Post Disaster Relief Operations using Ad-hoc Network

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Abstract - **World has become ground for various disasters. Irrespective of natural or manmade, disasters cause a huge destruction which results in the failure of conventional communication systems, where the communication infrastructure might be collapsed partially or completely. In such situations, the rescue teams are deployed immediately in order to save human lives. In such scenarios, communication plays a vital role for better disaster response information gathering. To meet such needs we present peer to peer communicating Ad-hoc networks, which doesn't have infrastructure and is very helpful during catastrophic or tumultuous activities. In general, Ad-hoc networks have nodes, long transmission link which again require towers for antennas in order to establish long distance communication. But by using peer to peer communication mechanism, number of nodes are used between the source and destination for long distance communication. This inturn decreases the cost and increases the availability. Since rescue team must be on site where victims reside in order to establish a communication between rescuers and the victims, this is the best and effective way of communication.Hence paves a way for the usage of spontaneous networks like Ad-hoc , which are quickly and easily deployable.**

Keywords: Disaster, Conventional communication system, Ad-hoc network, Tumultuous activities, Spontaneous network.

I. INTRODUCTION

Natural disasters like tsunamis, floods, earthquakes, hurricanes,e.t.c, and manmade disasters like explosion of nuclear reactors, large scale terrorist attacks,.e.t.c., occur around the world where hundreds and thousands of people become victims. When the disaster occurs, the conventional communication systems may be wiped off , cellular network infrastructure, wires gets breakdown, towers go down, and phones go dead, making the rescue operations more difficult. The people will not have any communication with their near and dear ones which creates a panic situation. They are also unaware of weather the rescue teams are near to them or not. The basic solution to this problem is to provide communication for people in disaster area by forming a network temporarily. But in such situation management of existing resources is a challenge for the rescue team. Advanced technologies have to be used in order to overcome this critical situations. There are many disaster information networks which are developed using internet over wired and wireless network. When there is a situation where internet or wired networks are completely unavailable,it is necessary to move for completely wireless technologies. In this project, "Mobile Ad-hoc Network" i.e. MANET which is having wireless communication technology such as Wi-Fi, is proposed. It is an infrastructureless, self-relying network which is composed of individual devices and they communicate among themselves directly. Usage of MANET can provide the communication and it is helpful during the disaster management. We can use smart devices like mobile phones, laptops,. e.t.c. as nodes. When there is increase in number of terminals, they require more power from the source which may not be provided at such emergency situations, so by applying power mode algorithms we can overcome such drawbacks. Mainly this wireless communication doesn't depend on a single topology, they may change randomly. But the feasible technology options are very limited. Use of portable wireless Ad-hoc networks for establishing communication with the aid of existing infrastructure in a post disaster situation in order to coordinate field activities of rescue crews can solve many problems exist
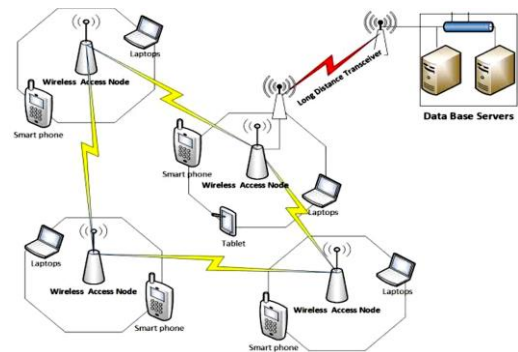

Figure 1. Mobile Ad-hoc Network configuration

Devices which are having wireless communication technologies such as Wi-Fi, are used as nodes or access

ISSN (Online) 2394-2320

International Journal of Engineering Research in Computer Science and Engineering (IJERCSE)
Vol 5, Issue 2, March 2018

points i.e. The nodes might be smart phones, laptops, tablets which can access to the network. architectures such as WSNPDM (wireless sensor network protocol for disaster management and LEACH (low energy adaptive clustering hierarchy),are well known architectures for disaster management. Implementation of these type of architectures can be beneficial for the disaster management.

