

Emergency Ad-hoc Network for Rescue Scenarios

G. Karthikeyan¹ R. Kalidoss²

^{1,2}Student

^{1,2}Department of Electronics & Communication engineering

^{1,2}RMD Engineering College, India

Abstract— Disaster remains as the major concern for both loss of property and lives. During disaster times, the affected areas suffer communication failure and it creates a major problem in reaching out to the victims. In order to reduce the impact of such events on communication, ad-hoc network is used.

Key words: Disaster; Communication Failure; Ad-Hoc Networks

I. INTRODUCTION

Ad-hoc networks are the ones that are built spontaneously to connect devices. This reduces the reliability on base stations to forward the messages further, especially at disaster times. In case of emergency situations after a disaster, it becomes increasingly difficult to communicate with the rescue teams [12]. With devices available that time it is possible to establish a local area network and to enable the rescue teams to map the victims. For example, let us consider the 2015 Chennai floods. Post heavy rainfall, the communication lines were disrupted. With many people staggered without a proper means of communication even the areas that were least affected were not able to get the services of the rescue teams initially. So, the major problem is the communication breakdown, and this can be reduced to a greater extent with the introduction of ad-hoc networks where tracking of victims has a higher probability with the communication exchange done between the victim and the rescue teams using intermediate nodes. The current scheme of things considers the possibility of choosing the best algorithms, reducing power consumption and improving efficiency and enabling it further this can be used for tracking purposes both in terms of mobile ad-hoc networks (MANET) and Vehicular ad-hoc networks (VANET).

The principle is based upon the occurrence and detection of the disasters and also to enable the communication which can be possibly affected during a disaster. There have been many instances in the past where the communication lines have been disrupted due to heavy rainfall, high winds, and also possibly due to lack of the resources that a network requires to provide its service. This has been a major problem and has been posing a major challenge in the field of communication. “Ubiquitous connectivity”, the term we generally use has seen a downfall in disaster scenarios. Reliability has been an issue and the features describing a wireless communication has seen a negative side when such events happen.

II. WORKING PRINCIPLE

Disaster management always has the two sides to be improved namely, prevention and relief. With the importance given to both, the set-up has been designed in such a way that it always provides the rescue teams to stay ahead with their plans and to execute their plans quick enough for a

comparatively easier rescue scenario and also enable to provide the necessary information clocked through the features of the technology to design a clear rescue plans further.

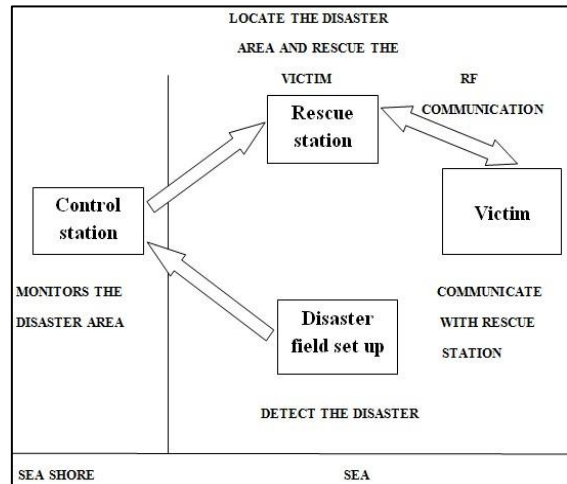


Fig. 1: Basic Working

The above diagram explains the basic working principle. Initially the disaster is sensed by placing sensors, which is depicted as the Disaster field set up. Once the disaster is sensed, it is reported immediately to the Control Station through RF signals. From the Control station

Rescue station is notified and from there the Ad-Hoc Network is established and the victim is tracked down effectively.

