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# ARMOR
# Smart Helmet for Alcohol Detection, Accident Detection and Notification using Internet of Things (IoT)

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ABSTRACT

The objective of the smart helmet is to provide a method and setup for alcohol or accident detection and informing. The system consists of sensors, WIFI and Bluetooth enabled processors and cloud-based infrastructures. Both the alcohol and accident detection system will correspond to the alcohol sensor values and accelerometer values to the processor for abnormal variations. When an accident occurs, the details are sent to the emergency contacts by using a cloud-based service. The bikes location is tracked by use of GPS. Similarly when the rider has consumed alcohol exceeding the limit of BAC the processor will automatically shut downs the bike's ignition system and not allowing the rider to ride the bike. The system promises a consistent and quick delivery of statistics relating to accident and alcohol consumption in real time. Thus, by making use of ubiquitous connectivity which is one of the features for smart cities, a smart helmet is built.

## 1. INTRODUCTION

According to 2015,the global status report safety by WHO [1] states that every year nearly 1.25 million people die in a road accident and in that 1.25 million deaths one-third of the death are due to drink and drive accident. Nearly one fourth of the accident is from motorcyclists. Some of the cause of the accidents is due to the reckless driving, over speeding and alcohol consumption driving. Many people lose their life within first one hour of the accident because of lack of no ON-SITE medical assistance has been provided which leads [2] to:

(1) Late reporting of an accident.
(2) Inaccurate GPS location.

The objective of the project is to build an IoT (Internet of Things) that leverages on ubiquitous connectivity, data, and sensing analytics that are the basis of IoT applications. The IoT involves of smart machines cooperating and interacting with other devices, objects, environments and infrastructure. The huge amount data that is generated and processed into useful action that can "command and control" things, to make our lives safer and easier [3]. IoT has application has various benefits like remote monitoring, manage and control the IoT device in real time data. The base of the project lies in the brilliance of the microprocessor. In order to analyze the full potential of the Cloud computing and the ubiquitous sensing, a combined framing of both is required. Thus IoT application must be able to provide support for the following [4]:

1. Reading data streams directly from the sensors.
2. Transparent and scalable processing of data.
3. When any of the two events of interest are detected then the predetermined action has to be initiated by utilizing the various cloud computing technique.

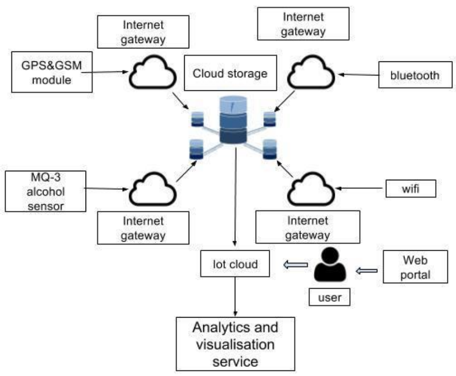


Fig 1. The interaction between various stakeholders in cloud-centric IoT framework

## 2. METHODOLOGY

IoT, accident detection [7] and alcohol detection [5] are the three areas in which fast progress is being made. Vijay savani focused on alcohol detection and accident prevention of vehicle [6]. Shadman sakib [8] outlines the implication of GPS location detection of the car and notifying it to the user. Konnect [7] focuses on the helmet that notifies the emergency contacts that the rider has encountered with an accident and the information like GPS coordinates and time of the accident event will be sent in the form of a message. There have been many advanced techniques in the development of communication between vehicles (V2V technologies), AKA vehicular ad hoc networks [9]. The 802.11p working group authorized the IEEE 802.11p standard [10], serving a viable solution for inter-vehicular security application. To improve the traffic safety through the use of vehicular communication the U.S Department of Transportation (DOT) has initiated a project that is based on testing the effectiveness and safety benefits of the wireless connected vehicle technology in the real world [10]. Monitoring system proposed by Jung Et. Al [11] contains non-intrusive active electrode equipped on the seats of the car. The data collected is sent through a wireless PAN and data is analyzed and processed to recognize if the driver is stressed or not. However it is seen that it is only applicable for short communication range.

## 3. PROPOSED SCHEME FOR SMART HELMET - ARMOR

This paper portrays the prototype of the smart helmet - called ARMOR. A combined network of sensors, WIFI and Bluetooth enabled processor, and cloud computing infrastructures are utilized to build a smart helmet for alcohol or accident detection and notification. The helmet is designed to work in two different modes

1. Alcohol detection and ignition of motorbike
2. Accident detection and immediately alert emergency contacts.

The helmet is designed to recognize whether the rider is wearing the helmet or not (similar to seat belt reminder in a car) if the rider fails to wear the helmet, the helmet will alert to wear (it will only alert when the bike ignition is on).

