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A New Approach to System Design for Disaster Management and Monitoring using Wireless Sensor Network

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Abstract

WSN are simple continuous monitoring system and it is now become new technologies for disaster management. In this paper we propose the different model for the disaster scraps detection based on the energy efficient architecture which can successfully monitor any type of disaster situation. This model focus on sensor nodes which are used former to a disaster and central nodes are installed in nearby for the emergency operations. Different centres and ports are linked to the sensor network databases which query the sensor nodes following a disaster. In that situation, rescue teams are assigned one mobile central node and guided to a region based on the data in the sensor network database. In this paper we will focus on the disaster monitoring and disaster managing operations through wireless sensor networks.

Keywords: disaster management, wireless sensor network, energy efficient architecture, sensor nodes, monitoring.

Introduction

WSN commonly occur a large number of small, low-cost sensor nodes dispersed over a wide area. The sensor nodes are mixed with sensing, processing and wireless communication capabilities. Each node is usually equipped with a wireless radio transceiver, a small microcontroller, a power source, and multi-type sensors. These components enable a sensor node to sense the environment, communicate and exchange sensory data with other nodes in the area, locally process its own data and make smart decisions about what it observes. This will lead to detection of events and unusual data behaviours whenever and wherever they occur. This feature is called event detection. Event detection functionality of WSNs has attracted much attention in variety of applications such as industrial safety and security, meteorological hazards, and fire detection.

In monitoring system the equipment used for detection is the heart of the work. The monitor system devices are installed in different places. Sometimes it is not easy to install equipment in some areas for many reasons such as lack of access to power or unable to connect to signal wiring. In addition, tools used for measurements are very expensive. To resolve this problem, a wireless sensor network can be implemented to help in data communications. The advantages of using a wireless network are: using less energy, no need for hardwiring, and high transmission distance.

Now, the wireless sensor network is cheaper and more efficient then other systems, the high flexibility can be used in various ways depending on the need to measure different values in the environment, it can be used to measure the amount of carbon dioxide using gas sensors. In structure measurement, it can measure the motion of buildings. Or in the military, it can be very important as it uses a large number of sensor nodes to scatter in battlefield to measure temperature, vibration and movement of enemy spies and so on.

WSN Architecture Overview

The proposed WSN system architecture for flood forecasting mainly consists of sensors, which sense and collect the relevant data for calculations, some nodes referred to as computational nodes which have large processing powers and implement our proposed distributed prediction algorithm and a manned central monitoring office which verifies the results with the available online information, implements a centralized version of the prediction algorithm as a redundancy mechanism, issues alerts and initiates evacuation procedures. Different types of sensors are required to sense water discharge from dam, rainfall, humidity, temperature, etc. The data collected by these sensors are used in the flood

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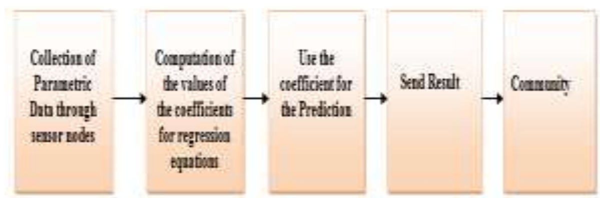
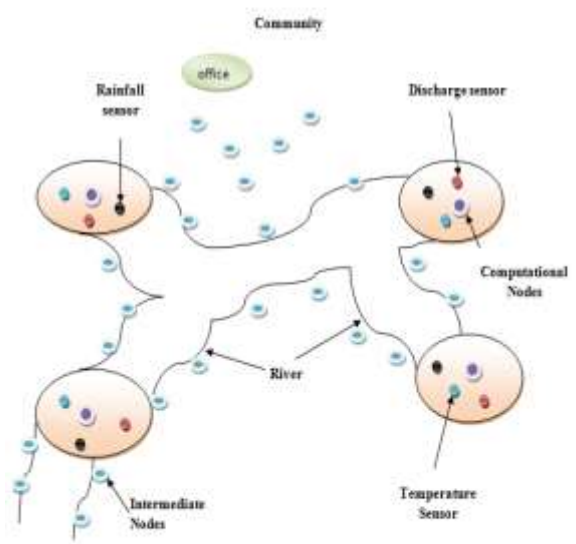
prediction algorithm. The computational nodes possess powerful CPUs required to implement the distributed prediction model. The computational nodes are supposed to communicate the prediction results to the monitoring node. They also have communication between themselves for detecting malfunctioning of nodes. The work of the central node is not our concern. However it is important to include a manned central node in this whole process to raise the alarm and co-ordinate evacuation measures if needed [16].