II.PROPOSED METHOD:

In this project, a prototype device is constructed aiming for the disaster management application and the disaster relief communication .It help to evaluate its function and performance through many disaster applications like Voice Over IP (VOIP), file transfer and text message broadcasting . Prototype system also includes an android application which help connecting smartphones to network. This system might meet many problems that exist in emergency communication systems and it can be improved in different ways for the use of many applications. In Ad-hoc network, if we have communicate for large distance, we have to deploy accessing node with long distance transmission link. This inturn increases the infrastructure and cost. Hence, we come with a solution to go for the peer to peer communication mechanism. For this, we just have to deploy nodes with small range of communication and cover the large distance. By implementing such mechanism we can reduce cost, power, error rate e.t.c,
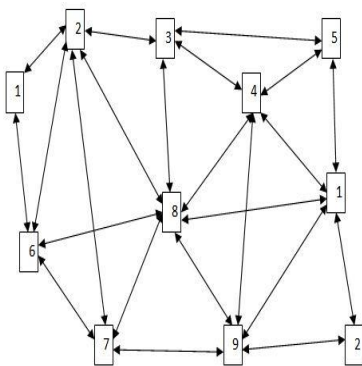

Figure 2. Peer to Peer communication in Ad-hoc Network

III.ARCHITECTURE:

The block diagram of the proposed system is shown in fig.3 .It consists of multiple wireless nodes/devices. Each

node consists of communication equipment which is used for communication between the nodes. The coverage area of each node is approximately 100m to 1km which depends on type of module we use. These nodes are portable and hence makes easy to carry in the field. Nodes have to be maintained within the coverage area in order to organize Ad-hoc network among them. The entire network is connected to a data center through long distance communication links. For better redundancy a network should have more than one node with long distance transceiver. This provides gateway for wide area network through which we can exchange the information at the time of disaster. The application installed in these devices enable various services like peer to peer communication, message broadcasting , VOIP etc. as this application is a software element. Any user can connect with the network by installing this application with a smart phone/tablets. This is mainly aimed for the utilization of rescue members at the time of disaster.

3.1. Wireless network nodes:
Basically, a node consists of two parts .One is for intermodal communication and the other is for user access. The communication between the nodes is facilitated by IEEE802.11b,g,n standard wireless LAN(local area network).Since we are using Zigbee module, each node covers a 100m diameter area and is supportive for Wi-Fi capable smart devices .By using this we can communicate with the nodes that are in coverage area. Further architecture of a node and its specifications are given in below
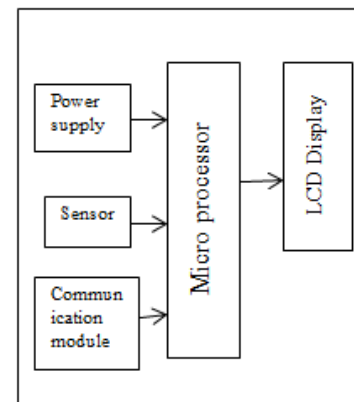
Figure 3.1.1. Architecture of wireless network node

Specifications :

Standard	-	IEEE802.11
Frequency	-	2.405GHz to 2.48GHz

Signal power   -   1 to 100 mW
Transmission speed   -   250kbps
Maximum distance   -   10 to 100m

3.2. Communication link:

Each node is equipped with a sensor, microprocessor, Zigbee unit, transceiver and a user access unit. Here transceiver acts as a link to wide area network. Since satellite communication equipment configuration is bulky and costly, Therefore we are going for Zigbee to make it cost effective for long distance communication link. Zigbee has low data rates and requires a clear LOS(Line Of Sight) for long distance communication. Since we use this network only to transmit the most critical messages and receive the important data from the nearby network node of same type, Zigbee will be the perfect choice. XBeepro 868 module is used for implementing Zigbee for long distance communication. This module is connected to the node via arduino uno module through arduino uno supportive xbee shield. The arduino convert erial to Ethernet in order to provide long distance transceiver data through nodal ip network. Ethernet shield is placed in between arduino board and node for the better conversion of serial to Ethernet. As we know that zigbee has low data rates i.e. its data rate ranges between 20-250 kbps, long distance communication might be limited, because long distance communication requires high data rates. Therefore this method is effective only for transmitting broadcast text messages /update text messages.The multiple wireless nodes are connected mutually and automatically by auto configuration function by using different protocols. This results in the effective connectivity of one node with the neighboring nodes. Node will be connected with neighboring node which has strong electromagnetic field power density and this process is repeated to organize minimum spanning tree network. Therefore, an Ad-hoc network is organized in the disaster area. When the neighboring node moves or failed, then the node will selects the best neighboring node automatically by the same procedure as above. Hence , dynamical reconstruction of communication in wireless Ad-hoc network is maintained.

