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Energy Efficient Outlier Detection In WSN

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Abstract

A wireless sensor network consist of large number of nodes that possesses very small battery life and data processing capabilities but these microelectronics system are capable of measuring physical and various environment related consequences like sound, pollution causing agents etc.Energy efficiency is the major aspect that needs to be taken care of while developing any protocol for the WSNs. This is because of the fact that the SNs are highly constrained in terms of power and their batteries are generally neither' replaceable nor rechargeable.We will study sensor rank scheme and will make an efficient algorithm and also compare it with the original one under the same simulation conditions. We will also add the concept of clustering and added the cluster head.

Keywords: Wireless, Sensor Nodes, Outlier, Clustering, Gateway

1.INTRODUCTION

A wireless sensor network consist of large number of nodes that possesses very small battery life and data processing capabilities but these microelectronics system are capable of measuring physical and various environment related consequences like sound, pressure, motion, pollution causing agents etc. Wireless sensor network can be utilized in a wide variety of military applications such as war field monitoring and many more application like chemical spill prevention, heath care application, nuclear plants and traffic control etc. In surveillance applications, sensors are deployed in a certain field to detect and report events like presence, movement, or intrusion in the monitored area. Data collected by sensors are transmitted to a special node equipped with higher energy and processing capabilities called "Processing Node" (PN) or "sink". The processing node of wireless sensor network collect and compare data from various sources i.e. sensor nodes and thus extracting useful and meaningful information. In the architecture SNs are grouped into clusters controlled by a single command node. In wireless sensor network the sensor nodes are capable of doing only short distance communication which is radio based and responsible for detecting any target or event.

Every cluster has an entryway node that manages sensors in the cluster. Clusters can be formed based on many criteria such as communication range, number and type of sensors and geographical location. Sensors receive commands from and send readings to its gateway node, which processes these readings.

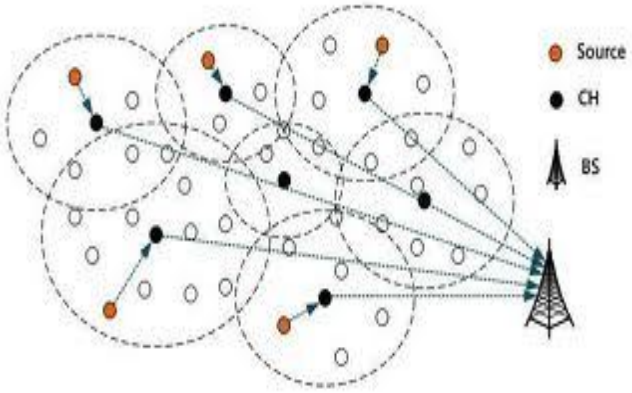


Figure 1: Sensor Network Architecture

Gateways can track events or targets using readings from sensors in any clusters as deemed by the command node. However, sensors that belong to a particular cluster are only accessible via the gateway of that cluster. Therefore, a gateway should be able to route sensor data to other gateways. Gateway nodes interface the command node with the sensor network via long haul communication links.

Outlier detection refers to the method of looking for problem in data of any event related to network in our case. These anomalous patterns are often referred to as outliers, anomalies, discordant observations, exceptions, faults, defects, aberrations, noise, errors, damage, surprise, novelty, peculiarities or contaminants in different application domains.

In WSNs, outliers can be defined as, "those measurements that significantly deviate from the normal pattern of sensed data" [1]. This definition is based on the fact that in WSN SNs are assigned to monitor the physical world and thus a pattern representing the normal behaviour of sensed data may exist. Potential sources of outliers in data collected by WSNs include noise & errors, actual events, and malicious attacks.

When the complete data is analyzed as per the central data approach by any central authority outliers can be identified properly and can be tackled appropriately at the corresponding station. When type of data is considered the outliers can be classified as local and global outliers:

Local Outliers: Taking the point that local outliers are recognized in wireless sensor network at individual sensor nodes, techniques for reducing communication overhead and maintaining scalability of network with proper

determination of outliers is important. Many event detection applications, for example, vehicle following, surveillance and monitoring can be done using local outlier detection. Local outlier identification has two variations in wireless sensor network. One variation is that historical values are used for determining the wrong or faulty value in the given sensor network. Another option is adding historical reading of their own; where the value of neighbor is taken to determine the value is proper or not i.e. the anomaly is based on the feedback from the neighbor node. When compared with the second approach the first one lags as it doesn't provide that much accuracy and robustness in the detection of outliers.[6]