Figure1:



A Complete Flow chart for transferof Information & data from sensors to the human community

Figure2:



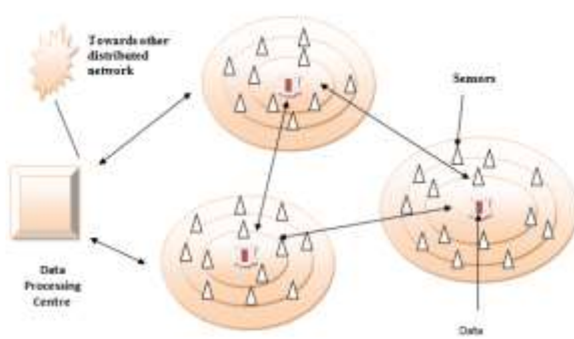
WSN approach for flood prone area.

The next important aspect is to minimize the effect of a node failure while connecting the computational nodes to the central. Intermediate nodes have to be deployed to ensure this connectivity in case the central does not fall within the communication range of all the nodes. Fig2 is the entire picture of the WSN at site is given. As we can see the river has been broken into several monitoring zones. In each zone, a sensor node collects data and sends them to its computational node. Data collection and localized prediction takes place at each computational node. The computational nodes then send the data to the central office node and also share it among themselves

WSN for Food and Water Level Monitoring

Each year floods cause loss of thousands of lives and billions worth of property in India. Last year, major loss of human lives, cattle as well as billions worth of establishments was reported in the floods in Bihar and West Bengal[17]. Each year both Ganga and Yamuna break their boundaries and cause numerous losses. Although all these losses cannot be eradicated fully but the losses to lives and property can be reduced to barest minimum level, if the protective measures can be taken before the disaster has struck in the form of flash floods. This can be made possible with the help of communication technology employed on top of wireless sensor networks. The system development involves the various phases and of course, all phases are equally important. Starting with the first phase of data collection, level one is to deal with the physical deployment of sensing devices in the riverbanks and implementation of an effective localization scheme depending on the situation and environment. The flow path of the river, past records of water flow and future prediction of the route of the river, influence the placements of the wireless sensors. These sensors form clusters to communicate with the local base stations. The local base stations are powerful enough to communicate with one another directly using wireless communications.

Figure3:



WSN aggregation and data collection approach

The data sent from the sensors are aggregated in the local base stations to provide as inputs to the data processing centers. Fig.3 shows a pictorial view of the deployment of sensor nodes and data aggregation.

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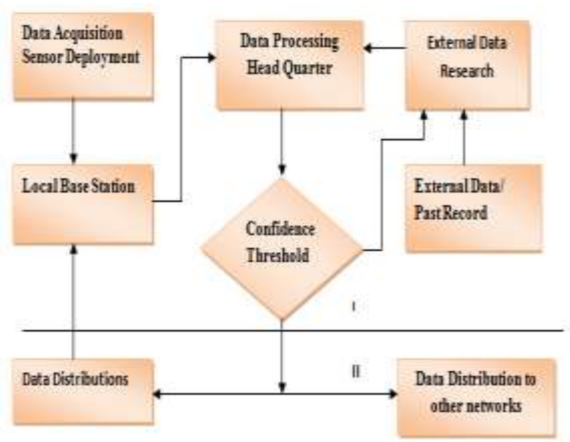
Level two deals with the setup of local base stations as well as with data communication at district level. Level three could be involved with the central monitoring system at the headquarters to process acquired data. Data analysis then takes place either at headquarter or at outside research centers that particularly do high-risk flood analysis. Fig.4 shows various phases used for monitoring system[17].

Figure4:



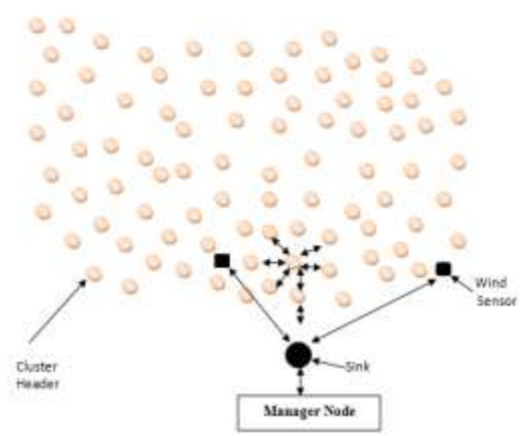
A new approach for smart WSN

WSN for Forest Fire Detection

Forest house millions of rare species of animals, birds and insects. Forest fires cause not only the loss of their shelters but also cause huge loss to flora and fauna. Forest fires are common in the middle ranges of Himalayan region of India due to Lightening, excessive heat or carelessness on the part of local natives. There have been numerous occasions when the forest fires broke out due to the negligence of the natives in Uttarakhand, Chhattisgarh, and north-eastern states. Although it is almost impossible to put off raging fires, but the calamity can be averted provided the information about the site of the fire can be immediately sent to the nearest control centre and adequate measures be taken to control it, before it engulfs everything. A large number of sensor nodes are densely deployed in the forest. These sensor nodes are organized into clusters so that each node has a corresponding cluster header. Sensor nodes can measure environment temperature, relative humidity and smoke. They are also assumed to know their location information by equipment's such as Global

