A Review Paper on Pre and Post Accident Detection and Alert System: an IoT Application for Complete Safety of the Vehicles

Vaishali Shrivastava
Computer Science and Engineering
Maulana Azad National Institute of Technology
Bhopal, India

Manasi Gyanchandani
Computer Science and Engineering
Maulana Azad National Institute of Technology
Bhopal, India

***Abstract*— Every day, numerous people die all over the world because of traffic accidents occurring along road. The main reason for these accident deaths is the lack of information of the upcoming obstacles on the road and the delay in the arrival of rescue team at the accident point due to their unknown position. An efficient approach to reduce traffic deaths and injuries is to alarm the driver about hindrances on the roadway that can be the reason for mischance, prior and if there is an occurrence of the mishap event, find the mischance spot and give therapeutic help to them as early as possible. The target of this paper is to give a brief review on several methodologies that has been given for road accident avoidance and detection of accident based on various parameters and provide medical help. It will include two perspectives as firstly it include pre accident detection system where various methods are applied to detect the accident prior to its occurrence so that it can be avoided. Methods like V2V communication between vehicles or VANET for the inter vehicular communication are described in order to pre alert about the accident. Secondly about the post alert system which uses several methods to detect the accident cause and confirms the occurrence of accident and later alerts the rescue teams to provide medical facilities to the victims. Also the combined system containing both the modules is included in the paper.**

***Index Terms*— GSM/GPRS, IOV, Pre alert, Post alert, VANET, V2V.**

I. INTRODUCTION

At present time in country like India where there is high population and due to urbanization there is a high demand of cars by the people which has eventually led to increase road traffic and accidents, thus keeps the lives of people at high risk. Street car crashes has driven for in excess of 1.25 million deaths worldwide each and every year and in excess of two hundred thousand deaths in India alone in 2013, as detailed by the World Health Organization [1]. Although the hasty increase in the number of vehicles in India, poor infrastructure and defects in road engineering are worrying, poor driver training remains the biggest challenge. This is due to the lack of the alerting system and emergency providence in the country. All things considered it is important to have a framework which diminishes the odds of mishap event and giving medicinal offices to the casualties as ahead of schedule as conceivable with a specific end goal to spare existences of the general population experienced road accidents. There are systems that runs for solving above problems by decreasing the chances of road accident occurrence which involves various methods used for vehicle to vehicle communication so that vehicles can share the information among them and hence can lead to avoidance of accidents between them up to some extent. A latest technology known as Internet of Vehicles (IOV) is becoming popular with respect to safety of vehicles running on the road. Many systems involves Vehicular Ad hoc Network(VANET) which is a subpart of IOV for accident avoidance by providing vehicle to vehicle (V2V) communication which shares the data about the street and traffic conditions and hence leverages a high chance of accident avoidance. Also there are some systems which make usage of different laser sensors like Radio Detection And Ranging(RADAR), Light Detection And Ranging(LIDAR) to detect the collision of the vehicle prior to the collision which helps to minimize the accidents. But these sensors work well when the inter-vehicular space is more than 1 m which is a kind of disadvantage of these system. Systems are also designed for detecting the accidents that occurs on the road and alerting about it to various respective team. These two systems together can work as pre and post accident detection and alert system. The pre detection system will work for detecting the accident prior to its happening, it will include mechanisms which will collect information about the vehicle environment on the road and use that information to alert the driver to avoid the mishappening that can occur and the post accident detection and alert system will work for determining accidents and alerting teams to provide victims proper help facilities.

II. LITERATURE SURVEY

For pre detection of the accident Vaishali et al[2] has described different laser sensors like LIDAR ,RADAR which uses laser light beams to find the distance between vehicle and the object coming forward to it. But these systems were not that efficient when the distance between vehicle and object is more than 1 m. By the time the new technologies evolved like vehicle to vehicle communication network or VANET where every vehicle can communicate to every other vehicle and the street side unit which ended up being more effective with a specific end goal to limit the street mishaps. Also for post detection of accident earlier systems used speed of the vehicles as parameter to determine whether the accident occurred or not. But nowadays different IOT sensor gadgets are utilized as a part of vehicles to decide the mischance event based on few parameters. Laura Carolina Dasuha at el [3] uses a method called CoMoSeF(Co-operative

