International Journal of Advanced Research in Engineering and Technology (IJARET)
Volume 11, Issue 7, July 2020, pp. 100-107, Article ID: IJARET_11_07_012
Available online athttp://iaeme.com/Home/issue/IJARET?Volume=11&Issue=7
ISSN Print: 0976-6480 and ISSN Online: 0976-6499
DOI: 10.34218/IJARET.11.7.2020.012

IOT BASED ACCIDENT DETECTION SYSTEM IN VANET

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ABSTRACT

Increase in the population of vehicles and lack of proper traffic management has driven the rise in the accidents. The survey reports on an average 3,700 people are killed every day globally in road accidents. The worst part is large number of victims lost their lives due to late information to emergency services. The proposed system tackles this issue with VANET (Vehicular Ad-hoc Network) architecture involving Vehicle-to-Infrastructure communication. The system is cable of reaching emergency services in no network coverage area via radio-frequency communication. On average, the response of the system takes less than 10 seconds to reach out emergency services thereby rescuing the precious lives of the victims.

Key words: Vehicular Ad-hoc Network, Vehicle-to-Infrastructure communication radio-frequency communication.

Cite this Article: A. Mari Kirthima, Ambika G.N and Rajesh N.V, IOT Based Accident Detection System in VANET, *International Journal of Advanced Research in Engineering and Technology,* 11(7), 2020, pp. 100-107.

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1. INTRODUCTION

Road Accidents has become a serious issue in the recent years due to increase in population and significant increase in the number of vehicle owners. Annual Global Road Crash

Statistics states that, approximately 1.3 million people die worldwide in road crashes and about 20-50 million people are disabled each year. Every day, nearly 3700 people die because of these fatal road accidents. In spite of taking some necessary steps, it is increasing in alarming rate. Unfortunately, the arrival of an ambulance to the accident spot is delayed because the emergency services is not informed in time. Moreover, sometimes, they are reported but cannot trace the exact location. Consequently, it causes the loss of life as the information doesn't reach to the emergency services immediately in time.

As such, to track the accident and inform the emergency services is the crying need to save the valuable lives. The main thrust of this project is to propose an efficient VANET based Accident Detection and Human Rescue System (ADHRS) that decreases the mortality rate of road accidents. The ADHRS ensures the medical facilities to the accident victim like an ambulance reaching at the accident location in time without any delay. This process will save time for the areas situated in a remote place that is outer part of central city.

VANET is a system that allows vehicles to communicate using wireless media with other vehicles and roadside infrastructure in the traffic area. Communications between vehicles on the VANET system are in two ways, Vehicle-to-Vehicle communication and Vehicle-to-Infrastructure communication. Communication between vehicles and vehicles known as the term (V2V) is carried out when a vehicle with another vehicle is at a short distance. The relationship between V2V and others can be used as a hops to deliver messages from vehicles that are farther away. Communication between vehicles and Infrastructure is directly connected through the RSU infrastructure with OBU in vehicles. Every vehicle in the RSU access area will be on the same network so that vehicles can get information directly through V2I without having to connect directly to other vehicles first.

2. RELATED WORK

With the motivation of reducing casualties, I proposed in paper [1] that VANET can be used to provide information about events in traffic areas such as when an accident occurs. When a vehicle breakdown occurs, the message containing area of accident is broadcasted to other vehicles through Ad-hoc V2V or through RSU. Vehicles that are far from the accident site can change their travel route so there is no traffic jam near the accident area. In addition, the broadcast of accident news will make it easier for the police and ambulance to go directly to the accident site quickly. But the author failed to explain how the VANET communication is used when there is no signal. Author concludes that Vehicles that continue to move at high speed will be at greater risk of failure when transferring data if they only rely on communication between vehicles, especially when the vehicle is driving in the opposite direction. Here in this case prefers to use RSUs which is stationary.