The helmet is designed to detect alcohol content in the rider's breath and if it exceeds the standard limits then it will disable the ignition system of the vehicle. An MQ-3 alcohol sensor is mounted on the helmet and it's used to monitor the alcohol content in the rider's breath if the BAC (blood alcohol content) if the rider's breath is more than 0.02% to 0.05% in 100 ml blood [12] then the helmet will trigger the ignition system and it will disable the ignition of the vehicles.

The helmet is also designed to detect an accident and instantly alert emergency contacts. A 3-axis accelerometer is used to regularly monitor the head orientation of the rider and the helmet position and thus calculate the possibility of the accident. When the threshold limit is exceeded then a text message containing the GPS location of the rider is automatically sent to the emergency contacts. The text messages are repeatedly sent again at a regular interval of time to locate the rider's position.

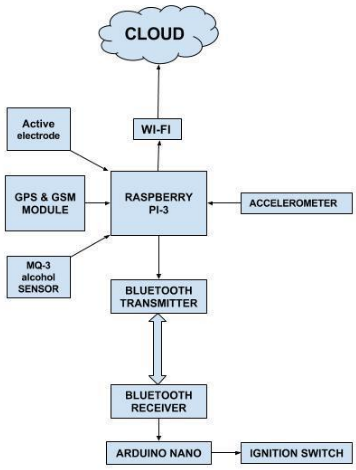


Fig 2. Block diagram of ARMOR

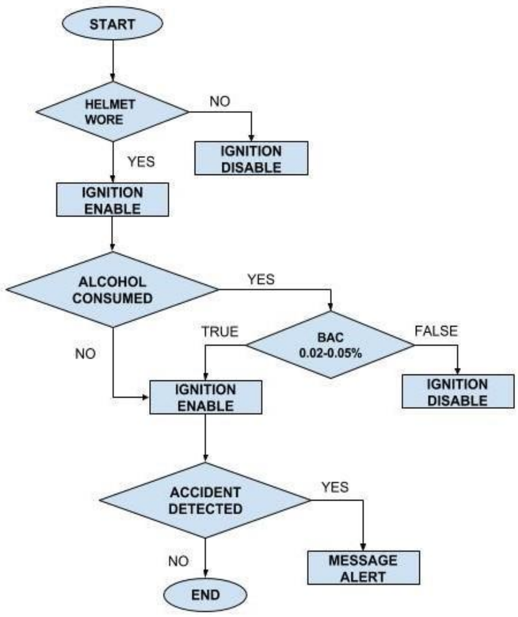


Fig 3. Flowchart of working

## 4. CHALLENGES ASSOCIATED WITH THE ARMOR

1. Need to avoid false positives from being triggered from the sensors that have been attached to the accident detection system is used to determine is an accident has occurred. When the rider accidently drops the helmet, there are chances of triggering the accelerometer values and sends emergency message alert to the contacts. Hence it will result in a faulty function of the system and waste of resources on false incidents of reports.
2. Delay in notification reaching the contacts, as soon the helmet detects an accident the data has to be secretly

transferred to the emergency contacts. If in case the contact failed to receive the message then the system has to be designed to repeatedly send the message until the message has been delivered.

## 5. WORKING PRINCIPLE

The armor a cheap, effective alcohol, accident detection and notification system to address the foretasted problems. Though an integrating sensors with a raspberry pi-3 that provides a rapid alcohol and accident detection, they are limited in terms of processing and notification capabilities. The raspberry pi-3 is a WI-FI and Bluetooth enabled minicomputer which is used to interact with cloud computing and with the bike. This expands the computational and cloud storage capabilities of the system. The system on helmet communicates with both the cloud-based incidence response and the bike and then notified via RESTful architecture over HTTP using JSON.

*1. Alcohol and accident detection system*

An alcohol sensor MQ-3, a tri-axial accelerometer, GPS & GSM module are connected in raspberry pi-3 and the entire setup is present in the helmet. Alcohol sensor will detect the BAC through the rider's breath and a threshold value is defined in the system, if the sensor detects alcohol content more than the threshold value then the processor will detect alcohol in rider's breath. The accelerometer ADXL345 is a digital accelerometer that detects the variation in spatial components along 3 orthogonal directions X, Y, and Z. A threshold value is set giving allowance for minor level head tilt not pertaining to an accident. When the accelerometer detects any sudden change in threshold values in all 3 directions is observed simultaneously, the change in resultant acceleration values is calculated. Average variation of acceleration values is calculated over time and then compared with the threshold values if the value is exceeded then the processor will detect a crash.

*2. Bike ignition control system*

Ignition control system is between the helmet and the bike the alcohol sensor in the helmet will detect the alcohol content and if the BAC is more than the limit it will tell the raspberry pi-3 will send a command to the bike, raspberry pi having an inbuilt Bluetooth module it will send a command to the bike. The bike ignition system is connected to Arduino nano, a Bluetooth receiver HC-05 is connected to the Arduino nano so that it will receive the commands from raspberry pi and further action will be taken.