Mobility Services of the Future) [4] that use a sensor controller area network (CAN) BUS installed in all the vehicles where the sensor is functioning as communication between vehicles. The CoMoSeF has been designed using cheap sensors that can be installed on every vehicle through which vehicles can communicate with each other. Another exploration zone called Internet of Vehicle (IOV) has advanced which incorporates essentially five kinds of vehicular interchanges; specifically, Vehicle-to-Vehicle, Vehicle to-Roadside, Vehicle-to-Infrastructure of cell systems, Vehicle-to-Personal gadgets and Vehicle-to-Sensors. Particularly it following the foundation on development of VANETs[5]. Communication between vehicles is done in vehicular ad hoc network (VANET) where the information is shared among vehicles. VANET is utilized for making a system with vehicles that can associate with different vehicles and roadside units[6]. For building up correspondence in the vehicular system, IEEE 802.11p (WAVE) convention is being utilized [7]. An entire vehicle to vehicle correspondence framework is actualized by N.G Ghatwai et al [8] in addition; it detects blind spot to reduce the collision on road. In this, GPS is used which gives the information about the dimensions of the vehicle steering and its angle coordinates to the On Board Unit (OBU) of every vehicle and then after processing , safety messages are shared among vehicles through RF transceivers. For post accident detection system Hari Sankar S et al [1] given an solution for street auto collision location and emergency vehicle administration. It utilizes GPS, Accelerometer sensors and mishap identification calculation to distinguish the mischance and a rescue vehicle administration framework which gets the area of the mischance spot and sends the data to the closest emergency vehicle and then the emergency vehicle is dispatched to the mishap spot promptly. Nicky Kattukkaran et al [9] involves a heartbeat sensor and an android application in order to detect the heartbeat of the driver/victim and sends the information to medical authorities using android application. Chatrapathi.C et al[7] proposed a system for automatic accident detection and management where an accident occurred is detected and using VANET the shortest path is found and provided to the ambulance. Ambulance receives the route information from the server and follows the route with the help of GPS. Norsuzila Ya'acob et al [10] uses PIC 16F microcontroller, piezoelectric sensors, GPS and Global System for Mobile (GSM) modules to detect traffic accidents. Piezoelectric sensor detects and measures the severity of the force impacted on the vehicle and sends out a help message to central emergency server which gets the location coordinates and dispatches the ambulance to the accident location using the respective coordinates. The intelligent irrigation system for agriculture filed advances a impending solution to provide specific irrigation management based on the requirement of each crop i.e., crop specific that lets the producers to capitalize on their yield while saving the water. The system can be handled via android application it can be controlled from anywhere [20-22]

III. PRE-ACCIDENT DETECTION SYSTEM

This section of the paper covers various methods that have been proposed to detect the accident before its occurrence in order to avoid the accidents. The main function of this module is to detect the possibilities of occurrence of the accident and inform to the vehicle driver as to alert them. Some systems have been implemented for the forward collision detection to predict the occurrence of the accident early using various sensors and other have defined a vehicular ad hoc network VANET using different methods and protocols for the same purpose. The communication between vehicles provides chances of lowering the risk of road accidents as vehicle will transfer their information to one another which will help to use the information to avoid the accident. Fig.1 shows a V2V communication system which involves RF module attached to each vehicle [8]. These are responsible for transmitting and receiving the messages between vehicles. It also uses GPS to find the deceleration which can cause accident along with following methods to provide communication between vehicles.

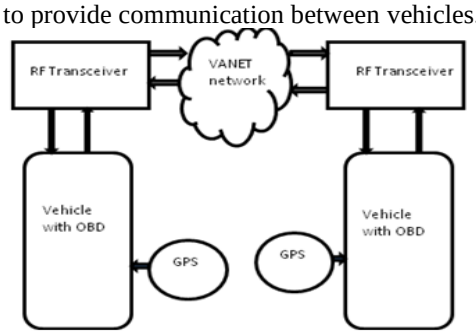

Fig 1. V2V communication

A. Forward Collision Detection Sensors

Forward collision detection has a critical influence in Pre Accident Identification System. The forward collision detection method uses different sensors which include RADAR, LIDAR/LASER or Camera with a specific end goal to identify the vehicle forward impact [2]. For the avoidance of road accidents, the system should have ability to estimate the detection range, radius-of-curvature, relative speed, etc. between the Host vehicle and all other appropriate targets (i.e.: roadside objects, pedestrians, vehicles, etc). The angular information, range and range rate of different vehicles as well as objects around the host vehicle can be estimated by sensors radar, lidar, and cameras progressively in real time.