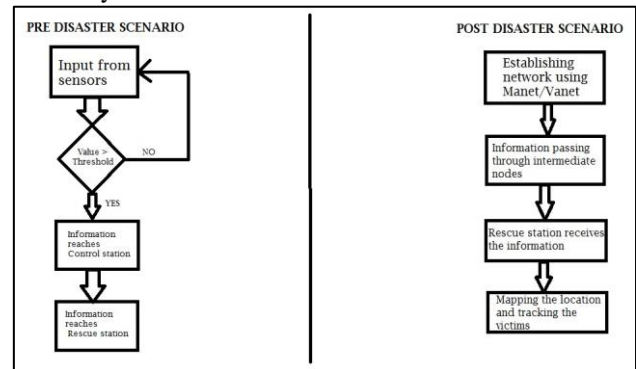


Fig. 2: Flowchart

A. Pre Disaster Scenario

Pre-Disaster scenario analysis greatly helps in reducing the impact of the disaster. The sensors of varying types are planted at different places which enables the data to be collected continuously to monitor the affected place. In general, it can be used to sense the various environmental parameters and if anything sensed abnormal there can be a clear indication to the control station and the rescue station can map it easily. The various environmental parameters that can be sensed generally are the vibrations for detecting earthquakes and other man-made disasters, humidity for

checking the dams' status, temperature for forest fires etc. Also, there are previous regular instances that have been occurring which can be useful in detecting it as quickly as possible. All the parameters that are sensed are initially sent to the control station. Also, the degree of abnormality is measured with respect to the threshold set. As the environmental parameters are analog in nature and the corresponding digital outputs are to be obtained, usage of Schmitt trigger becomes vital. Then the signal obtained from the disaster regions are further demodulated and decoded. This decoded signal is given to the microcontroller and it is recorded in PC. Thus, the recorded value can further be used in rescue stations for mapping purposes. Also, the plot of the affected areas can be made which can support the plans of the rescue teams further. Furthermore, the data collected throughout can be used for analysis which can later result in findings that can support the identification of best available methods handled to avoid or protect the people stranded in a disaster.

B. Post Disaster Scenario

Post Disaster scenario is largely about the rescue operations that can be carried out to save the victims. Previously, various natural and even man-made disaster events have taught that during a disaster most of the available resources and the facilities become inaccessible thus making it difficult for the people to seek help with the existing resources. Recently occurred calamities also proves that the existing resources become idle and probably can't meet the demands of the users at the right time. Such events bring out the challenges that the existing technologies should address to improve the factor of reliability to a greater extent and also to establish a well true meaning of "quality of service" one talks about. In this case, the concept of Mobile Ad-hoc networks and Vehicular Ad-hoc networks (VANET) can be used. So, the communication establishment at a local level is concentrated which further aims at disseminating information at a secure and a quicker pace.

C. Base Station

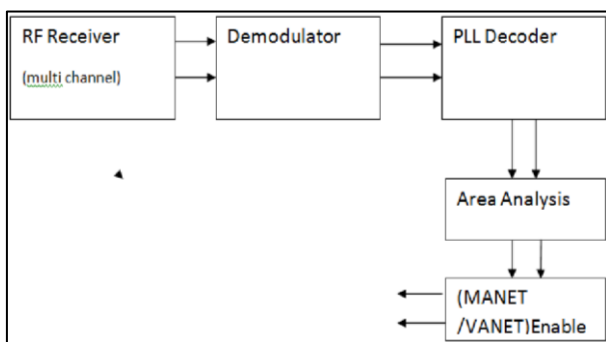


Fig. 3: Block Diagram of Base Station

As shown in the block diagram, the Base Station receives the signal from the Disaster field set up. On receiving the signal it is demodulated and then area analysis is done. Here the magnitude of the disaster is calculated and also MANET/VANET is enabled in the affected areas for communication.

D. Control Station

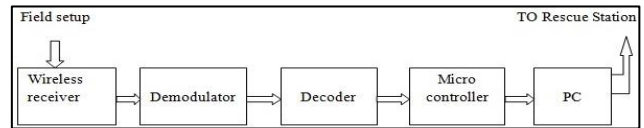


Fig.4 Block Diagram of Control Station

The Control Station also receives signal from the Disaster field setup using a wireless receiver. The received signal is then demodulated and decoded. It pretty much does the same work as the Base Station up to this point. Since the Base Station has done the work of enabling the MANETs/VANETs, the Control Station intimates the Rescue Station to reach out for the victims in the disaster affected areas. The decoded signal is stored and sent to the Rescue Station which consists of coordinates of the area which is affected and needs the help of rescue team.

