IoT Based Vehicle To Vehicle Communication: Traffic Congestion And Accident-Avoidance System

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Abstract- *This paper proposes a framework using IoT that detects vehicle accidents and identification of traffic congestion and connect this information to respective control authorities through other vehicles and base stations on real time basis. Various parameters of vehicle such as tracking of live location of the vehicle within the coverage area and measuring the distance between the vehicles can be monitored by the system. Vibration sensors and ultrasonic sensors are used to design a prototype and algorithms illustrate the concept. Network connectivity and data transmission is through integrated GSM and GPS within the system which is used to obtain the location coordinates of the accident zone and the notification about the accident is sent to the registered mobile number and immediate help is obtained at the exact location. If two vehicles are in the vicinity of each other, immediately a notification that is an alert message is sent through the BLYNK app.*

Keywords- Blynk, IOT, GPS, GSM, Sensors.

I. INTRODUCTION

Towns and cities suffer traffic congestion due to sluggish nature of transportation, infrastructure developmental activities such as repair and maintenance of roads, limited road widening, and fly-over projects compared to the rate at which the new vehicles adding to the traffic on regular basis. The growth of vehicles every year is because of affordable vehicles coming to the market and enhancement in family income. These two orthogonal growing trends lead to traffic congestion. Communication technology can give major relief to this problem without enhancement of physical transport infrastructure through the coordinated movement of vehicles.

In some places due to traffic congestion in peak hours, more than 70% of the population are stuck on the road. There is a possibility when someone by mistake takes a wrong road and leads to diversion or when there is a roadblock ahead. These circumstances can be avoided if the driver was provided with some safety information beforehand so that they can avoid traffic or road blockage by taking some alternative route which helps to maintain a strategic distance from the street mishaps.

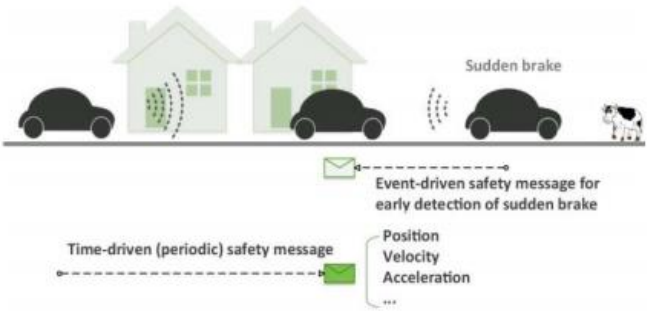

Fig.1.1: Collision avoidance using V2V communication

Fig 1.1 shows that, whenever a vehicle moving in front applies a sudden break, a safety message for early detection of sudden break is sent to the vehicle behind. This early detection helps us to avoid collision.

India is the country with a higher number of accidents compared to all other developing countries. The major reason behind this is the lack of traffic control, lack of infrastructure and accident management [1]. The term (Vehicle to Vehicle) V2V elucidate that vehicle can communicate with each other wirelessly when they are connected. With this proposed V2V module, the person driving the vehicle with this module installed in it can take measures to reduce the collision, improve safety and road traffic efficiency. The National Highway Traffic Safety Administration (NHTSA) affirms: "V2V technology has the potential to address approximately 80 percent of multi-vehicle crashes" [2]. The instant an accident has taken place, the life of all the traveller in that vehicle is at risk. Response time is vital, and it needs to be improved or reduced completely to save the lives of the travellers [3]. It is the response time that can save lives of the travellers. There are several approaches and methodologies that can be used to bring down the number of accidents and to contribute to our society to reduce the number of accidents happening in our daily life and to save lots of life.

The main intention of this paper is to reduce the time factor in the event of accidents. Accidents in our daily life occurs because of not continuing to maintain a standard distance between the vehicles on the road. In urban areas accidents are most common phenomena where some accidents occur during night-time when the visibility is quite low [4]. During such cases it will be difficult for an ambulance driver to identify the accident spot with the help of phone calls made by the citizens. There are many cases where an accident occurs during the night and the person met with the accident is unconscious then it would take hours for someone to find out and inform the authorities about it. So, saving such precious time will indeed save lives [5].

To overcome these issues, we proposed a system as shown in Fig 1.2, which is a combination of low-power sensors, a microcontroller which is cost effective and an IoT platform which is powerful enough to create an application that can function without any human interferences. The core of this application is a NodeMCU which is a microcontroller based on Wi-Fi and is used to take readings from an accelerometer sensor and an ultrasonic sensor. The main function of an accelerometer sensor is to sense any abnormal tilt in the vehicle and the main function of an ultrasonic sensor is to sense the distance between the vehicles on the road. With the gathered data from these two sensors, the system identifies an accident which has taken place and uploads the data onto the BLYNK application and sends notifications to the people who have to do with it and makes it more efficient. It is a fast communication system without the need for any human interference.