B. VANET

VANET is an application of Mobile Ad Hoc Network (MANET) where mobile nodes are vehicles [4]. VANET is a framework less system in which the hub can said to be a Road Side Unit (RSU) or the moving vehicle. It gives a blend of remote medium techniques and the attributes specially appointed system which utilizes an alternate topology for correspondence and framework subordinate modes. It provides interaction in vehicles under a special approach [6]. In V2V communication in VANETS, the vehicle can take broadcast and share useful traffic news that is, traffic conditions and traffic accidents in a particular area or with other vehicles. In VANET there is a wireless V2V communication network which uses RF module shown in fig 1 [8]. To work in a VANET circumstance and to make a

vehicle-to-vehicle (V2V) and vehicle-to-foundation (V2I) interchanges, the Wave Station characterizes the engineering, Interfaces and an arrangement of standard conventions. In V2V correspondence organize all vehicles share the data among them keeping in mind the end goal to give the present status of the vehicle running out and about.

A wireless communication system between vehicles currently is experiencing a rapid growth. Vehicular to Vehicular (V2V) focuses on infrastructure and inter-vehicle communication system. There are different measures for the foundation of remote system between vehicles as DSRC (Dedicated Short Range Communication), WAVE (Wireless Access in Vehicular Environments) and IEEE 802.11p which can be utilized as a part of VANET [7]. A VANET organize utilizing IEEE 802.11p is shown below in fig. 2[4].

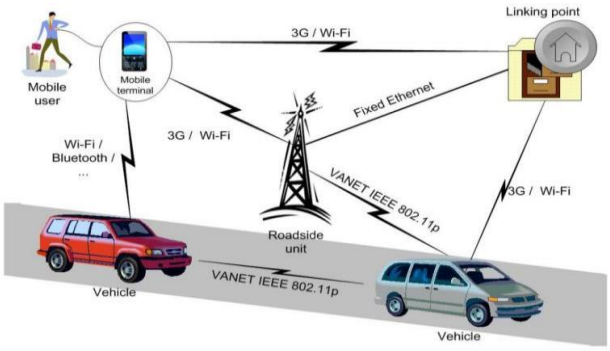

Fig 2.VANET network using IEEE802.11p

C. Important Aspect of Vanet:

1) *High Mobility:* In VANET, the hub moves at rapid that consolidates the work in the system. With the goal that it is difficult to ascertain the vehicle position and to give security to hub protection.
2) *Information Sharing:* Generally VANET is ad hoc in nature where vehicles are connected to each other in a network, each vehicle connected shares the information with other vehicles frequently.
3) *Restricted data transfer capacity:* In VANET, the standard DSRC band ought to be estimated as constrained, the width of the DSRC band was 27 MHZ. The throughput was 27 Mbps which is a hypothetical esteem.
4) *Availability of the transmission medium:* VANET can be executed for one city, a few urban communities or for nations. This implies organize measure in VANET is topographically unbounded. The widespread accessibility of this remote transmission medium is great favorable circumstances in IVC, turns into the inception of some security issues, identified with both the idea of transmission in remote condition and to the security of interchanges utilizing an open help.
5) *Energy storage and computing:* The VANET hubs have no issue of vitality, processing limit or capacity disappointment. This grants VANET utilization of requesting method, for example, RSA, ECDSA execution and furthermore gives boundless transmission control.
6) *Power assets:* VANET is described with unfaltering force or vitality assets. There are restricted power issues since vehicles are the system hubs. The battery on the vehicles give the system a more drawn out and more steady wellspring of intensity rather than different types of portable systems[6].

D. RF Module

The nRF24L01 is a significantly planned, ultra low power (ULP) 2Mbps RF handset IC for the 2.4GHz ISM (Industrial, Scientific and Medical) band. With peak RX/TX streams lower than 14mA, a sub µA close down mode, impelled control organization, and a 1.9 to 3.6V supply expand. The nRF24L01 joins a whole 2.4GHz RF handset supporting a quick SPI interface for the application controller [8].