III. MANETS/VANETS

The usage of MANETs and VANETs has been on an increasing side with the usage being found in some of the applications nowadays. Ranging from military applications to the emergency scenarios [2], MANETs and VANETs can be used to establish a communication spontaneously without any infrastructure. Hence, the concept of MANET/VANET is used here to ensure the transmission of emergency messages in disaster affected areas where the communication lines are disrupted. Also, the message being transmitted between the nodes of the network are encrypted for security purposes [5], so a third party cannot interfere leading to further chaotic situations. This can be ensured by improving various parameters that are to be considered while transmitting a message. A suitable routing protocol is chosen to transmit the messages in an efficient way so that the message reaches the rescue team within short period of time. The major challenge lies in the identification and discovery of the route and hence an efficient routing protocol is chosen.

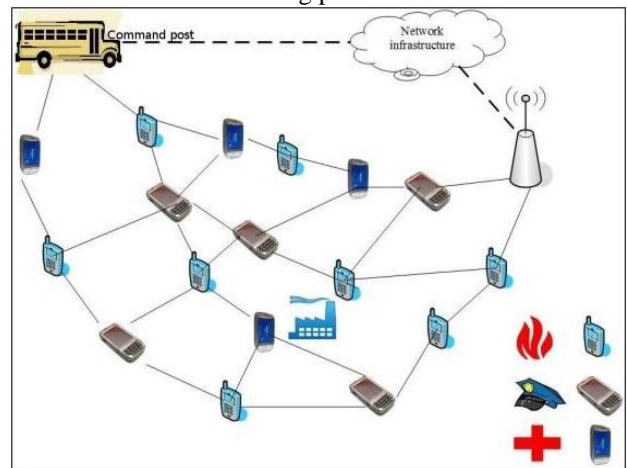


Fig. 5: Establishing Manet/Vanet

Once Ad-Hoc network is established in the disaster affected area, then the victims in that area can have basic communication. With the magnitude of signals being received the victims can be tracked down by the rescue team efficiently and are able to reach them in the time of need of help.

IV. ROUTING PROTOCOL

There are various routing protocols that are existing to serve different purposes. Different routing protocols [1] find their presence at different applications and in this case, there is a need for an efficient as well as “less” consumption in every parameter considered as the available resources in this case is limited, say power or bandwidth.

In case of MANET power becomes a crucial factor as there can be these devices tend to be a fixed in nature in most of the cases and the availability of power can depend upon the magnitude of the disaster. Also, the transmission of the information will be a broadcast type the flooding of message will be a factor to be considered and eventually can result in congestion and redundancy. This can reduce the efficiency of the network and also the capacity of devices are studied to derive a better solution with the existing ones. Satisfying demand of the situation, Location Aided Routing protocol [6][8] edges over other protocols. An energy aware Location Aided Protocol which is regression based [3] can be used because the route discovery and the transmission of messages are very much limited thus not flooding every other node. The location of the node is obtained through GPS [4] [11] [10] and the search space for the new routes can be reduced. Therefore, location aided routing is comparatively the better one that can be used in this scenario.

In case of VANET, as power remains a less impact factor and the other important factor to be considered is mobility. With all factors considered, geographic forwarding techniques [9] [13] can be used and again it can be an efficient way of transmitting information.