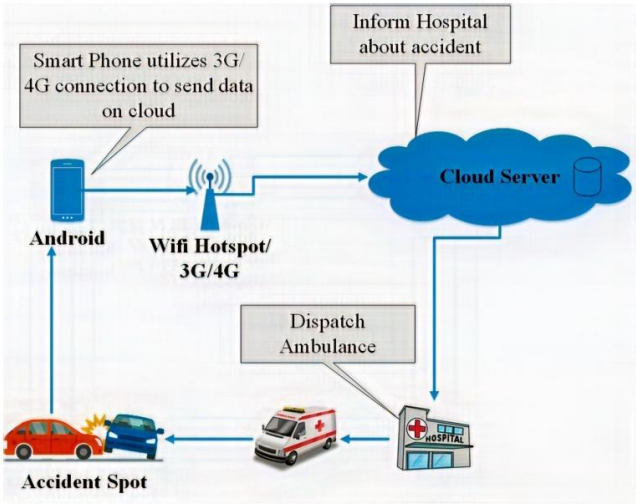

Fig.1.2: Accident Detection and Reporting System (ADRS)

A capture scene of the adversary is depicted in Fig1.3. Here, whenever two vehicles are in the vicinity of each other, a notification that is an alert message is sent through BLYNK app.

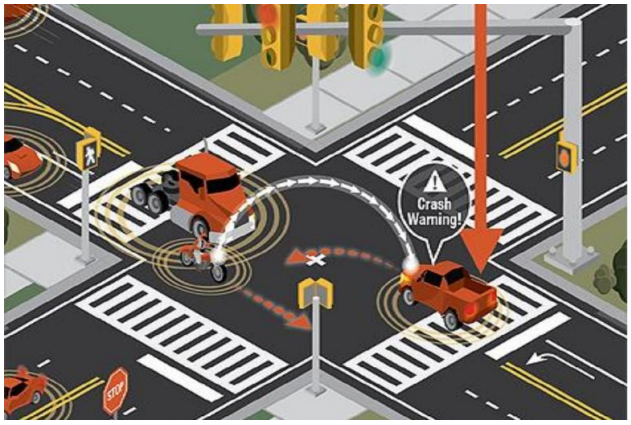

Fig.1.3: V2V communication using IoT

II. REVIEW OF TRAFFIC CONGESTION AND ACCIDENT-AVOIDANCE SYSTEMS

Some of the related works on traffic congestion and accident avoidance are as follows.

Chunxiao Liao, et. al proposed a "Shrewd Traffic Accident Detection System Based on Mobile Edge Computing" in the year 2017. This paper proposes a savvy car crash location framework dependent on Mobile Edge Computing with vicinity, low idleness and processing, and vehicle recognizable proof. Our framework uses basic cell phones to get increasing speed and speed and Journal of Xi'an University of Architecture & Technology Volume XII, Issue V, 2020 ISSN No: 1006-7930 Page No: 2159distinguishes pictures indicating mishap scenes primarily at servers if there should arise an occurrence of bogus positives, acknowledging computerization of mishap identification and advising environmental factors and divisions like clinics and branches of transportation progressively[4].

NajiTaaib Said Al Wadhahi, et. al proposed "Mishaps Detection and Prevention System to decrease Traffic Hazards utilizing IR Sensors" in the year 2018. The paper here is making use of IR sensors and Arduino Uno innovation. The framework has two stages namely Accident Detection and Accident Prevention. The recognition eliminate is conveyed utilizing IR sensors that could recognize and alarm the individuals by sending SMS using GSM module that contains mishap area as well as the predefined numbers utilizing GPS module. Second Phase, Accident counteraction is done utilizing IR sensors by notifying the driver about the vehicles around it when the distance between them is past the edge esteem. Re-enactment results and Prototype is introduced in this paper. [5]

Sanjana. K.R, et. al proposed "An Approach on Automated Rescue System with Intelligent Traffic Lights for Emergency Service" in the year 2015. They proposed a framework which will naturally identify street mishaps utilizing sensors, advise them to close by crisis administrations and family members through GSM. It is completely computerized, finds the mishap spot utilizing Google guide, and controls the traffic lights, assisting with arriving at the emergency clinic in time. This framework can be viably executed in high populated nations like India. [6]

