

# A Review paper on “Vehicle Accident Detection, Tracking and Notification Systems”- A comparative study

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**Abstract** - In the past few years a marvelous growth in the field of technology and sciences has been observed. This rapid improvement in the field of science and technology has proved to be a blessing in order to make the human lives easier. No doubt, advancing technology has helped humans to provide themselves with a more reliable and efficient form of transportation, but with increasing population and thus increasing demand of transportation media, the traffic on roads have rapidly increased and with this increase, the number of accidents and road casualties are unstoppable. Many efforts have been taken to limit the number of road casualties such as updating design techniques of automobiles, lane design and heavy traffic control systems. But still there is a great need of implementation of a system for vehicle tracking, accident detection and notification and a plenty of work has been done for the same. Many people lose their life just because the families of the people are not timely informed and thus the medical requirements are not fulfilled on time. In vehicle tracking and accident detection and notification systems, any kind of accident is detected automatically and an alert is sent to the required person. Whenever the accident detection system implemented in a vehicle, detects an accident with the help of sensors installed (maybe an accelerometer sensor or a vibration sensor), it will automatically send SMS/Email notification to the registered numbers. These numbers could be of his family members or a police station or maybe nearest hospital. Along with the notification, the co-ordinates of the location at which accident has taken place can be shared using the Global Positioning system(GPS). Various different technologies such as GSM (Global system for Mobile) and Wi-Fi have been used for designing such systems. In this paper, some of these systems have been discussed and reviewed in order to highlight their advantages, disadvantages and future scope.

**Key Words:** Vehicle Tracking, Accident, detection, SMS notification, GPS, GSM, Mqtt Protocol, Wi-Fi.

**Abbreviations:**GPS, Global Positioning System;GSM, Global system for Mobile; MQTT, Message Queuing Telemetry Transport; SMS, Short Message Service; HTTP, Hyper Text Transfer Protocol; IFTTT.

## I. INTRODUCTION

Each day in the newspapers or in news the mankind read about thousands of people dying in road casualties [8] not because of improper medical facilities or non-availability of efficient medications but just because the families of the people did not get timely informed. Isn't it sad? that just because of delayed communication, a number of people are dying every day in the world. To overcome this delayed communication a number of accident detection, notification and vehicle tracking systems have been developed in the recent years. Some of the systems proved to be of great use but still lack somewhere. This review paper aims to review some of these designed and proposed systems for Accident detection, notification and vehicle tracking. These systems if practically interfaced and implemented in vehicles can help saving lives and that too by informing the families of the people indulged in road casualty or by contacting the nearest hospital and by sharing the exact co-ordinates of the location where accident has taken place. These designed or proposed systems use a variety of sensors such as Vibration sensor or an Accelerometer or simply a vibration switch. The heart of these IoT enabled or Embedded systems is a low cost but reliable microcontroller such as ESP8266 NodeMCU or an Arduino Uno R3 or Arduino Mega Board.

In the recent years various vehicle tracking, accident detection and notification systems have been developed, these all systems are based on different technologies, makes use different controllers and sensors to control the functioning of the system and sense the value of the parameter on which the functioning is based upon, or uses different communication protocols to establish the communication. Over the years the technology has advanced and so have these systems.

In this review paper various systems for vehicle accident detection, tracking and notification have been discussed and reviewed in terms of their pros, cons, limitations and future scope. In this paper systems using various microcontrollers such as Arduino Uno, ESP8266 NodeMCU, R-Pi (Raspberry Pi), based on technologies such as GSM (Global system for Mobile), Wi-Fi, GPS (Global Positioning System) have been discussed. These systems make use of different Sensing

devices such as Accelerometer, vibration sensor, and establish communication using different Communication protocols such as HTTP (Hypertext Transfer Protocol), MQTT (Message Queuing Telemetry Transport).

## II. MATERIAL AND METHODS

A number of researchers have carried out their studies on vehicle accident detection, tracking and notification system.

Bansal, B., Garg, V. [1] describes a prototype IoT system for accident detection and notification using an ESP8266 NodeMCU as the controller and a simple vibration switch as the sensing device. This prototype system makes use of Wi-Fi technology. Here in this prototype vibration sensor continuously senses the vibrations and the sends them to the NodeMCU controller which is a Wi-Fi enabled controller. NodeMCU acts as a gateway between the vibration sensor and the Adafruit Cloud platform. All the vibration sensor values are Published to Adafruit IO every two seconds using MQTT (Message Queuing Telemetry Transport) protocol. IFTTT (IF This Then That) is a trigger creating, condition checking and appropriate action performing platform, on this platform a trigger is created, which has subscribed to the vibration sensor values and this trigger constantly monitors the vibration values and whenever the vibration values exceeds a preset threshold value i.e. automobile has collided with some object, the trigger gets activated and an HTTP (Hyper Text Transfer Protocol) request is made to ClickSendSMS which sends out the notification to the registered mobile phone numbers.