Global Outliers: Global outliers are popular as they have global perspective and also they draw more attention as they focus on the complete characteristics of WSN instead of working locally like local outlier. On basis of different network architecture, different type of identification can be done on many nodes. All the data collected id transmitted to sink node in the centralized architecture. It delay the response time very much and cause a lot of communication overhead. Cluster head collect the data and identifies outlier in cluster based approach. It has better response time and energy consumption as compared to the former one.[2,3]

2.PROBLEM FORMULATION& OBJECTIVE

Energy efficiency is the major aspect that needs to be taken care of while developing any protocol for the WSNs. This is because of the fact that the SNs are highly constrained in terms of power and their batteries are generally neither' replaceable nor rechargeable. The system model of trust voting algorithm with clustering to detect outlier nodes in WSNs takes a keen care of this issue.[4, 5] Generally, protocol complexity, node deployment, heterogeneity, requirement of GPS device, etc. are major issues for a given system model. The proposed model saves energy by using the concept of clustering with Sensor Rank [5]. As the proposed model will use the concept of clustering in which the main purpose of adding the static clustering is to provide energy-efficiency for making clusters and using a probability function for CHs election. In this we will have fixed number of clusters and will carry out the simulation accordingly with the goal to make algorithm more efficient.In this research we study few of outlier detection techniques to identify outlier in WSN. The summarized objective of paper is as follows.

- The objective of our work is to find an Energy saving method for outlier detection in WSN.
- As the SNs are limited in energy so we will try to use cluster head (CH) to save all the outlier detection reading found in the cluster.
- Main focus will be to find the Inter-Cluster Outlier in the wireless sensor network.
- Implement the proposed energy saving algorithm for abnormality detection in MATLAB.
- Simulating already present method sensor rank in MATLAB under same condition and comparison of our algorithm with the same.

3. PROPOSED WORK

The Pseudo code of Proposed Model is as Follows:

Step1: Start and deploy a sensor network of hundred nodes in the .m file created in MATLAB.

Step 2: next step is creation of clusters as per the proposed methodology with constraint of immobile sensor nodes.

Methodology: selection of a cluster head on the basis of distance nearest to the sensor nodes and thereby making clusters.

Step 3: calculation of rank of each sensor node using Sensor Rank [57].

Step 4: applying trust voting algorithm to the network created up to step 4 consisting of two steps:

a. Current reading vector is confirmed using self-Diagnosis phase.
b. In the second phase i.e. Neighbour diagnosis phase the vote of nearby nodes are given weightage as per their sensor rank i.e. higher rank higher weightage.

Step 5: For each vote association, $asso_{i,j}$, following formula is used to determine whether the reading is faulty or not.

$$dec_i = \sum_{S_j \in nei(i)} Asso_{i,j}.vote_j \qquad (i)$$

ifdec_i= +ve, node's reading is normal.

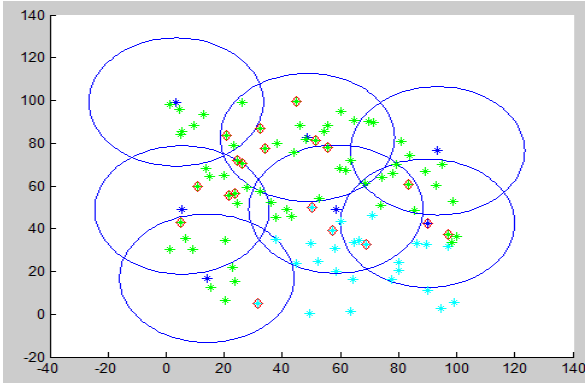
Otherwise, *dec*=-ve, implying that the current reading of node is faulty.[57]

Step 6: Collection of outlier data within the cluster using CH, it will send data to the base station located away from the network taken as assumption in the simulation. Aggregated data from the BS can be broadcasted to every cluster head, thereby recognising outliers simply and efficiently.

Step 7: Stop

4.SIMULATION AND RESULTS

The model is simulated in MATLAB 7.8.Initially we created a network based on in which nodes are distributed randomly. Now Clusters Heads are elected from the given network and clusters are made based on [58].