V. VICTIM COMMUNICATION

Victim communication becomes crucial as it acts as the source of information. The information has to be passed on an emergency basis and hence in order to facilitate this, the device that the victim probably has will use the selected range of frequencies. The range can be selected depending upon the distance one expects based upon the geographical locations and remoteness of a place and such values remains dynamic in nature, varying place to place. With those selected range of frequency, the devices can be used to establish the communication with the nearby devices. The frequencies are finally generated by mixing the carrier frequency and the modulated frequency. This mixed signal is transmitted [7] to the RSSI at the receiver station. This can be really helpful as the well-established communication lines are disrupted due to the occurrence of the disaster. In addition to the fact that most of the devices do remain idle without serving the actual purpose the involvement of the devices in establishment of the communication can revolutionize the concept of developing a wireless communication further.

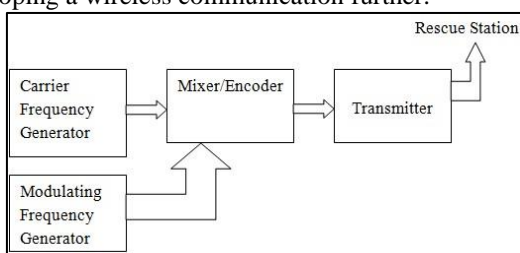


Fig. 6: Block Diagram of Victim's Communication

A. RSSI

Receive signal strength indicator is used to check the intensity of the signal received at the rescue stations. RSSI is a measure of RF power input to the transceiver. This value is based on the gain setting in the receiver chain and the measured signal level in the channel. The concept of inverse relationship between the location and intensity of the signal can be used to track the victims. As the rescue team moves towards the place from where the signal is received, the signal increases. The block diagram depicting the usage of RSSI is given below.

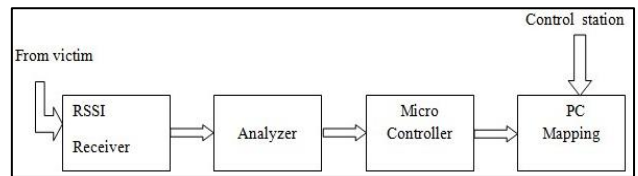


Fig. 7: Rescue Station

The Rescue station uses the signal strength from the RSSI module to track down the victims. As the rescue team gets closer to the victim the signal strength will be more and hence they can reach faster. The entire system of tracking can be plotted in a user interface.

VI. USER INTERFACE

As mentioned earlier the entire process of tracking the victim can be plotted in user interface. Not only tracking, but the area analysis done by the base station and other parameters such as humidity and temperature measured from the sensors, everything can be shown in the user interface.

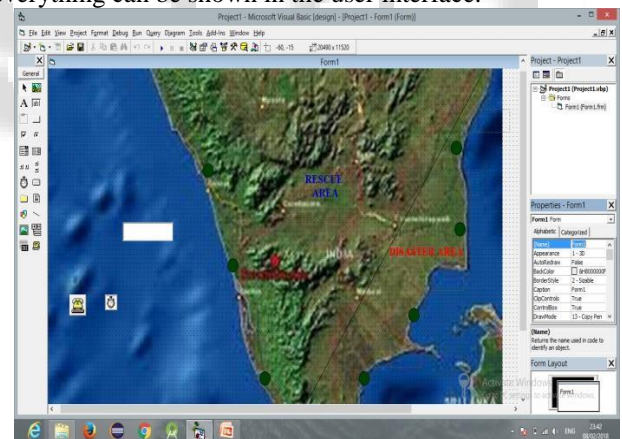


Fig. 8: Simulated Output

The simulated output shown in the figure above has been generated using Microsoft Visual Basic 6.0 Software which is widely used for creating User Interfaces for applications. The Microsoft visual basic is an integrated development environment (IDE) for its component object programming (COM) features. It can be easily programmed making it easier to generate user interface more customized to the required application. In this case the affected areas are plotted in a map and the tracking of victims using RSSI can also be viewed by the rescue team. Also, the temperature and humidity inputs are displayed directly on the view. Other parameters like distance and power consumption can be monitored regularly and can be shown as a graphical output using this software. The software for creating the UI can be

changed as per requirement and ease of use but the model for the UI will remain the same.