E. CoMoSeF

The CoMoSeF is outlined with the objective of increasing the smoothness, security, and decrementing the quantity of auto collisions by characterizing the utilization of portability in more current construct vehicles in light of client necessities [3]. CoMoSeF is made utilizing cell phones at a cost of shoddy sensors that can enhance the speed of data dispersal. CoMoSeF first objective is to center around administrations for vehicles that don't have worked in framework and information CAN-Bus, utilizing ease and promptly accessible[4]. The main objectives of CoMoSeF users are vehicle manufacturers, fleet operators, drivers and other road users. Implementation activities to be implemented in the near future CoMoSeF will show benefits and impact in several countries around the world. The CoMoSeF administration ought to have a huge effect as it will add to enhancing street security by giving movement data, climate figures. CoMoSeF will focus on[3]: Back-end applications, street side units, sensors and so on to help drivers choices.

Intelligent street side units with data screens, that present individual information to vehicles.

Innovative work of geo-throwing conveyance programming and a Local Dynamic Map database to store and keep up data gathered from the earth of ITS Station in its region. Data combination, considering the ecological recognition information accessible.

Brilliant HMI solution for appear and adjust messages for drivers.

Development of a reproduction framework to demonstrate an extensive scale perspective of the whole correspondence framework with symptomatic instruments.

F. Advantage of Pre Accident Detection System

Pre accident detection system utilizes VANET, radar and video Advancements to limit the probability of mishaps, in this manner making a more secure street for any individual who crosses it [11]. When the pre accident detection system is used it reduces the chances of mishappening occurrences, however protects everyone, counteracts harm to organization vehicles, and guarantees that the driver remains on track.

IV. POST-ACCIDENT DETECTION SYSTEM

This section of the paper comprises of the methods used for the detection of accident and consists of alert system to

inform the rescue teams about the accident. A few sensors are appended to the vehicles for getting the data of vehicle position and its directions to discover the event of the mischance. Hari Sankar S et al[1] uses Accelerometer sensor to detect the angle of tiltness of the vehicle, Norsuzila Ya'acob et al[10] uses Piezoelectric sensor for dynamic-force measurements such as oscillation, impact, and high-speed compression or tension. Paper[6] uses Biomedical sensors along with vibration sensor and airbag sensors to detect the occurrence of the accident. In [11] [12][13] based on the speed or acceleration of the vehicle the accident detection algorithm is applied and the accident location is detected using GPS/GPRS modems. There is also a switch in the vehicle which is used when there is requirement of medical help in case when a sudden life causing disease like heart attack occurs [14]. Accident detection module incorporates GSM and GPS innovation. Security empowering module incorporates a tactile unit which guarantees the state of safety belt and the driver. In the event that there ought to emerge an event of any incident, the vibration in vibration sensor increases past the most extreme and information is sent to GSM module. The GSM module by then send message to specific expert reporting the incident occasion [15]. The below sensors and devices can be used to implement accident detection system. These sensors are installed on the vehicles and they continuously senses the respective parameters and based on the data collected by these sensors accident detection is done. Sensors used in this system discussed below:

A. MPU 6050 MEMS Accelerometer

The MPU-6050 gadget is a blend of a 3-hub whirligig and a 3-pivot accelerometer on similar silicon bite the dust together with a locally available Digital Motion Processor. The gadget can get to outer magnetometers or different sensors through an assistant I2C transport enabling the gadgets to assemble a full arrangement of sensor information without mediation from the framework processor. The 3-axis gyroscope is used to detect tiltness in the vehicle and the 3-axis accelerometer measures the speed changes of the vehicle which is used to detect the accident or normal condition. The Gyroscope Range is 250 500 1000 2000 and Acceleration Range is 2 4 8 16g [1]. The mems accelerometer is generally mounted over top of the vehicle for the best experience of the force that is applied on the vehicle [1][14].

B. Vibration Sensor

Vibration sensors are sensors for measuring and analyzing linear velocity, displacement, proximity and variety of shocks triggering. The Vibration module based on the vibration sensor SW-420 and comparator lM393 to recognize if there is any vibration that past the edge. The limit can be balanced by the on-board potentiometer, when there is no vibration and this module yield rationale low the flag demonstrate LED light and the other way around. Vibration sensor is mounted on the vehicle such that it experience sudden shocks and vibration created on the vehicle due to collision[16].