BankerSanket Anil, Kale Aniket Vilas, Prof.S.R. Jagtap proposed an "Intelligent System for Vehicular Accident Detection and Notification" in the year 2014. The paper here provides a system which gives an idea of what can be done to provide medical help and other facilities after the accident as soon as possible. A flex sensor and accelerometer can be used to detect an accident spot, the location of the accident will be notified to the desired person, such as the nearest hospital, police, and owner of the vehicle through SMS sent using GSM modem which contains coordinates obtained from GPS along with the time of the accident and vehicle number. Thus, this paper accentuates the detection of an accident and post-accident system for informing about it. Simulation result on the hyper terminal is also provided for further enhancements in this paper. [7]

Nicky Kattukkaran et. al proposed an "Intelligent Accident Detection and Alert System for Emergency Medical Assistance" in the year 2017. The main aim of the system is to alert the nearby centre about the accident spot and toarrange for animmediate medical care. The accelerometer which is attached within the vehicle senses the lean of the vehicle and the heartbeat sensor mounted on the body of a user senses the abnormality of the heartbeat to know the seriousness of the accident. The systems are designed in such a way to make the choice and send thenotification to the smartphone, which is connected to the accelerometer and heartbeat sensor, through Bluetooth. The Android application on the registered mobile phone will be sent as a text message to the nearest medical centre and the registered contacts. The application shares the exact location coordinates of the accident that can save time.[8]

Arif Shaik et. al proposed "Keen Car: An IoT Based Accident Detection System" in the year 2018. This paper portrays the plausibility of furnishing a vehicle with innovation which will recognize a mishap and promptly ready crisis staff. When there are an auto collision people around must effectively look for help, for example, calling 911 for crisis administrations. There is no programmed warning to the police, emergency vehicle, companions, or family. The Internet of Things (IoT) frequently will not deliver a programmed notice and reaction to the scene. A signal from an accelerometer and a GPS sensor is inevitably sent to the cloud and from that Journal of Xi'an University of Architecture & Technology Volume XII, Issue V, 2020 ISSN No: 1006-7930 Page No: 2160point, an alarm message will be delivered to whoever is bought into that vehicle. The sign will show the GPS area along with the coordinates and the seriousness of the mishap can be analysed. The rescue vehicle will utilize the GPS directions to reach the accident scene instantly.[9]

III.TRAFFIC CONGESTION AND ACCIDENT-AVOIDANCE SYSTEM USING IoT

This proposed system is a self-accident detection technique, and it does not depend on external inputs to detect accidents.[10]As shown in Fig 3.2, the system consists of various sensors such as vibration sensor, ultrasonic sensor along with GPS receiver, ESP 8266, LCD display, buzzer that work collectively to detect accidents instantly and will send location coordinates to nearby smart vehicles and sends notifications to the stored number via Blynk app as shown in Fig 3.1.

Fig.3.1: BLYNK Application

For regulating and observing hardware projects from Android devices as well as from iOS requires a platform that quickly builds interfaces for these applications. Such a platform is BLYNK. Once the BLYNK app is downloaded, a project dashboard will be created in which we will be arranging the buttons, graphs, sliders, widgets etc. onto the screen according to the project needs. BLYNK app can also be used to control hardware remotely. The three main components via which the
BLYNK app functions are:

- BLYNK server
- BLYNK libraries
- BLYNK app.

By using BLYNK app one can arrange different buttons, graphs, and other widgets onto the screen according to the project requirements. BLYNK server plays a major role in providing communication between hardware and the BLYNK app in our smartphone.

Some of the features of BLYNK appare it can connect to cloud using different wireless devices such as Wi-Fi, Bluetooth, USB, GSM etc. It has easy to use widgets and the notifications such as Emails, twitter, messages can be sent easily.

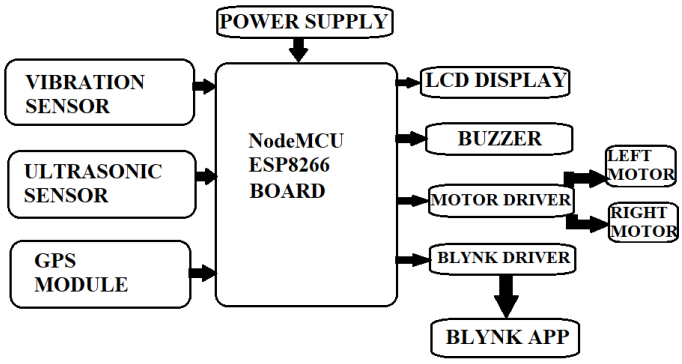

Fig.3.2: The proposed block diagram for vehicle-to-vehicle communication using IOT.