VII. CHALLENGES

The major challenge is to choose a suitable protocol. Though many works have been carried out in improvising the quality of the transmission, the compromise of power comes at the cost of reliability. There is a possibility of usage of Cluster based protocol and the fact that the power consumption and redundancy can be greater in this protocol it remains second to that of location-based routing protocols but CBSR is better in case of larger networks. Hence situational analysis can be made and the routing protocols can be chosen accordingly. Selection of frequencies remain dynamic as the power should be considered in this case. Also, the routing has to be modified based on the availability of the nearby nodes and the compensation techniques available can be implemented which remains as a factor to be checked under all disaster scenarios.

VIII. CONCLUSION

This work presents the way of implementing ad-hoc network for rescue purposes. The necessity of communication at important scenarios get satisfied and the challenges in implementation are met to a certain extent. The division of the scenario gives a particular clarity to the problem. Also the study of MANETs and VANETs and their corresponding protocols give a wide range of possibilities for implementing them. This creates a versatile characteristic with multiple protocols finding a place at single application, with the better one being chosen based on the situations.

The future work throws a challenge in parameter control aspects ranging from power to mobility. Also the situation analysis can be improved with various cognitive techniques that can be used to further enhance the environmental awareness of this system. These cognitive techniques can be used to create a healthy information usage technique which further boosts the analytical process of the problem that exists now.

REFERENCES

- [1] Neeraj Verma, Sarita Soni, "A Review of Different Routing Protocols in MANET", *International Journal of Advanced Research in Computer Science*, pp. 338-342.
- [2] Konstandinos Koumidis, Panayiotis Kolios, Christos Panayiotou, and Georgios Ellinas, "ProximAid: Proximal adhoc networking to Aid emergency response", *IEEE* 2015
- [3] Khushboo Singh, Anubhav Sharma, Nikhil Kumar Singh, "Linear Regression based Energy Aware Location-Aided Routing Protocol for Mobile Ad-hoc Networks", 2015 International Conference on Computational Intelligence and Communication Networks, pp.114-121.
- [4] S.Mangai, A.Tamilarasi, "Hybrid Location Aided Routing Protocol For GPS Enabled MANET Clusters", *Proceedings of the International Conference on Communication and Computational Intelligence – 2010*, pp. 404-409.
- [5] Houda Moudni, Mohamed Er-rouidi, Hicham Mouncif, Benachir El Hadadi, "Secure Routing Protocols for Mobile Ad Hoc Networks", *IEEE* 2016.
- [6] Shruti, Uma Kumari, "Few location based routing protocols in wireless sensor network", *IEEE* 2015, pp.749-752.
- [7] H. Li, L. Song, and M. Debbah, "Energy efficiency of large-scale multiple antenna systems with transmit antenna selection," *IEEE Trans. Commun.*, vol. 62, no. 2, pp. 638–647, Feb. 2014.
- [8] Goyal, M., "A modify the directional aware nodes using LAR Routing Protocol & GPS technology in MANET", *IEEE* 2013, pp.909-913
- [9] Jia Meng; Hao Wu; Hengliang Tang; Xingyu Qian "An Adaptive Strategy for Location-Aided Routing Protocol in Vehicular Ad Hoc Networks" *IEEE* 2013, pp 405-410.
- [10] Jitender Grover, Shikha, Mohit Sharma, "Location Based Protocols in Wireless Sensor Network – A Review", *IEEE* 2014.
- [11] Dipankar Deb, Srijita Barman Roy, and Nabendu Chaki, LACBER: A New Location Aided Routing Protocol for GPS Scarce MANET, *International Journal of Wireless & Mobile Networks (IJWMN)*, vol.1, No 1, August 2009.
- [12] Yang Ran, "Considerations and Suggestions on Improvement of Communication Network Disaster Countermeasures after the Wenchuan Earthquake", *IEEE* 2011.
- [13] Saleh Yousefi, MAhmad Siadat MIousavi Mahmood Fathy, "Vehicular Ad Hoc Networks (VANETs): Challenges and Perspectives", 2006 6th International Conference on ITS Telecommunications Proceedings.