In[2], proposed the working of Microcontroller based Accident Detection System using vibration sensor and alerts emergency services using GSM module. By using a vibration sensor, accident can be detected automatically. This system replaces the old mechanisms of the notification of accidents that is based on witnesses, who may give incorrect or incomplete information. The SMS can be sent by interfacing GSM and GPS without android phone and apps. In [3], a Smart Accident Detection and Control System (SAD-CS) for intersecting road. The SADCS detects the accident in the intersecting area, takes the immediate steps to avoid the further accidents, minimize the loss of lives and prevent to create unusual traffic jam on the road. The system uses three sensors fire sensor, shock sensor, gas sensor to detect accident which increases the complexity of circuit interfacing. This is limited to intersection of roads. The system did not consider the major constraints such as bad weather, hilly regions, and remote areas and has not defined the behavior of the system for the above constraints. In this system there is exist a central structure that manage overall working if incase that shuts down

there is no other back up and system fails. In [4],Proposed a system that gathers information of vehicle which met with accident. The main objective is to get the latitude and longitude information in order to provide an emergency service which reduces the mortality rate. This system consists of vibration sensor and GPS mainly to detect the accident and send the location to emergency services. It also has a special feature to reduce the speed of vehicle when the vehicle comes to the proximity of school, hospital and accident zones by using RF transmitter and receiver which is installed in sign boards kept near schools and hospitals. In [5], proposed a VANET based system that detects the accident and report to emergency alert system .when an accident occurs between two cars, and the application detects it using OBUs automatically, and information about this incident to our dedicated server. The installed server finds out the nearest hospital location with the help of GPS system, medical centers database and reported the location of the accident to the nearest medical center. After figuring out the nearest location, it sends a message to the medical center to request an ambulance service at the reported location. Since it uses centralized approach the task of finding nearest hospital and informing them is time consuming instead informing emergency alert directly can save time. In [6], The brief survey on Accident detection where he discusses about VANET. His overviews that in VANET-based accident detection system, in case of an accident, information to the emergency department is sent using the VANET based ad-hoc network between moving vehicles. The location of the accident spot is identified by the GPS system. The explanation is limited to the working architecture specifying the components OBU and RSU. The implementation details, the software and hardware requirements are kept hidden. The communication reliability among two fast moving vehicles may be uncertain under circumstances. In[7], proposed an VANET based Smart Accident system.The system is an integrated framework that consists of a centralized server. The system detects the accident and alerts the emergency service via the central server which has the control over the working of the system. It uses three bio-medical sensors and one vehicle sensors which can increase the probability of false alarm and performance degradation since high use of sensor increase the complexity of circuit. The lighter and simple circuit is easy to implement and highly reliable. The author failed to provide the precise implementation details. Also, the system is not tested for different scenarios to check its behavior to estimate the accuracy and the reliability of communication.

3. IMPLEMENTATION

The proposed system behaves according to architecture of VANET. Vehicle – Infrastructure and Infrastructure – Infrastructure communications are used in this architecture.

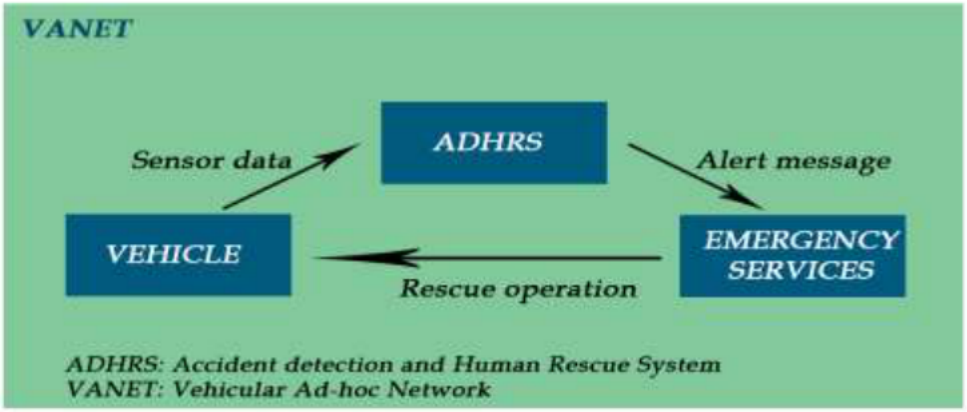

Figure 1 Architectural design of overall project

The proposed system acts as a bridge between vehicle under breakdown and emergency services. The sensor data is fetched and evaluated ever now and then to detect accident and once detected an alert message is sent to Emergency services for immediate rescue. By using VANET as core Architecture the system aims to track the accidents in fewer seconds and alert the emergency services and pre-defined contacts. OBU attached to Vehicle triggered when the vehicle breaks down, the alert message is generated and sent to nearby RSU in the road side infrastructure. The message is circulated between RSUs placed at every certain range along the road until it finds the network. As soon as the network coverage area is found the message is transmitted to emergency services for immediately. Thereby thriving to reduce the mortality rate.