Positioning System GPS. Every sensor node sends measurement data, as well as the location information, to the corresponding cluster head. The cluster header calculates the weather index using a neural network method and sends the weather index to the manager node via sink. The sink is connected to a manager node via a wired network. A few wind sensor nodes are manually deployed over the forest and connected to the sink via wired networks to detect wind speed. The manager node provides two types of information to users: (1) Emergency report for abnormal event (e.g. smoke or extremely high temperature is detected); (2) real-time forest fire danger rate for each cluster based on the weather indexes from the cluster header and other forest fire factors[17].

Figure5:



WSN for forest fire protection

WSN for Earthquake Sensing

Mass destruction of human lives and property happens when earthquake strikes. The most ferocious earthquake that happened in India was on 26th January, 2001 that rattled not only India, but the other neighbouring countries like Pakistan, Afghanistan and Iran also couldn't escape its fury. Lakhs lost lives, limbs and cattle and loss to the property was unaccountable. Though loss to the property cannot be ruled out, but many precious human lives can be saved by timely action. System architecture for our approach has been shown in Fig.6 each sensor detects earthquake event every sampling period based on seismic frequency spectrum. To handle the earthquake dynamics such as highly dynamical magnitude and variable source location, each sensor maintains separate statistical models of frequency spectrum for different scales of seismic signal energy received by sensor

Figure6:

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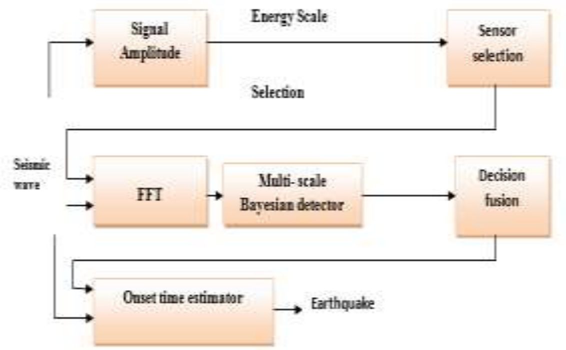

latest approach for earthquake monitoring system

Various studies indicate that the frequency-based detector has better detection performance when the sensor receives higher signal energy. Therefore, it is suggested that, the base station first selects a minimal subset of informative sensors based on the signal energies received by sensors while satisfying system sensing quality requirements. The selected sensors then compute seismic frequency spectrum using Fast Fourier Transform (FFT) and make local detection decisions which are then transmitted to the base station for fusion. In addition to the detection of earthquake occurrences, node-level earthquake onset time is critical for localizing earthquake source. In this approach, the base station first identifies an individual earthquake and estimates a coarse onset time.

Results and discussion

The predicted values of river-levels are found to be extremely close to those measured from the sensors. Therefore, only one line can be seen for both the actual and the predicted lines. Only once the river water level crossed the flood line signalling the onset of flood as shown in Fig. 7. False alarms are not generated in any predicted values justifying the reliability of our scheme. Due to lack of actual real time data showing variation of several different parameters varying with the water level, we have simulated the regression model for water level with reference to two parameters only-rainfall and discharge from dam. Now we calculate the difference in the actual and predicted values to find the error. The fig 8 below shows the percentage errors in predicted water level at different time instants compared to the actual water level measured at those instants

Figure7:

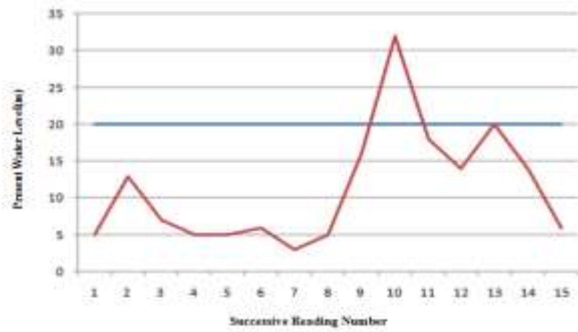

Chart show actual and predicted values of water levels.

Figure8:

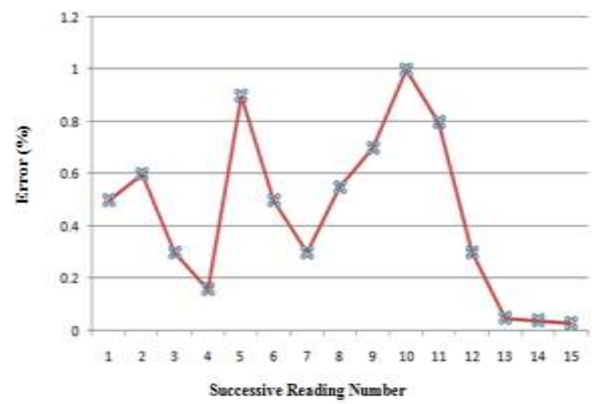

Chart Shows Percentage Error in Predicted Water Level to the measured water level.