Kalyani, T., et. al. [2] describes a prototype Embedded system for accident detection and alert system. Arduino Uno R3 is the heart of this prototype system, this system makes use of GSM (Global system for Mobile) technology. Here a vibration sensor is used as the sensing device, which constantly senses the vibration values and sends them to the Arduino board where the vibration sensor value is compared to preset value in the program and if the received value exceeds, a message using GSM is sent to the registered numbers. In this prototype and LCD module is used for displaying the message sent by Arduino. Along with this a GPS (Global Positioning System) module have been used for identifying the exact coordinates of the location of the vehicle i.e. for tracking down the vehicle.

Bergonda, S., et. al. [5] describes a prototype IoT system for vehicle accident detection, notification and tracking. This prototype system makes use of a Raspberry Pi as a controller. This prototype also makes use of a vibration sensor as a sensing device. When the designed prototype is switched on, led in the system will be turned on, as indication of proper power supply being available. Whenever the vibration sensor senses a collision or any obstacle in the way of the automobile, it sends an interrupt to the controller i.e. R-pi3.

The GPS receiver used in the prototype receives the coordinates of the place where the vehicle has met with an accident. These coordinates of the location are sent via a WhatsApp message to the registered mobile numbers. These coordinates would be received using the internet services of

the receiver's mobile phone. Python has been used for programming the raspberry pi.

Kodali, R. and Sahu, S. [3] describes a MQTT based vehicle accident detection and alert system. This system is based on Wi-Fi technology. NodeMCU is used as a controlling device. But unlike the other 3 prototypes, an accelerometer module is used as a sensing device. An accelerometer continuously senses the X, Y, Z direction coordinates of the vehicle and the NodeMCU publishes the to the LOSANT cloud platform using MQTT protocol. These values are uploaded to the LOSANT dashboard continuously and whenever it senses any deviation from the preset values, a system generated email is sent to the registered email address regarding the accident of the automobile.

Manuja M et al. [4] describes a proposed system that overcomes the major disadvantage in the other systems, which is no information in the remote areas. In the paper [4], they created a system which uses various sensors such as temperature sensor, flame sensor, MEMS sensor and piezoelectric sensor. The use of these additional sensors is an add on advantage to this proposed prototype. When the MEMS sensor detects an accident, it notifies the rescue team by sending an alert message. The temperature sensor sense the temperature conditions of the vehicle and if the values surpass the threshold, an alert message is sent. The GPS modem interfaced sends out the location of the vehicle.

Priya, E., et al. [6] describes a system which is very similar to the system proposed by kodali, R. et al. [3]. But Priya, E. uses an additional ultrasonic sensor for getting information about the distance between the collided vehicles. Also ATmega 162 microcontroller has been used, which increases the cost of the system. An alarm has been used in the system along with the GPS and GSM Modules. The working flow is very similar to the system described earlier in the paper.

Reddy, V. et al. [7] describes a system which uses a Raspberry Pi controller as the heart of the system which for sure increases the cost of the system. Both GSM and Wi-Fi has been used for sending the alert message, in case one fails the other may still work. The major advantage of this system is the camera module which provides us with the photographs of the nearby area, which may be very useful to identify the location and in case of police cases. This system uses accelerometer for detecting the accident.

## III. RESULTS AND DISCUSSION

As mentioned earlier in the Introduction and Literature Survey, various vehicle accident detection, tracking and notification systems have been developed over the years. Four such systems have been reviewed in terms of various parameters. The parameters on the basis of which these Embedded/IoT systems have been reviewed are:

- Microcontroller used
- Technology it is based upon
- Sensing device
- Communication Protocols
- Requirement of additional smart devices
- IoT Platform used

- Additional platforms required for fulfilling the notification purposes
- Cost
- Size

On the basis of the above mentioned parameters the following four vehicle accident detection, tracking and notification systems have been discussed and a comparative study is established in order to produce their advantages and disadvantages:

#### A. Development of Message Queuing Telemetry Transport (MQTT) based Vehicle Accident Notification System [1]

##### Advantages:

- Vibration switch is a very easily available and cheap sensor.
- Small in size
- Wi-Fi technology and MQTT protocol makes the communication very faster.
- Vibration sensor value is published to Adafruit platform every 2 seconds.