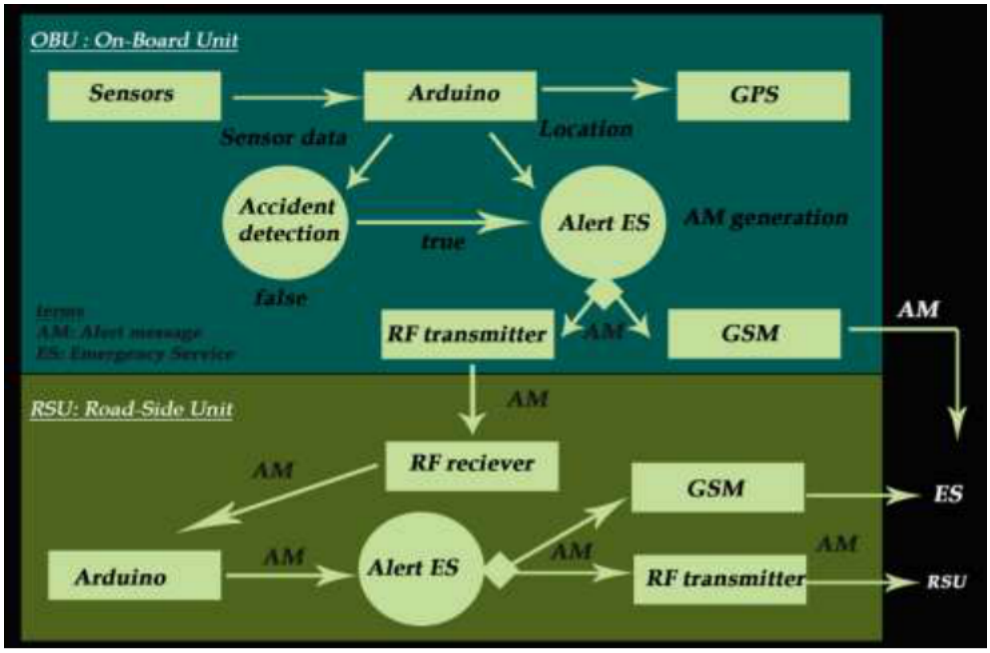

Figure 2 Component design of ADHRS

The component design depicts the use of hardware components used in the proposed system. There are two main components that is OBU and RSU. OBU is used to detect the accident and to alert Emergency services. RSU is used as a carrier when there is no network to forward the alert message to Emergency services. RSU contains those elements which are required to traverse the message sent from OBU, like RF module and GSM module controlled by Arduino. Whereas, OBU contains elements such as sensors, GPS to detect accident and find location along with RF and GSM modules for the communication between Emergency service in case of network or RSU when there is no network.

The various hardware components and their uses in the proposed system are given below:

- Sensors: Three different sensors are used to detect accident more precisely. The three sensors are Vibration sensor, Ultrasonic sensor, and tilt sensor. Vibration sensor is used to gather vibration data of vehicle. Ultrasonic sensor is used to find the obstacle in the proximity of vehicle and tilt sensor gives the tilt angle of vehicle. All three data is combined to evaluate whether breakdown has occurred or not.
- Arduino: Arduino Uno is a microcontroller board based on the ATmega328. The Uno is the latest in a series of USB Arduino boards, and the reference model for the Arduino platform; for a comparison with previous versions. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16

MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button.

- GPS: The GPS module is found in recent technologies like smart-phones, automobiles, where it is used to track commerce all over the globe. These modules are getting cheaper and small in size with the passage of time. These tiny GPS modules are receiving GPS coordinates from satellites. It includes tiny processors and antennas that directly receive the data sent by the satellites and compute your position. The location of vehicle is continuously fetched and sent to Arduino.
- GSM: GSM stands for global system for mobile communications and is the network standard for much of the world.GSM is an open, digital cellular technology used for transmitting mobile voice and data services. It operates at either the 900 MHz or 1800 MHz frequency band.GSM supports voice calls and data transfer speed up to 9.6 kbps with the transmission of SMS. The GSM is used when there is a network coverage found.
- RF module: RF module consists of RF transmitter and RF receiver to emit and receive radio signal. It is used for applications that need two-way wireless data transmission. It features high data rate and longer transmission distance. The communication protocol is self-controlled and completely transparent to user interface. It provides bidirectional UART serial data transfer, high sensitivity, reliable transmission range and error checking of data in built. The RF module is used when there no network coverage in the place of break down.
- The behavioral design depicts the process involved in the proposed system. The below figure shows the process and data flow in the system.The working and flow of data is shown in the figure 3 involving the process of ADHRS system. The system has two main components OBU and RSU as discussed above. The OBU is fixed in the vehicle and RSU in road side Infrastructure likes light poles. The process in OBU is initiated when Vehicle attached with OBU starts to move.