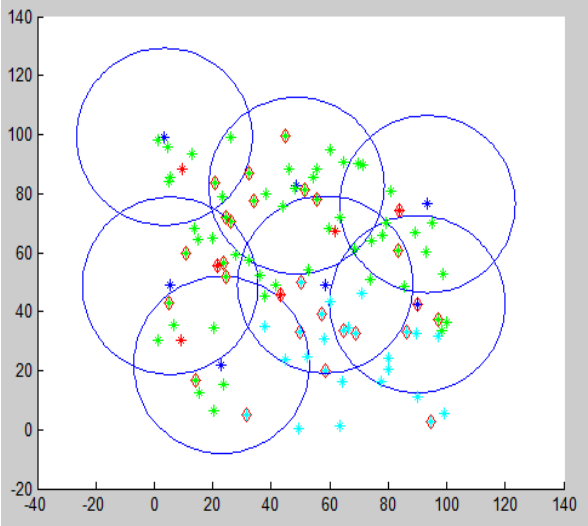
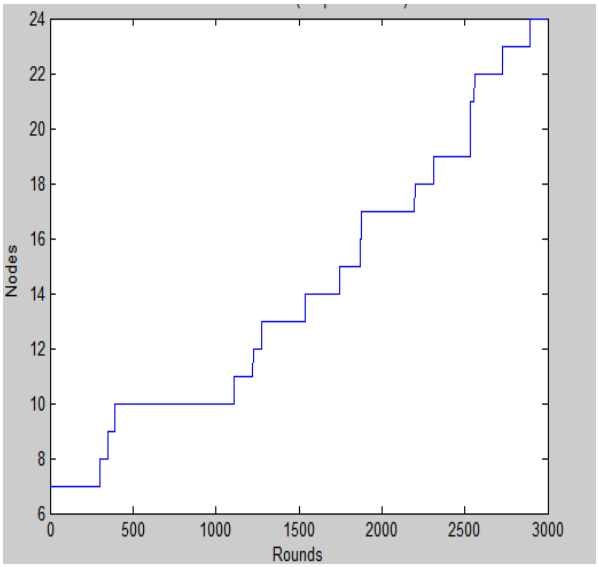


Figure 2: Network structure after some rounds of simulation (1000&2500)

Figure 2 shows dark blue stars (*) which are marked as Cluster Heads.Each Normal node will elect its cluster head decided as per proposed method andthe Red coloured (*) Faulty Nodes found in the network in each cluster.

5.ANALYSIS

Based on various parameters we have carried out the simulations like total number of nodes hundred deployed using random number generator Rand applied to a field size of 100*100. Other parameters like probability of cluster is 0.2 and threshold value lie between 1 and 10. It has all nodes normal and simple with same energy level of 100 joules per node. These parameters are taken after studying different research papers used in Wireless sensor network. Figure 3 showing outlier/Faulty Nodes detected in each round of simulation. It shows that outlier per round is more in Hybrid Technique as compared to old technique.



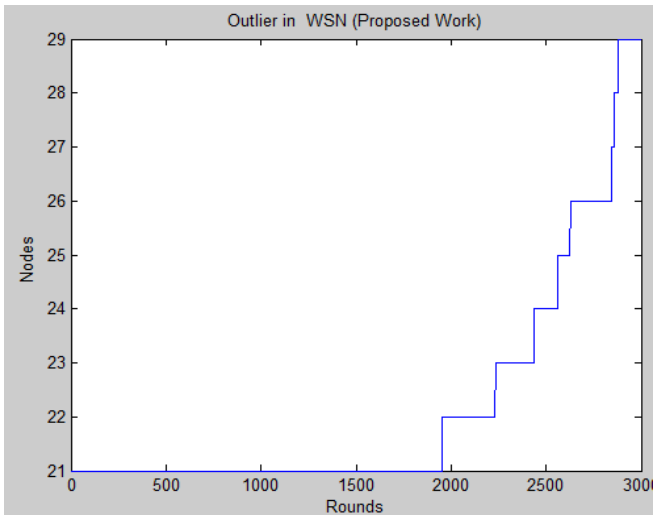
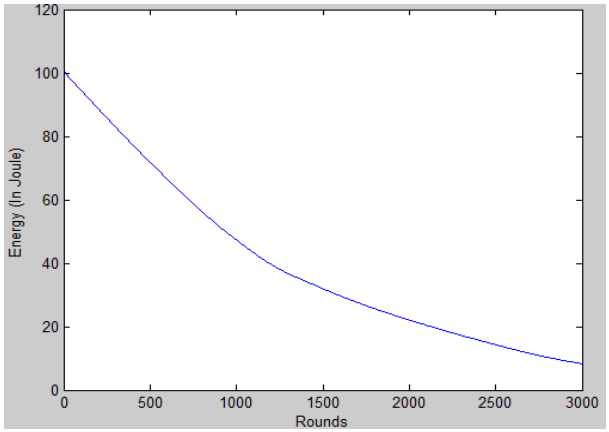