The entire setup as shown in Fig 3.2 will be present in each smart vehicle. In Fig 3.3, which shows how two vehicles communicate with each other using Blynk bridge, both the vehicle 1 and vehicle 2 will be equipped with the setup shown in Fig 3.2.

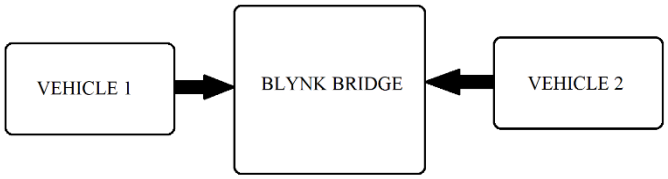

Fig.3.3:Communication between two vehicles via Blynk bridge

3.1 SYSTEM COMPONENTS AND SPECIFICATIONS

This section presents the component modules depicted in Fig.3.1 that are used to meet the required objective of congestion detection and accident avoidance.

1) *GPS MODULE:*The Global Positioning System (GPS) as shown in Fig 3.4is formed from a constellation of 24 satellites and their ground stations. GPS is a worldwide radio-navigation system which uses "man-made stars" as reference points to calculate positions accurate to meters.

Fig.3.4: GPS Module

Some specifications of GPS module include power supply of 12V DC, driving current 17mA, on board Power switch and SMA Antenna socket, serial/TTL output.

*ULTRASONIC SENSOR:*An ultrasonic sensor as shown in Fig 3.5 has two main components: the transmitter and the receiver. The transmitter emits ultrasonic sound waves and converts the reflected sound waves into electrical signals.

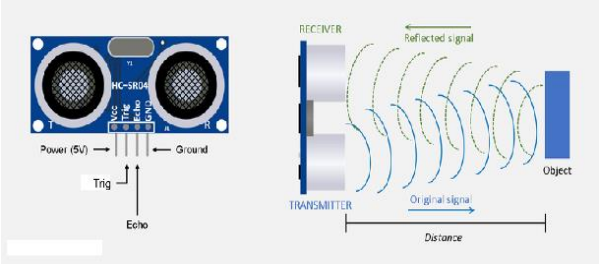

Fig.3.5: Ultrasonic sensor

Some more features ofHC-SR04 Ultrasonic Sensor include it has aninput voltage of 5V, adriving current ofmaximum 20mA, a digital output of 5V-0V, a working temperature of 15°C-70°C, and an ultrasonic frequency of40KHz and range of2cm – 400cm.

*VIBRATION SENSOR:*The vibration sensor as shown in Fig 3.6 is also called a piezoelectric sensors which measures the changes within the pressure, temperature, acceleration, force or strain by using piezoelectric effects and by changing it into an electrical charge.

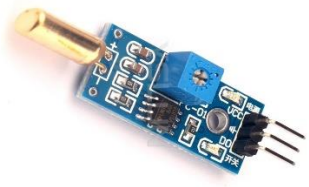

Fig.3.6: Vibration sensor

Some of the features of the Vibration Sensor Module include it has an input voltage of 3.3V to 5V, an output which is in the form of digital switch output is (0 and 1), the PCB size ranges from 3.2cm x 1.4cm. It is normally a closed type

of vibration sensor with a clean signal, good waveform, comparator output and a strong driving ability. It also has a fixed bolt hole which makes it more convenient in installation.

L298N MOTOR DRIVER IC: L298N Dual H Bridge Motor Driver is used mainly for controlling the speed of the vehicle as well as to control the direction of the motors as shown in Fig 3.7.

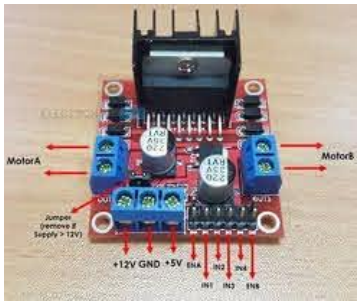

Fig.3.7: L298N Motor Driver IC

L298N Dual H Bridge motor driver technical specifications include a Double H Bridge Drive Chip: L298N, a logical voltage of 5V, a driving voltage of5V-35V, a logical current of 0-36mA and a max power of 25W.