As seen above, the mean error is about 0.5% with the maximum error less than 1.2% which is excellent for any forecasting algorithm. The weighted root mean square error is found to be around 0.4%. Finding the weighted root mean square error also helped us identify readings in which data was corrupted, thus giving minimum or no weightage to those readings.

Conclusion

The WSN is commonly used for monitoring and detection of disaster prone areas. WSN can be proved a very good technology where other technology or applications fails due to disaster impact. WSN can be used to locate the victim and it may help the rescue agents to assess the victims and to make effective plans. WSN is not only helping to make disaster recovery plans but also disaster prevention methods.

In our paper we have highlighted the WSN architecture, its characteristics, kind of disasters and how we can address them by using WSN. This paper will be helpful for Indian scenario because India

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somehow lacks in infrastructure and impacted from disasters due to its old and under developed infrastructure, changing climate and high population is also a strong reason, also it is prone to adversary attacks from different countries.

References

1. *X. Luo, M. Dong, and Y. Huang, "On distributed fault-tolerant detection in wireless sensor networks," IEEE Transactions on Computers, vol. 55, pp. 58-70, 2006.*
2. *F. Martincic and L. Schwiebert, "Distributed event detection in sensor networks," in Proceedings of the International Conference on Systems and Networks Communication, 2006,pp. 43-48.*
3. *M. Bahrepour, N. Meratnia, and P. J. M. Havinga, "Fast and Accurate Residential Fire Detection Using Wireless Sensor Networks," Environmental Engineering and Management, vol. 9, pp. 215-221, 2010.*
4. *M. Marin-Perianu and P. J. M. Havinga, " D-FLER – A Distributed Fuzzy Logic Engine for Rule-Based Wireless Sensor Networks," Springer Verlag, Germany, 2007, pp. 86- 101.*
5. *A. Khelil, F. K. Shaikh, B. Ayari, and N. Suri, "MWM: A Mapbased World Model for Wireless Sensor Networks," in Autonomics Turin, Italy 2008.*
6. *M. Bahrepour, N. Meratnia, and P. J. M. Havinga, "Sensor Fusion-based Event Detection in Wireless Sensor Networks," in SensorFusion'09, IEEE, Ed. Toronto, Canada, 2009.*
7. *S. J. Russell and P. Norvig, Artificial Intelligence: A Modern Approach, 2 edition: Pearson Education 2003.*
8. *Wireless Sensor Networks for Emergency Navigation, Yu- Chee Tseng, Meng-Shiuan Pan, and Yuen-Yung Tsai*
9. *Kewei Sha; Weisong Shi; Watkins, O.; "Using Wireless Sensor Networks for Fire Rescue Applications: Requirements and Challenges," Electro/information Technology, 2006 IEEE International Conference, pp.239-244*
10. *Drought forecast model and framework using Wireless Sensor Network by Journal of information science and engineering 22, 751-769, 2006*
11. *How secure is your Wireless Network? Safeguarding your wi-fi LAN, Lee Barken, 2004 Literature Survey on Wireless Sensor Networks-July 16, 2003.*
12. *Wireless Sensor Network Security, A survey Security in Distributed Grid and Pervasive computing. Yang Xiao, (Eds) pp. 2006, Auerbach Publication, CRC Press*
13. *A Survey on Secure Localization in Wireless Sensor Networks: Avinash Srinivasan & Florida Atlantic University, FL USA.*
14. *Harper, M., The use of thermal Desorption in Monitoring for the Chemical Weapons Demilitarization Program. Journal of Environmental Monitoring 2002**,** 4, 688-694.*
15. *Siegmund M. Redl, Matthias K. Weber, Malcolm W. Oliphant,"an introduction to GSM", Boston: artech House, 1995 [3] Vijay K. Garg, Joseph E.Wilkes,"principles and applications of GSM", Prentice Hall, 1999*
16. *Victor Seal, Arnab Raha, Shovan Maity, Souvik Kr Mitra, Amitava Mukherjee and Mrinal Kanti Naskar, "A Simple Flood Forecasting Scheme Usingwireless Sensor Networks" International Journal of Ad hoc, Sensor & Ubiquitous Computing (IJASUC) Vol.3, No.1, February2012*
17. *Harminder Kaur, Ravinder Singh Sawhney, Navita Komal "Wireless Sensor Networks for Disaster Management" International Journal of Advanced Research in Computer Engineering & Technology Volume 1, Issue 5, July 2012*