*3. Accident notification system*

The notification system is split into two parts the client and the server. Raspberry pi acts as client and server is a cloud-based web service. The monitoring system makes the use of the values gathered from accelerometer and GPS to send data to the cloud-based notification system.

WI-FI in raspberry pi has the capability to act as a station in a typical networking system. Raspberry pi can connect to the access point and can use internet services via the same access point, if available. The usual steps included are [12]:

- Connecting to an access point.
- Connect to an HTTP Server with and without proxy.
- Performing POST, GET, PUT and DELETE.
- Parse JSON data using "jasmine JSON parser".

*4. Custom APIs*

The increased complication associated with integrating monitoring, development and ticketing systems result in ineffective delivery of alert, straining the component working in the helmet and bike. The main problem that needed to be overcome include alert fatigue, the possibility of missing an event, message failure and increased time for data transmission and incident resolution. In order to solve this issue, we make use of an incident resolution platform Pager Duty. The main role of the Pager Duty is it will create a Pager Duty REST API [14,15] to notify the emergency contacts when an accident has been detected. Raspberry pi will send Pager Duty a trigger event to report a new or ongoing problem. Incoming events that are sent through the API are routed to a Pager Duty service and computed.

Usually a custom API is created by making the system make a plain HTTP call or run a command-line script. The REST (Representational State on Demand) is architecturally based on which the protocols are arranged. It is resource based and the resource is determined by URIs. The representation is transferred between client and server in the form of either JSON or XML. Pager Duty REST API takes JSON and form encoded content as the input and the output is in JSON.

The different steps involved in triggering the incidence response and alerting services is as follows:
Step 1: An account is created in Pager Duty.
Step 2: API key is generated.
Step 3: Sending a POST request to an API with necessary authorization and parameters.
Step 4: Triggering an incident using API.

## 6. RESULT

As soon as the abnormal variation is obtained, a trigger is sent to the Pager Duty from raspberry pi. Pager Duty then initiates a call to the helmet sim number (GSM module is present in the helmet) and the helmet will start alerting with a buzzer if the alert was by mistake the rider can disable with a push of a button in the helmet and if the rider failed to respond within 5 minutes then the helmet will send an alert message to the emergency contacts. The accident alerts received by the contacts will have a predefined text "John is unresponsive to calls and message, ACCIDENT OCCURRED". Also, the GPS coordinates of the rider are also sent in the message. Fig 4 shows the alert message received by the emergency contacts the alert messages are sent every 3 minutes to the contacts until the contact acknowledges the notification.

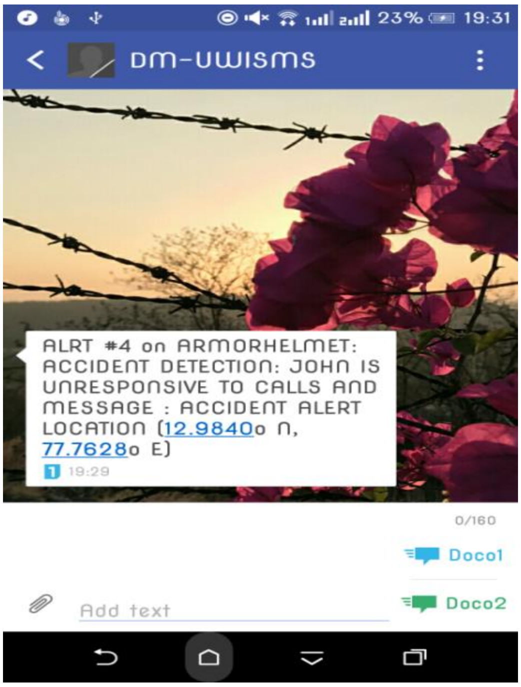


Fig 4. Text message received by the emergency contact

## 7. CONCLUSION

As soon as the abnormal variation is obtained, a trigger is sent to the Pager Duty from raspberry pi. Pager Duty then initiates a call to the helmet sim number (GSM module is present in the helmet) and the helmet will start alerting with a buzzer if the alert was by mistake the rider can disable with a push of a button in the helmet and if the rider failed to respond within 5 minutes then the helmet will send an alert message to the emergency contacts. The accident alerts received by the contacts will have a predefined text "John is unresponsive to calls and message, ACCIDENT OCCURRED". Also, the GPS coordinates of the rider are also sent in the message. Fig 4 shows the alert message received by the emergency contacts the alert messages are sent every 3 minutes to the contacts until the contact acknowledges the notification.

## 8. FUTURE SCOPE

As a future of the project is that the helmet is equipped with a camera mounted to the helmet and the entire video will be recorded and it will be stored in the data storage of the helmet and the videos can be accessed wirelessly so the helmet will act like a BLACK BOX containing all data.

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