BUZZER: A buzzer or beeper as shown in Fig 3.8is an audio signalling gadget, which may be electromechanical, mechanical, or piezoelectric in nature and can be used as timers, alarm devices etc.

Fig.3.8: Buzzer

LCD DISPLAY: A liquid-crystal display (LCD) as shown in Fig 3.9 is a display device that uses the light-modulating properties of liquid crystals combined with polarizers. Liquid crystals use a reflector or a backlight to produce images in colours or monochrome.

Fig.3.9: LCD display

Some of the features of 16X2 LCD module includes an operating voltage of 4.7V to 5.3V, a current consumption of 1mA without backlight, an alphanumeric LCD display module meaning it can be used to display both alphabets and numbers. It consists of 2 rows and each row can print 16 characters which can also display any custom generated characters. It is available in Green and Blue backlight.

*NodeMCU ESP8266 BOARD:*The ESP8266 as shown in Fig 3.10is designed and manufactured by Espressif Systems which contains all analytic elements of the computer which includes CPU, RAM,Wi-Fi, a modern OS, and SDK. The features like low power consumption, plug and play mode, Arduino like software and hardware I/O, programmable Wi-Fi module etc., makes NodeMCU a tool that makes it best suitable for implementing various projects based on IoT.

Fig.3.10: NodeMCU ESP8266 board

Some more features of NodeMCU includes an operating voltage of 3.3V, an average operating current of 80mA, a flash memory of maximum 16MB which is attachable, and a processor named Tensilica L106 of 32-bit which has a processing speed of 80~160MHz. NodeMCU also supportsP2P (Wi-Fi direct), soft-AP and has an intermingled TCP/IP protocol stack.

IV.TRAFFIC CONGESTION AND ACCIDENT DETECTION ALGORITHM

The main aim of this vehicle to vehicle (V2V) communication using IoT is to avoid accidents and to escape the traffic congestion by detecting any roadblock ahead. A capture scene of the adversary is depicted in Fig 4.1. and VTV based communication is given in Algorithm 1.

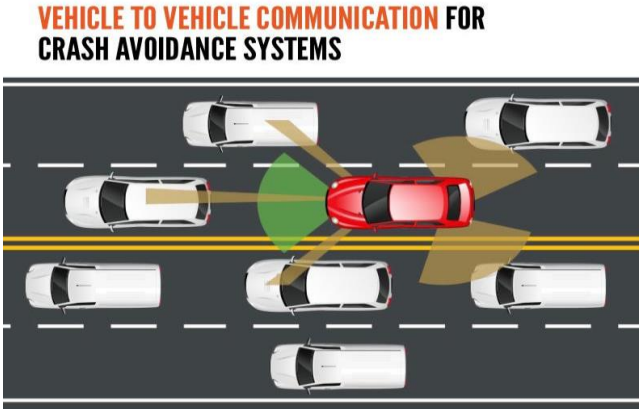

Fig.4.1: System scenario of V2V

ALGORITHM:

Variables used Vt: Vibration threshold, U1: Ultrasonic sensor reading, G: GPS module, d: distance, B: Buzzer.

Algorithm 1: Ion based V2V communication system

```
1. procedure V2V (Vt, Ul, G)
2.     System Initialization
3.     Read the value
4.     if Vt >= 43.5MHz then
5.       d = A            where, A = some constant value
                                    (Distance of obstacle)
6.       if A < X         where, X = some constant value
                                    (Predefined in the program)
7.           then, B = 1 (High)
8.           else
9.                B = 0 (Low)
10.      else if Ul >= 4 (in cm) then
11.               Measure the value of Vt
12.               Check if Vt >= 43.5MHz
13.      else
14.          Read all the value (Vt, Ul, G) again
15.          System gets initialized again
```

a. Apply power supply in NodeMCU ESP8266 board.
b. GPS will be turned on and searches for the IP address. After obtaining the link the same will be sent to the user through Node-MCU.
c. Initialize the sensors with 9600 baud rates.
d. Measure the amount of vibration, if the values are greater than threshold, check the distance of the obstacle.
e. Check the distance of the obstacle. If the distance is lesser than some fixed value "X", send message to the registered emergency contact along with the exact geographical location (latitude and longitude values) and turn on the buzzer.

The flow diagram of the proposed system is shown in the Fig 4.2. As soon as the vehicle starts, GPS module turns on or get initialized and the geographical location is detected at real time. When the GPS module turns on, the vibration sensor also turns on or get initialized. When these two modules turn on, the ultrasonic sensor starts reading the input.

