Wireless sensor networks for disaster management

Abstract –The world we are living is an event for disasters daily. Some of the disasters are naturally occurring and some occurring due to man-made catastrophes. So not only nature but also human beings are equally responsible for the happenings of these disasters. With the developments in the technologies it is very much possible to find a way to tackle these disasters. Wireless Sensor Networks (WSN) can be used in the developments of disaster management. Hence there is a need for development of a system for the disaster control and management. Also, keeping in mind about developing a structure which is efficient in terms of functioning and the costing. With this paper, we attempt to present some literature study and methodology used by other authors and find the pros and cons in their study. Also, we try to formulate an analysis of the proposed studies.

Keywords-Wireless Sensor Networks (WSN), Disaster management.

Introduction

With the advancements in the WSNs it is possible now to detect and monitor various parameters in our surroundings. The sensors in a networks help us to monitor and keep track on the various paramenters. These parameters include temperature for fire detection, flow mesurement for detection of floods, Global Positioning System (GPS) for location trackink to name a few. With the monitoring of these parameters we can detect any disaster and with the network implementation we can be able broadcast the information. The broadcasting of information would help to reach many people and will alert the people, so that they can move to a safer place. In this paper we will be discussing about the iplementation done in the field of disaster

management and would be focussing on the various aspects of the WSNs. The architecture details, componets used, networks used are some of the things to be discussed. Other than WSN, the use of Ad-hoc relay station, mobile communication, base station functions, cell and cluster functions are also being discussed.

The implementation of Wireless Sensor Network (WSN) in a system has been done by many researchers over the years and there are various techniques of implementing them. Development and updating of technologies has made this even more possible. A. S Bhosle et al.[1] presented classification of various sensors depending upon its function and about the different types of WSN protocols. The network consists of wireless sensor nodes, sink nodes, base stations, a gateway for information transferring, a backbone network and an observer at the output side. The WSN protocols are responsible for the communication between a sensor and the network devices in a network. The sensors can be classified based on their physical properties. These include the flow, positioning, temperature, pressure, acceleration etc. D. V Kishore et al. [2] discussed about the problems of disasters occurring at a mine or excavation location. The main concern in the article was about the blasts occurring in the mines and the consequences of that being an increase amount of air pollution, noise pollution and an increase in the chances of accidents in the mine area. They provided a hardware architecture using the traditional electronic components and with the help of that demonstrated the ways of tackling a mishap. S. Saha et al. [3] proposed an architecture which was based on mobile communication network. The use of mobile communication concepts like cluster, cell, base station and

frequency usage was discussed within the architecture. S. Rasaneh et al. [4] proposed an energy resourceful model and implementing the model with an additional communication network would make it more efficient. The model implementation included a hybrid network and a multi hop routing technique for the efficient energy usage. Also, the model implementation included deployment of sensors in various types of environments and depending upon that the sensing operations can be performed. With the use of multi-hop there will be less chances of signal loss or distortions. Thus, in this way the model can become more efficient. S. M. George et al. [5] proposed a Distress network for disaster management and the system architecture consists of 3 components; a Body Net, Sense Net, Vehicle Net & Area Net. Body Net is a body worn WSN device which is used to keep a continuous track on the various aspects of a person like heartbeat, blood pressure, location etc. Sense Net is used for sensing the data and is mainly used keeping track of the monitored data. Vehicle Net is responsible for the detection of any disaster is also responsible for the transmission of information. Area Net is used for carrying large volumes of data and as it supports large bandwidth so that helps in sending images, videos and audio data. Kaur, Harminder et al. [6] proposed an architecture consisting of a cluster, an Ad-hoc network, base station, antenna and a satellite. Using these components an efficient disaster can be created. The architecture works on the principle of multi hopping.

After the literature analysis of various articles, we now focus on the methods used in the implementation part of the article. A. S Bhosleet al. [1] in his proposed model demonstrated a disaster about when fire breaks out.

Consider in a network, there is a fire exposed area there are more than one sensors to sense the fire, these sensors can for example: – thermistor, RTD, thermocouple etc. The wireless sensor node detects the fire and searches for the nearest sink node, then the sink node verifies the collected data with its predefined threshold value. If the threshold value is less than the received data, then a warning signal is send to the end user via base station and the backbone network. If the threshold is greater than received data, then an emergency message is send to the end user via base station and backbone network. D. V Kishore et al. [2] proposed a hardware architecture which had a transmitter and a receiver section. The sensors collected the sensed data as per their property, the various sensors deployed were gas sensor, light sensor, temperature sensor and vibration sensors. The sensed value is converted to digital form by the analogue to digital converter and then is given to the multiplexer, the multiplexer then encodes all the sensed values and sends them to the transmitter and then the transmitter antenna transmits these values to the receiver section. The receiver antenna receives the transmitted values and these values are send to the de-multiplexer. The de-multiplexer then decodes the values and sends them to the microcontroller. The microcontroller then sends the decoded values to the output devices and we can see the output. S. Saha et al. [3] in proposed a heterogenous hybrid model of a network and sensors. The focus was providing a better network coverage and to limit the usage of Ad-hoc relay station (ARS). This was achieved by simply placing the ARS at the edges of the cell and with that the ARS was shared by multiple cells. Sensors nodes were placed in a cell to sense various parameters like temperature, vibrations, location, light intensity etc. In a disaster situation, the sensor

nodes help in detection of the survivors. After detection, the information is passed to the mobile communication network and the ARS and the base station are responsible for the effective communication between the network. S. Rasaneh et al. [4] proposed a structure using a simple cluster model of a communication network consisting of sensor nodes, head nodes, second level head nodes and base station. The sensor nodes are used to sense different functions accordingly; these are seismic vibrations for earthquake, temperature for fire, flow measurement for floods, weather sensors for humidity etc. In a disaster situation, the sensor nodes in a cluster firstly sense the various parameters as per their individual sensor properties and then send the collected data to the second level cluster head and then a cluster head receives all the data from other second level cluster heads from every cluster. Then, the base station receives all the data from the cluster heads. The data is send from a second level cluster to the cluster head to have an efficient data flow without any signal losses. This structure uses the multi-hop technique so that data can transmission can be done efficiently. Kaur, Harminer et al. [6] proposed an architecture involving usage of a mobile network, radio and satellite communication. During any disaster, the sink nodes collects data from the local sensors and ARS. The data is then collected by the base station with the help of the sink nodes in the network. The base station sends the data to the antenna and the antenna broadcasts the signals to the satellite. The satellite then sends the warning about the disaster to the local hospitals and the ambulance.

There are various gaps in the above discussed articles. We cannot be relying on an architecture that is a hardware based as within any kind of disaster it

cannot be accurate and depending upon the intensity and how powerful the disaster is the hardware with not withstand and would surely be damaged. Also about the deployment of ARS in the edges of cell, then the signal handling capacity of the ARS gets affected and this produces latency in the network. This affects the performance of the architecture. In the fire disaster system, the distance between the cluster and the operating network is very large and if there is any latency introduced in the network, then it would be very late for the signaling about the disaster.

With the developments in the field of Wireless Sensor networks we can surely be opting on trying and formulating new ways to find solution to these problems. Also with the ongoing problems in terms of disasters there is a need to do to. After the study, there are still many developments that can be done in many aspects of the architecture, technology used and the components used. The focus must be on trying new developments and if possible go to find the solutions of the current problems related with the disaster management. WSN can help in predetermining of the any disaster and we can then alert everybody about it.

References

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