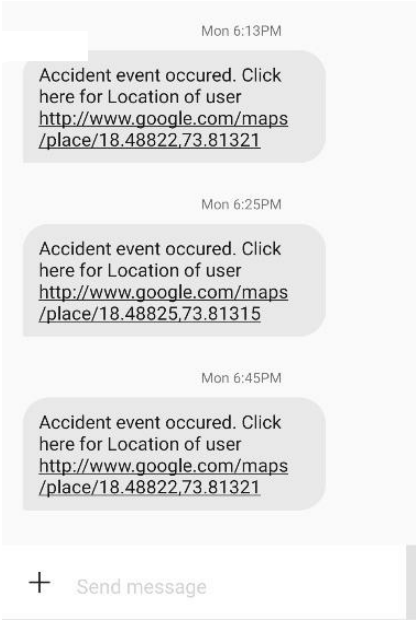

Fig. 6. Screen shot of received SOS message in case of accident

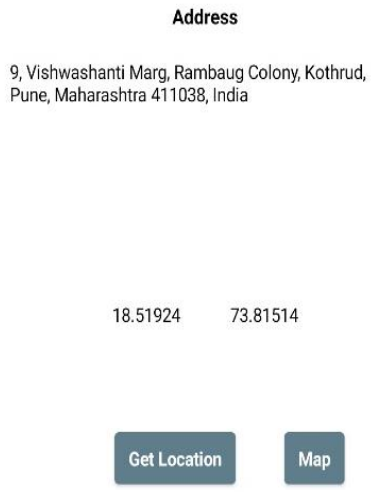

Fig. 7. Screen shot from android application for location updates

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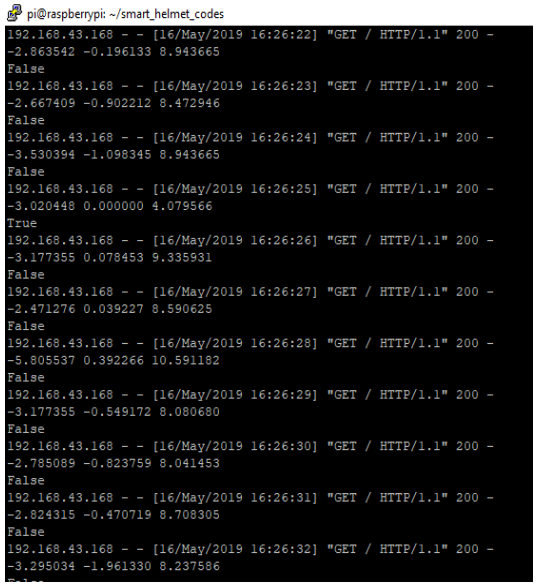

Figure 8: Output of notification system to notify about rear vehicles.

For voice command, an offline text to speech converter is used for a quick and accurate response.

E. Android Application for the smart helmet

The android application is created to connect the user's mobile to the helmet. User enters the hotspot credentials to get connected with helmet and allow helmet to use the internet. Through the mobile application user can get location and weather updates as well as connectivity status and notifications for helmet. User interface consists of 8 buttons having different purposes.

Start button consists of the functions like enabling accident detection as well as setting the emergency contacts as shown in figure 10. Location button gives the current location as well as provides access to maps through which directions to the required destination can be set. The hotspot button allows user to connect a new device to the helmet using his hotspot credentials. My information page is used in case of an emergency. It contains the basic information of user such as name, address, blood group, etc. Dropbox is used to access the uploaded images and videos. A capture button clicks the instant picture and upload it on dropbox. These are the features provided by smart helmet through the android application as shown in Fig. 9.

Fig. 10 shows the successful registration of the emergency contacts. At the bottom the added numbers in the database can be seen. The SOS message is to be sent to these saved numbers.

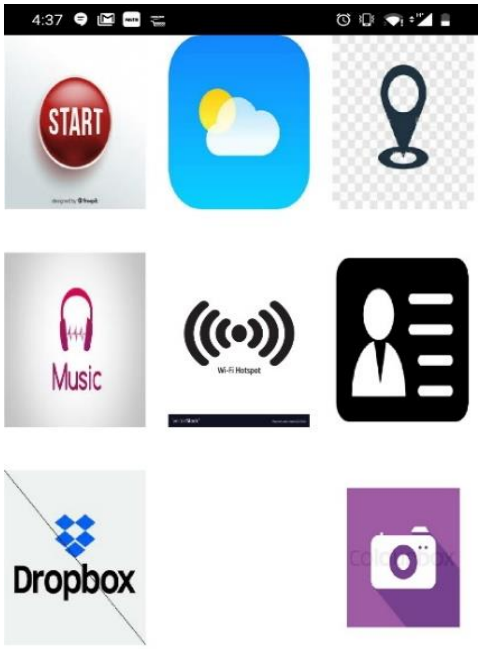

Fig. 9. Smart helmet application user interface

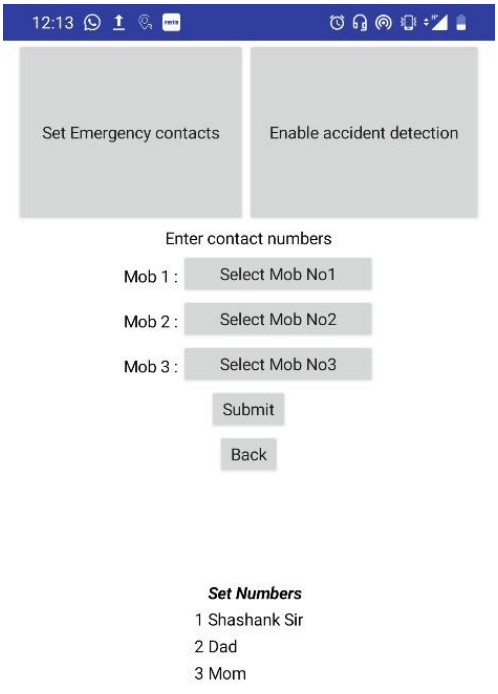

Fig. 10. Smart helmet mobile application

CONCLUSION

IoT technology has been used in the project because it allows to utilize the internet services to make the system smarter and more accurate. The features in helmet makes the journey of riders safe, comfortable and convenient. For further convenience of the riders, an Android application has been designed which provides additional functionality to the helmet.

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The smart helmet helps riders to save their life by bringing the immediate medical help in case of an accident. Also the features of this helmet attract the users to wear it which ultimately achieves the goal of increasing the use of helmet.

FUTURE SCOPE

In future, communication between multiple helmets to make it more user friendly can be targeted. Also, a force sensing resistor can be used to avoid the wrong accident triggering by enabling the features of helmet only when it is worn. Additionally, a solar panel can be implemented to increase the power backup and to make efficient use of natural resource.

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