If the threshold is not greater than 43.5MHz, the vibration sensor gets initialized again. If the threshold is greater than 43.5MHz, then the distance of the obstacle is checked.

If the distance is not less than some fixed value (say X), the buzzer is turned off. Otherwise, the buzzer turns on. As soon as the buzzer turns on a safety message is sent to the registered emergency contact with its exact geographical location and with its latitude, longitude values and speed of the vehicle. Once the message is sent to the registered emergency contact numbers the algorithm ends.

Some of the benefits of the proposed system are it is reliable, more user friendly, location of the vehicle can be easily found, speed of the vehicle can be monitored, mobile number can be changed at any time, alert messages are sent to mobile phones for remote information, easy location finding for Emergency vehicle etc.

Some of the limitations are sending data is not secure, GPS accuracy is not appropriate.

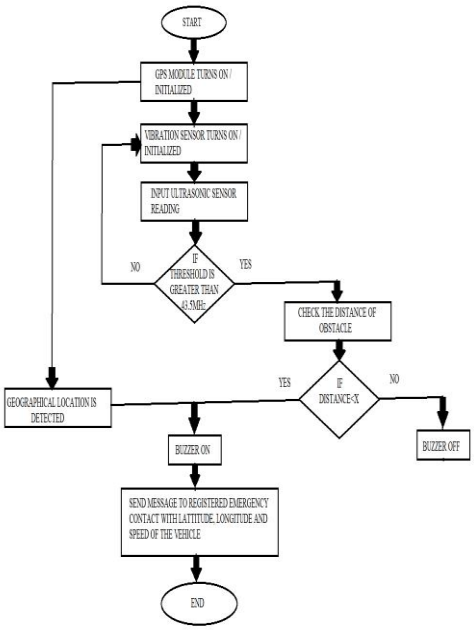

Fig.4.2: Flow diagram of VTV communication

V. RESULTS AND DISCUSSIONS

The hardware module designed is shown in Fig 5, wherein all the sensors and output devices along with IoT connectivity and GPS modules have been integrated on a vehicle. Similar vehicles have communicated each other to identify possible collisions and communicate to neighbouring vehicles to avoid such accidents. In this section, some results of implementation have been discussed.

The ability to wirelessly exchange information about the position and speed of the surrounding vehicles in V2Vcommunication helps in avoiding crashes, easing traffic congestion and in turn improve the environmental conditions. The designed system is as shown in Fig 5.1.

Some of the notifications on LCD Display mounted inside the vehicle are as shown in Fig 5.2.

Longitude:

Latitude:

Emergency call contact hospital:

Met with an accident:

Roadblock ahead:

Fig.5.2: Notifications on LCD display

The notifications are not only displayed in the LCD display, which is inside the vehicle, but also the same notifications are sent to the registered emergency contacts if the vehicle has met with any kind of accident or damage. These notifications are sent via Blynk application as shown in Fig 5.3.

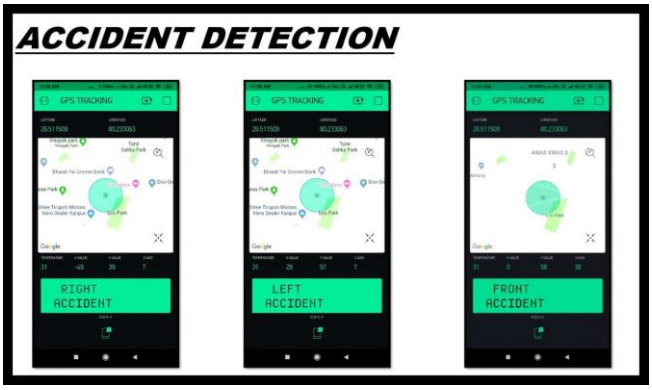

Fig.5.3: Blynk app notification

VI. CONCLUSION AND FUTURE SCOPE

This paper proposed an approach that assures a convenient technique to simplifies the life by supporting user friendly provision of detecting collisions and help to take decision to avoid such situations. The vehicle can be easily tracked, and important notifications are received. In time of emergencies, immediate care will be taken, and first aid can be provided. This project can be implemented in different areas of security and surveillance with further research and innovation. The system can perform the real time monitoring of desired area with a good accuracy.

The proposed system can interface with the airbag system installed inside a vehicle that prevents the person inside the vehicle from commanding the steering wheel or window and some other interior objects. This system can also be enhanced by interconnecting camera to the controller module to take photographs of the spot that makes it easier to get a clear picture of the accident spot.

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