C. Piezoelectric Sensor

A piezoelectric sensor is a device that uses the piezoelectric effect, to measure changes in pressure, acceleration, temperature, strain, or force by converting them to an electrical charge. A piezoelectric sensor works on the principle of conversion of energy in mechanical and electrical energy forms. At the point when an polarized crystal is put under strain, some mechanical deformation happens in the polarized crystal, which leads in the age of the electric charge. The produced electric charge or the mechanical disfigurement would then be able to be estimated utilizing a piezo sensor [10].

D. Raspberry Pi 3

The Raspberry Pi 3 is a little single-board PC comprise of 1 GB RAM memory with remote LAN and Bluetooth availability. It comprises of secure computerized card opening which store working framework to be kept running on the raspberry pi and 20 GPIO pins which bolster normal conventions like I²C. For video yield, HDMI and composite video are upheld, with a standard 3.5 mm phono jack for sound yield. The raspberry pi 3 has on-board Wi-Fi, Bluetooth and USB boot capacities. The Raspberry Pi 3 utilizes a Broadcom BCM2837 SoC with a 1.2 GHz 64-bit quad-center ARM Cortex-A53 processor, with 512 KB shared L2 reserve.

E. Global Positioning System (GPS)

The GPS16X-HVS, manufactured by Garmin International, consists of a receiver and an integrated antenna. It receives signals in orbit from GPS (Global positioning System) satellites, and then uses signals to calculate position and speed. The GPS16X-HVS also provides a very accurate output of one pulse per second (PPS) for precise timing measurements.GPS beneficiaries utilize a group of stars of satellites and ground stations to figure position and time anyplace on earth. At any given time, there are no less than 24 dynamic satellites hovering more than 12 000 miles over the ground. Satellites are worked such that the sky over your site will dependably contain up to 12 satellites. The primary objective of the 12 visible satellites is to send information to the ground on the radio frequency (ranging from 1.1 to 1.5 GHz). With this data and some math, an earthly recipient or GPS module can ascertain its position and time[13]. At the time of mischance identified the GPS framework quickly finds the current position coordinates in terms of latitude and longitude which can be utilized to find the real position on the map[12][13][14].

F. Global System For Mobile Communication (GSM)

The GSM system is the most widely used cellular technology in use in the world today. It has been an especially effective mobile phone innovation for an assortment of reasons including the capacity to meander worldwide with the assurance of having the capacity to have the capacity to work on GSM organizes in the very same way - gave charging assentions are set up.GSM cellular technology uses 200 kHz RF channels. These are time division multiplexed to enable up to eight users to access each carrier. In this way it is a TDMA / FDMA system. At the point when a GSM module is

associated with a PC, this enables the PC to utilize the GSM modem to convey over the portable system. While these GSM modules are most much of the time used to give versatile web availability, a significant number of them can likewise be utilized for sending and accepting SMS and MMS messages[10]. The GSM is used in this module to automatically send the information of mishappening to the respective rescue teams and other bodies[15][16][17].

A flow diagram illustrates the scenario of accident detection system as:

G. *Advantage Of Post Accident Alert System*

Road Accidents are the real reason for individuals deaths as casualties are not being furnished with required medicinal offices inside time, however utilizing post Accident Alert System gives an advantage to the casualties by identifying their vehicle mishap and give them restorative help inside part of time consequently helps a lot in sparing their lives. GPS/GSM used in this system helps to locate the exact position of the accident and forward the information to the required rescue teams so that victim can get help from them within less time anywhere.