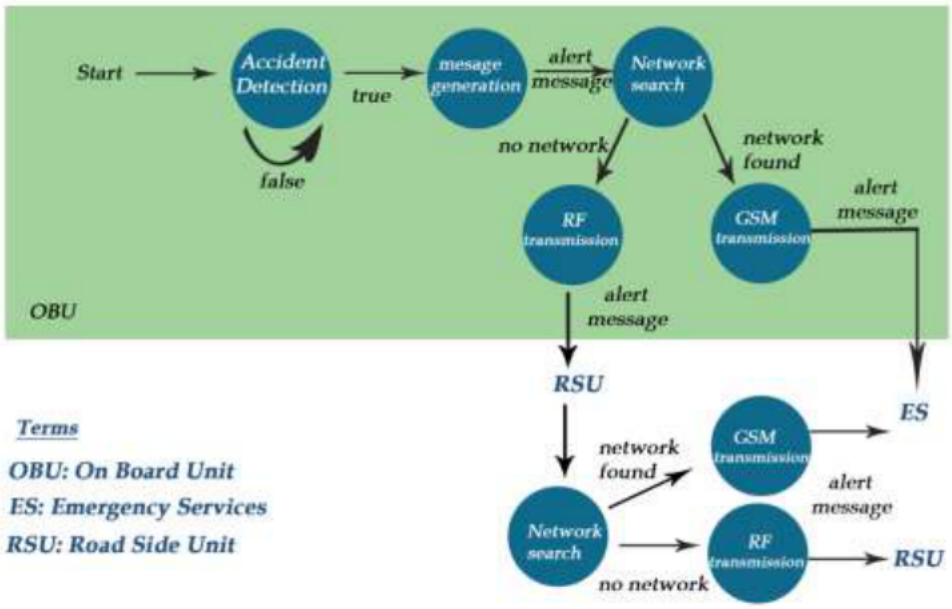

Figure 3 Process diagram of ADHRS

The first process is "Accident Detection" that starts working as vehicle start to move. The accident detection process is a continuous process which evaluates to identify whether

accidents has occurred or not. If process evaluates true then control moves to next process else, the control will be executing the same process. The next process is message generation, the location of vehicle which is frequently fetched by the controller is converted to string format to create a message as soon as vehicle breakdown is detected by accident process. After the message generation, the controller initiates the process “Network search” that finds for network coverage. If there is no network then the message transmission is done through RF transmitter through Radio Frequency and incase network is found, then GSM is used for the message transmission and message directed to Emergency services. When RF transmitter is used then message is sent to the next RSU having RF receiver untilnetwork is found. The RSU has controller that initiates the process “Network search” as soon as it receives the alert message. Again, if network if found, the message transmission switch to GSM and directly sent to Emergency services else, the same routine is continued that is message is sent to next RSU. Hence, the proposed system requires RSU to be placed at certain range based on the coverage area of RF module communication.

4. RESULT

Testing is conducted with Arduino IDE with necessary microcontroller (Arduino) and hardware component such as USB cable and 9-volt battery. A test execution result is seen in serial monitor of Arduino IDE. The behavior of module is tested for its input and output. The vibration sensor is made to vibrate and its output signal is tested. The vibration sensor signals LOW when there is vibration and HIGH when no vibration. Test case: must output 0 for vibration and 1 for no vibration. The sensor produced 0 as output when there was vibration and 1 when there was no vibration. The ultrasonic sensor is tested for its working, to find the distance of object placed at in front of the sensor. Test case: To find the distance of object placed in front of sensor.

```
11:39:38.384 -> distance is :9
11:39:39.417 -> distance is :9
11:39:40.424 -> distance is :9
11:39:41.389 -> distance is :9
11:39:42.392 -> distance is :9
11:39:43.400 -> distance is :10
11:39:44.396 -> distance is :9
11:39:45.407 -> distance is :10
11:39:46.430 -> distance is :10
11:39:47.432 -> distance is :10
11:39:48.439 -> distance is :10
11:39:49.449 -> distance is :10
11:39:50.434 -> distance is :10
11:39:51.420 -> distance is :10
11:39:52.407 -> distance is :9
11:39:53.427 -> distance is :10
11:39:54.413 -> distance is :10
11:39:55.446 -> distance is :10
```