3.3. AODV Protocol:

Ad hoc On-demand distance vector routing protocol is a reactive protocol i.e. routes are determined only when needed. Any message (hello) is used to detect and monitor links to neighbors. For example, "HELLO" message is broadcasted to all its neighboring nodes and further these nodes repeat the same until the message reaches the destination node. If any one of the node fails then there will be a link break detected then an error message is sent to the source node in a hop-by-hop fashion. If the failed node is inactive for some period of time then the inactive node is removed from the predetermined route and the source node reinitiates the new route.

3.4. Android application:

An android application acts as an interface between network and the user. This application has all the network facilities. When we start a service on a local device, it reserves a given name and then advertises its existence to other devices within its range. The framework used in the application is responsible for the service of advertising operation which leads to transparency in communication via technologies such as Wifi, Wifi direct. The knowledge of how these advertisements are managed is not required both user and the service.

3.4.1. Basic services of android application:

Android application provides some basic application to achieve effective communication in the network. Some services are listed below
1. Voice calling
2. Sending and receiving of data.
   • Individual messaging
   • Peer to peer messaging
   • Group messaging
3. Transfer of files. e.t.c.

IV. PROTOTYPING SYSTEM AND EVALUATION:

From the previous study, we could derive that the Ad-hoc network is very much robust and most effective to quickly construct disaster management system. The prototype is constructed in order to evaluate whether peer to peer communication can reach out the long distance without any failure, error/ loss of information within minimum time.
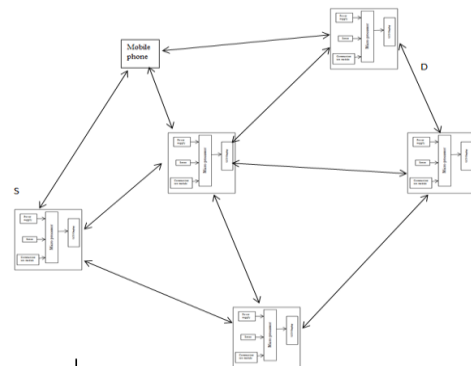

Figure 3.Block diagram of proposed method

In the above figure 3, we can see a small network which has peer to peer communication between the nodes. Each node has a Zigbee module, which transfers the data to the neighboring nodes within the range. In order to check this prototype we have connected a mobile phone to the network and send a message from it. Each node will get the messages which are in the range and by repeating this we can transfer messages to long distance. In case if there is any failure of one node in the network, the path changes and reach out the remaining nodes within the range.

Figure 4. Prototype system

In the above figure 4, we observe four nodes which are separated with some distance. Power supply is provided to each node in order to activate them. Mobile phone is connected to this network in order to transfer the information to nodes. An input message is given using an android application in phone and see the transfer of the same message to all the nodes. This is shown in the figure below
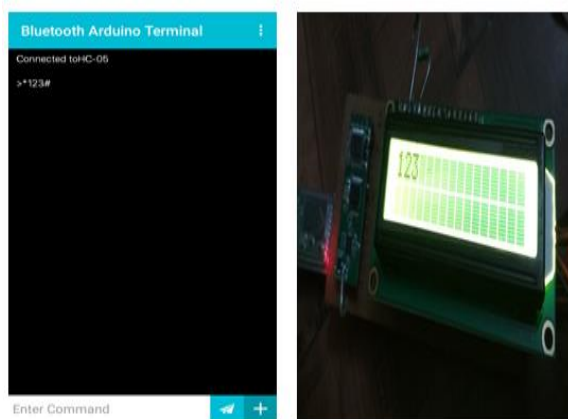
Figure 5. Results in android application and node display unit

V. CONCLUSION:

In this paper, we suggested a post disaster management system where various information with the disaster are provided. The system configuration and the architecture of the proposed method are described and their functions are explained keenly. The prototype system based on our suggested configuration was built to demonstrate its functionality. Peer to peer communication between the nodes helps to eliminate the usage of infrastructure like antennas, poles e.t.c., Now we are trying to implement more resource management at the time of post disaster. As a future research, evaluation of the more realistic and practical case where nodes are seriously damaged, implementing the recovery system for the partially damaged network, reducing the power consumption for efficient use, providing secure network which extend the scope of utilization of this system in military, defense, various security and monitoring applications.

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