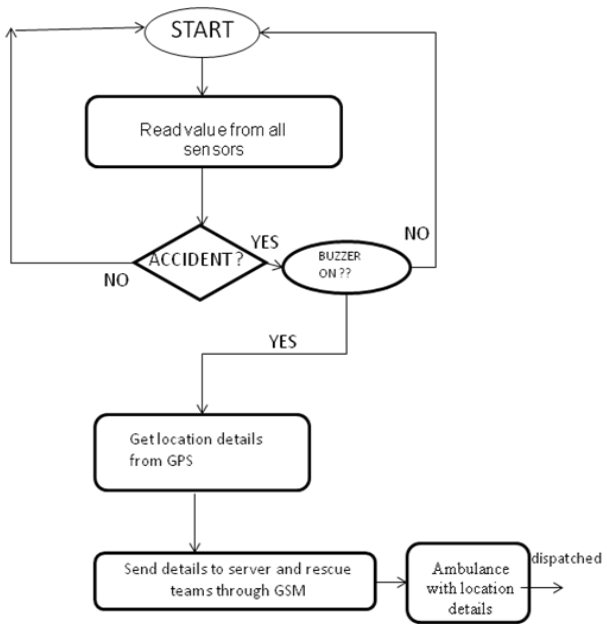

Fig. 3 Post accident detection system

V. COMBINE MODULE OF PRE AND POST ACCIDENT DETECTION SYSTEM

The two systems discussed above alone cannot provide complete safety to the vehicles moving on road, Thus above pre accident detection and post accident detection and alert system can be combined to a single module which is capable of both detecting and alerting accidents of the vehicles before and after accident. It will be more advantageous to have single module as one can be beneficial to other. VANET used in pre accident detection system can also be used to find the shortest path to provide ambulance a right and quicker way to reach to the emergency point. There are several advantages of VANET system which can be used for accident detection and alert system[10]. Also GPS/GSM modem used in later system can be beneficial to both as it can be used to transfer the information about current position of the vehicle to another vehicle and in case of accident it sends the location of accident to the server and rescue teams.

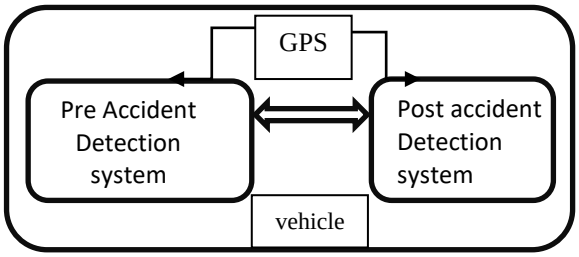

Fig. 4 Combine Module Of Pre and Post Accident Detection and Alert system

A. *Advantage of Combined Module Of Pre And Post Accident Detection And Alert System*

The combine module of pre and post-accident detection and alert system provides a great advantage of complete safety of vehicles. This consolidated framework will help enormously in lessening the deaths occurring on account of street mishaps. This framework will first help in evading the street accidents by imparting data to different vehicles and later it will help in identifying the mishap and alarms the few safeguard bodies keeping in mind the end goal to furnish casualties with restorative facilities.

VI. CONCLUSION AND FUTURE WORK

If the combined module will be implemented then the risk of road accidents will be highly minimized and number of road accidents occurring will drop down drastically. Most latest technology, VANET can be used efficiently in many ways using different standards of protocols to provide communication facilities between moving vehicles on the road. Hence when the vehicles communicates with each other while moving on the road the information that is required for determining the accident can be shared among them and the vehicle driver can get alert so as he drives carefully on the road after getting the information. In case if a vehicle meets an accident the system can determine accident at the earliest based on information from the several sensors mounted on the vehicle and provides the location details to the rescue bodies so that they can avail the medical services to the victims within few seconds and save their lives. The future work that can be done on this system is, a camera module can be attached to the vehicle to click picture immediately at the time of accident and send the image to the server. All the data collected at the server can be used for Big data processing in future to evaluate some results related to road accidents.

REFERENCES

[1] Hari Sankar S, Jayadev K, Suraj B And Aparna P, "A Comprehensive Solution To Road Traffic Accident Detection And Ambulance Management" , International Conference On Advances In Electrical,

Electronic And System Engineering 14-16 Nov 2016, Putrajaya, Malaysia.

[2] Vaishali B.Gadekar , "Review On Sensor Parameter Analysis For Forward Collision Detection System", International Journal Of Engineering Research And General Science, Volume 2, Issue 6, Issn 2091-2730 October-November 2014.

[3] Laura Carolina Dasuha, Teddy Mantoro, "Car To Car Communication In Vanet Using Co-Operative Mobility Services Of The Future (CoMoSeF)",Multimedia Computing And Systems (ICMCS), 5th International Conference,2016.

[4] Co-Operative Mobility Services Of The Future At Https://Www.Celticplus.Eu/Project-Comosef/.

[5] Anas N M, Farsheena K V, Layyina P V, Mirshad K T, Mofeeda K M & Sindhu T V (2017),Iov –Internet Of Vehicles, Volume 4,(Issue 1, Jan-2017), PP: 65-72. Issn: 2349 –3607 (Online) , Issn: 2349 – 4824 (Print).