Figure 4 Test results of Ultrasonic sensor

Results: the actual distance is 10 cm, the predicted distance is 9 cm, 10 cm. Hence the sensor works with an accuracy of about 90%.The GPS is tested for its accurate position details that is longitude and latitude. Test case: To find the longitude and latitude of location it is placed.

```
11:19:19.954 -> Lattiude :14.54 Longitude :74.72
11:19:20.923 -> lattitude: 14.54
11:19:20.970 -> longitude: 74.72
11:19:20.970 -> Lattiude :14.54 Longitude :74.72
11:19:22.606 -> lattitude: 14.54
11:19:22.653 -> longitude: 74.72
11:19:22.653 -> Lattiude :14.54 Longitude :74.72
11:19:23.638 -> lattitude: 14.54
11:19:23.638 -> longitude: 74.72
11:19:23.672 -> Lattiude :14.54 Longitude :74.72
11:19:24.784 -> lattitude: 14.54
11:19:24.784 -> longitude: 74.72
11:19:24.831 -> Lattiude :14.54 Longitude :74.72
11:19:25.808 -> lattitude: 14.54
11:19:25.808 -> longitude: 74.72
11:19:25.855 -> Lattiude :14.54 Longitude :74.72
11:19:26.912 -> lattitude: 14.54
11:19:26.912 -> longitude: 74.72
```

Figure 5 Test results of GPS

Results: Expected outcome: Latitude: 14.54, Longitude: 74.7 Actual outcomes: Latitude: 14.54, Longitude: 74.7The GSM module is tested for its accuracy in message traversing to the right person. Test case: To send the message “This message is from sim800L(Sharath)”.

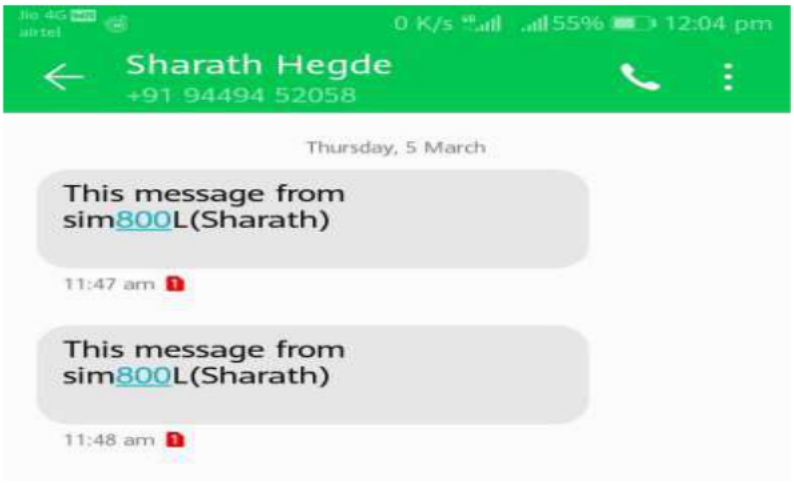

Figure 6 Test results of GSM

5. CONCLUSION

The proposed system works efficiently in the worst scenarios of no network coverage. The system has simple architecture and compact design which makes it easy to handle and reduce its chance of failure. Working of the system requires RSUs to be implanted in the road side light poles to make it work in all scenarios which makes it quite expensive but there nothing in this world more expensive than life.

FUTURE SCOPE

As discussed above, the system does not rely upon network and uses RF communication instead. But it requires all road side infrastructures to equip RSU which is decisive factor. All the RSUs installed needs proper maintenance to work as desired since the proposed system depends on RSUs in worst scenarios. This is the area of research where a new strategy must be developed to maintain RSU or to find alternative to RSU.

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