##### Disadvantages:

- False Alarms are observed due to ill maintained roads and speed breakers.

#### B. Accident Detection and Alert System [2]

##### Advantages:

- As GPS module have been used, the exact location of vehicle can be determined.

##### Disadvantages:

- Use of additional modules like GSM makes the system costlier.
- Communication is comparatively slower when GSM technology is used.

#### C. IoT Based Vehicle Accident Detection and Tracking System Using GPS Modem [3]

##### Advantages:

- Speed of vehicle can be monitored
- Mobile number can be changed at any time

##### Disadvantages:

- Costlier system
- False Alarms are observed due to ill maintained roads and speed breakers.
- Sending of data isn't secure
- Not applicable for remote places where network is poor.

#### D. MQTT Based Vehicle Accident Detection and Alert System [4]

##### Advantages:

- Simple system

##### Disadvantages:

- LOSANT platform is comparatively slower than Adafruit IO
- Use of Accelerometer makes the system costlier
- False Alarms are observed due to ill maintained roads and speed breakers.

#### E. Iot Based Automatic Accident Detection and Rescue Management InVanet

##### Advantages

- Additional information regarding the vehicle is received using the additional sensors.
- Faster and Quicker Process
- Reliable and Fast

##### Disadvantages

- Costlier System

#### F. IoT Based Vehicle Tracking and Accident Detection System

##### Advantages

- Reliable system

##### Disadvantages

- Ultrasonic sensor can be avoided
- Cost of the system increases due to use of the additional sensor.
- Nonfunctional in remote areas.

#### G. Design and Development of accelerometer based System for driver safety

##### Advantages

- More Reliable as both GSM and Wi-Fi have been used.
- Camera Module increases the usefulness of the system.

##### Disadvantages

- Costlier controller

Camera adds on to the cost of the overall system

## IV. CONCLUSION

Over the period of time various accident detection and notification systems have been studied and developed. This paper aimed to enlist their advantages and disadvantages on the basis of a comparative study. All these systems discussed above in the paper are entirely different from one another in terms of hardware and technology used but have the same purpose i.e. to detect accident and notify the registered users. There are various advantages of each system but there are a few disadvantages as well for example the problem of false alarms is a major drawback.

## V. FUTURE SCOPE

A more reliable system could be developed for remote areas. GPS and Wi-Fi should be used together in such a manner that the nearby police station and hospitals are automatically notified by the prototype itself so that faster medication can be provided. The system can also be interfaced with the air bag system of the car to ensure security of the driver. A camera module may also be interfaced to the device.

**REFERENCES**

[1]. Bansal, B. and Garg, V. (2019). Development of Message Queuing Telemetry Transport (MQTT) based Vehicle Accident Notification System. *International Journal of Engineering and Advanced Technology (IJEAT)* ISSN: 2249 – 8958, Volume-9 Issue-2, pp. 268-273.

[2]. Kalyani, T., et. al. (2019). Accident Detection and Alert System. *International Journal of Innovative Technology and Exploring Engineering (IJITEE)* ISSN: 2278-3075, Volume-8 Issue-4S2, pp. 227-229.

[3]. Manuja M et. al., (2019). Iot Based Automatic Accident Detection And Rescue Management In Vanet. SSRG *International Journal of Computer Science and Engineering (SSRG – IJCSE)*, ISSN: 2348 – 8387. Pp. 36-41.

[4]. Bergonda, S., et. al. (2017, April). “IoT Based Vehicle Accident Detection and Tracking System Using GPS Modem”, *International Journal of Innovative Science and Research Technology (IJISRT)* ISSN No: - 2456 – 2165, Volume 2, Issue 4.

[5]. Kodali, R. and Sahu, S. (2017). MQTT Based Vehicle Accident Detection and Alert System. *International Conference on Applied and Theoretical Computing and Communication Technology*, 186978-1-5386-1144-9\$31.00©2017IEEE, pp. 186-189.

[6]. Priya, E., et al., (2017). IoT Based Vehicle Tracking and Accident Detection System. *International Journal of Innovative Research in Computer and Communication Engineering*, Vol. 5, Issue 3, ISSN(Online): 2320-9801, pp. 4424-4430.

[7]. Reddy, V. et al., (2014). Design and Development of accelerometer based System for driver safety. *International Journal of Science, Engineering and Technology Research (IJSETR)*, Volume 3, Issue 12, ISSN: 2278 – 7798, pp. 3463-3468.

[8]. Dinesh Mohan, et. al., (2009) “ Road safety in India: challenges and opportunities” – Repost number – UMTRI-2009-1 <http://www.deepblue.lib.umich.edu>