Figure 3: Outlier per Round

Figure 4 showing the energy consumption (joule) after completion of each round while finding the faulty node in a network. It shows that consumption of energy is very low, which shows that the life time of network will increase.



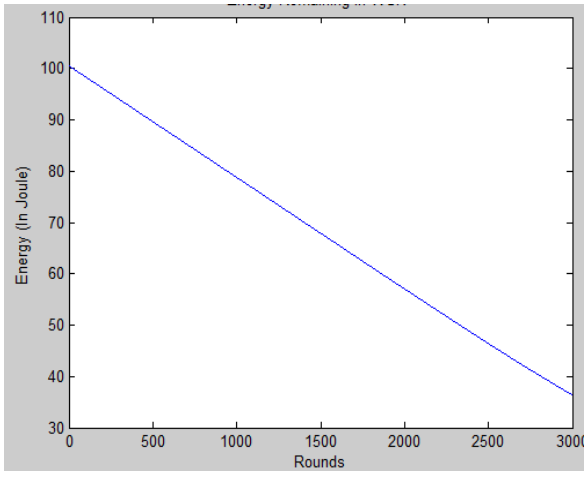


Figure 4: Energy Consumption per round

6.CONCLUSION AND FUTURE SCOPE

We studied sensor rank scheme and finally we proposed an efficient algorithm and also compared it with the original one under the same simulation conditions. We added the concept of clustering and added the cluster head. Cluster heads of each cluster thus formed perform the function of detection of outliers and send the aggregated data to the base station. The outlier information thus received is carried to the base station and base station transmits it to all the cluster heads.

Energy which is a major factor in wireless sensor networks is less consumed as compared to the original sensor rank also the efficiency for outlier get increased as the whole process is carried out by applying the concepts of clustering using the distance-based factors into consideration . Energy intake is exaggerated by message communication between nodes which is less due to the introduction of cluster heads, so our proposed technique is more resourceful than old Sensor Rank scheme.

A further direction of this study can be added by making one node of cluster very high power containing battery to perform all the calculation and thereby reducing pressure on cluster head node so that more contribution can be given toward faulty reading node detection. In the case of network failure a proper recovery mechanism for cluster head recovery by adding a vice cluster head can be added and their roles can be determined and can be compared on the basis of various parameters.

REFERENCES

[1]. Y. Zhang, N. Meratnia, and P. Havinga, “Outlier detection techniques for wireless sensor networks: A survey,” IEEE Communications Surveys & Tutorials, vol. 12, no. 2, pp. 159–170, 2010.

[2]. Z. Yang, N. Meratnia, and P. Havinga, “An online outlier detection technique for wireless sensor networks using unsupervised quarter-sphere support vector machine”, in Intelligent Sensors, Sensor Networks and Information. Processing, 2008. ISSNIP 2008. International Conference on, pp. 151 –156, December 2008.

[3]. T. Kavitha, A. Chandra, “Wireless networks: a comparison and classification based on outlier detection methods “in CSEA 2012, vol. 4, special issue 1; 2013

[4]. B. Sheng, Q. Li, W. Mao, and W. Jin, “Outlier Detection in Sensor Networks”, in proceedings of the Eighth ACM International Symposium on Mobile Ad Hoc Networking and Computing (MobiHoc), pp. 219-228, 2007

[5]. Xiang-Yan Xiao, Wen-ChihPeng and Chih-Chieh Hung, “Using sensor rank for in- network detection of faulty nodes in WSNs”, in proceedings of MobiDE’07, June 10, 2007.

[6]. F. Akyildiz, W. Su, Y. Sankarasubramaniam, and E. Cayirci, “A survey on sensor networks”, IEEE Communications Magazine, vol. 40, no. 8, pp. 102–114, August 2002.

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