[6] Patrick I. Offor, "Vehicle Ad Hoc Network (VANET): Safety Benefits And Security Challenges ," Social Science Research Network, 2012. [Online]. Http://Ssrn.Com/Abstract=2206077

[7] Chatrapathi. C, "Vanet Based Integrated Framework For Smart Accident Management System",International Conference On Soft-Computing And Network Security (ICSNS), Feb. 25 – 27, 2015, Coimbatore, India.

[8] N.G.Ghatwai; V.K.Harpale; Mangesh Kale, Vehicle To Vehicle Communication For Crash Avoidance System", International Conference On Computing Communication Control And Automation (ICCUBEA), 2016.

[9] Nicky Kattukkaran, "Intelligent Accident Detection And Alert System For Emergency Medical Assistance", International Conference On Computer Communication And Informatics (ICCCI),Jan 05-07,Coimbatore,India, 2017.

[10] Norsuzila Ya'acob , Ainnur Eiza Azhar, Azita Laily Yusof, " Real Time Wireless Accident Tracker Using Mobile Phone", 2017 7th Ieee International Conference On System Engineering And Technology (ICSET), 2 - 3 October 2017, Shah Alam, Malaysia.

[11] M.Newlin Rajkumar1, "Overview Of Vanet With Its Features And Security Attacks", International Research Journal Of Engineering And Technology (IRJET) Volume: 03 Issue: 01 | Jan-2016, Issn: 2395-0056.

[12] C.Prabha , R.Sunitha , R.Anitha, "Automatic Vehicle Accident Detection And Messaging System Using Gsm And Gps Modem", International Journal Of Advanced Research In Electrical, Electronics And Instrumentation Engineering, Vol. 3, Issue 7, July 2014.

[13] Sri Krishna Chaitanya Varma, Poornesh, Tarun Varma, Harsha, "Automatic Vehicle Accident Detection And Messaging System Using Gps And Gsm Modems", International Journal Of Scientific & Engineering Research, Volume 4, Issue 8, August-2013.

[14] Niravthakor, Tanmayvyas, Divyang Shah, "Automatic Vehicle Accident Detection System Based On Arm &Gps", International Journal For Research In Technological Studies, Issn: - Applied (Online) Vol-1, Issue - 1, Dec 2013.

[15] Md. Syedul Amin, Jubayer Jalil, "Accident Detection And Reporting System Using Gps, Gprs And Gsm Technology", Ieee/Osa/Iapr International Conference On Informatics,2012.

[16] Rahul Gautam, Shubham Choudhary, Surbhi ,"Cloud Based Automatic Accident Detection And Vehicle Management System ",International Conference On Science,Technology And Management (ICSTM),September 2015.

[17] Azeez, Raheem Ajetola, Ogunrinde, Mutiat Adebukola," A Web-Based Accident Reporting And Tracking System (ARTSYS) Using Sensor Technology", International Journal Of Advances In Engineering & Technology, Oct., 2015.

[18] Dr. I .Kala ,Ms. S. Preethi, Ms. R. Saranya, "An Iot Based Vehicle Tracking And Accident Detection System ", Ijaict Volume 4, Issue 11, March 2018.

[19] Hamid M. Ali, Zainab S. Alwan, "Car Accident Detection And Notification System Using Smartphone", International Journal Of Computer Science And Mobile Computing, Vol.4 Issue.4, April- 2015, pp.620-635.

[20] Parameshachari B D et. al Optimized Neighbor Discovery in Internet of Things (IoT), 2017 International Conference on Electrical, Electronics, Communication, Computer and Optimization Techniques (ICEECCOT), PP 594-598, 978-1-5386-2361-9/17/$31.00 ©2017 IEEE.

[21] Parameshachari B D et. al "Automation of Irrigation System through Embedded Computing Technology " 4th International Conference on Multimedia and Image Processing (ICMIP 2019), University of Malaya, Kuala Lumpur, Malaysia, during January 19-21, 2019. © 2019 Association for Computing Machinery. ACM ISBN 978-1-4503-6618-2/19/01…$15.00. PP 289-293. https://doi.org/10.1145/3309074.3309108.

[22] Parameshachari B D et. al "Advanced Picture Division: Graph- based Approach",2017 International Conference on Electrical, Electronics, Communication, Computer and Optimization Techniques (ICEECCOT), PP 368- 370, 978-1-5386-2361-9/17/$31.00 ©2017 IEEE.