www.ijecs.in
International Journal Of Engineering And Computer Science ISSN:2319-7242
Volume 3 Issue 6 June, 2014 Page No. 6783-6787

Energy Adaptive Approach for Node Inclusion and Exclusion in Dynamic Clustered WSN

Ranjita joon, Dr. MD Yusuf Mulge
M.Tech student, PDM College of Engineering for Women
Principal, PDM College of Engineering for Women
joon.ranjita@gmail.com, dryusufmulge@gmail.com

Abstract: A sensor network is an energy effective communication network organized under specific network architecture. One of such structured architecture followed by sensor network is clustered network. The communication in such cluster network is one of the effective challenges because of different kind of responsibility to different roles of a node. This communication becomes more challenging when the network is dynamic and any node can participate in communication. The proposed approach improves the effectiveness of communication in structured network while including or excluding a new node over the network. In this paper, a two level analysis approach is defined to perform the dynamic operations over the network.

Keywords: WSN, energy consumption, network lifetime.

I. INTRODUCTION

A Wireless Sensor Network (WSN) is composed of autonomous devices called sensor nodes that generally have low computational power, limited data transmission and power constraints. A WSN consists of sensor nodes that capturing information from an environment, processing data and transmitting them via radio signals. WSNs are increasingly present in our days and can be found in environmental area (climatic measurements, presence of smoke), in health area (measurement of vital signs, temperature), home automation (motion sensor and image sensor) and other areas. Generally, WSNs [1] have no fixed structure, and in many cases there is no monitoring station of sensor nodes during the operational life of the network, so a WSN must have mechanisms for self-configuration and adaptation in case of failure, inclusion or exclusion of a sensor node. Routing in WSNs is a series of process of forwarding information gathered by sensors to the sink or base station (BS). Routing protocols are classified into three categories: hierarchical routing protocols, location-based routing protocols and flat routing protocols [3][4]. In a flat routing protocol, every sensor delivers information collected by itself to BS directly. Location-based routing uses the location information of sensor nodes. In these two schemes, if we want to collect information of entire area in a network, a large number of nodes are involved in data transmission, leading to much energy consumption. On the other hand, hierarchical routing uses a less number of nodes compared to other routing protocols. Thus, it is more energy-efficient and allocates network resources more evenly than the other two schemes. In a hierarchical routing protocol, sensor nodes (SNs) form multiple clusters by choosing some nodes as cluster heads (CHs) and the remaining nodes as members of clusters. Each CH collects the sensed data from member nodes, compresses the aggregated data, and then transmits them to BS. The necessary energy is known to be proportional to the fourth power of distance in the propagation model of two-ray ground reflection [6]. A wireless sensor network can be divided into two types: Unstructured and Structured. Cluster-based network is considered as a structured way of the network. It is seen as an efficient way of establishing a communication route between nodes in the network. Furthermore, depending on the nodes' ability a network can be called as static or dynamic where dynamic refers to the nodes that can join into an established network and also leave out of the established network [4-9]. Communication between the sensor nodes can be very challenging in a wireless sensor network where typically wireless sensors are distributed in a large proximity and there is no structured environment.

The paper is organized as follows. Section I introduces wireless sensor networks. Section II of this paper includes the related work done by various authors in this field. Section III basic approach related to our approach. Section IV includes the proposed technique in detail. Experiment design for the simulation is present in section V. The work is concluded in section VI.

II. RELATED WORK

In recent times, a good number of studies on dynamic cluster based wireless network structures and communication protocol on them have been performed. Recently, several dynamic cluster-based structures for WSNs have been proposed [4-9] where a WSN is called as dynamic if it is facilitated by two operations: Join (i.e., join into a network) and Leave (i.e., leave from the network). The considered network mode is single-channel, multi-hop and without CD (Collision Detection) mechanism. Localization schemes in WSNs may be classified as range based and range-free. The range-based mechanisms [3], [5], [10], [16], perform localization by measuring properties such as point-to-point distance or angle estimates, whereas the range-free mechanisms [6], [8], [9], [11], [15] do not require any physical measurements to perform localization. Range free mechanisms may use hop count or area-based estimation to localize a node [6]. Generally, range-based mechanisms lead to more accurate localization. However, they tend to be resource intensive and may require specialized hardware [13], [16]. The method used for position estimation may be based on minimum mean/median square estimation [10], [15], convex programming [2], [4], or triangulation [16].

Many schemes have been proposed [5], [8], [9], [10], [11], [16] to increase security and robustness of localization by performing secure localization, location anomaly detection, or location verification. Accurate localization in the presence of malicious anchors that are transmitting erroneous estimates has been dealt with in [5], [10], [11]. The schemes in [5], [10] attempt to identify the anomaly and perform compromise resistant localization, whereas the scheme in [11] attempts to detect and remove the malicious anchors from the network. Typically, wireless sensor devices are deployed in a large physical area in order to perform some specific task such as environmental monitoring, disaster management, healthcare support, etc. In such scenario, crucial network operations such as data broadcasting, multicasting, routing, data gathering, etc. to play important role [1-3], [10-12].

III. EXISTING APPROACH

The proposed work is based on the effective dynamic operations on dynamic clustered network. The basic processing of proposed work is on network clustering architecture. The core of the clustering architecture is leach protocol. In this section, the clustering process is shown. LEACH uses a periodic distributed clustering function to balance energy costs throughout the network. Time is divided into rounds, and every sensor has a certain chance of self-electing itself as a cluster head.

LEACH is a clustering-based protocol that includes the following features:

1. Randomized, adaptive, self-configuring cluster formation,
2. Localized control for data transfers,
3. Low-energy media access, and
4. Application-specific data processing, such as data aggregation.

The complete processing of the LEACH protocol is divided in two main phases called setup phase and the steady phase. In case of setup phase, the cluster head decision is taken place. It checks whether a node is normal node or the cluster head. During this phase, each node presents its eligibility to present itself as the cluster head. The request for setting it up as the cluster head is formed. The next stage is the steady state, where act of cluster head is performed. That accepts the data from the nodes perform the aggregation and send data to the base station. The clustering phase of the work is shown here under

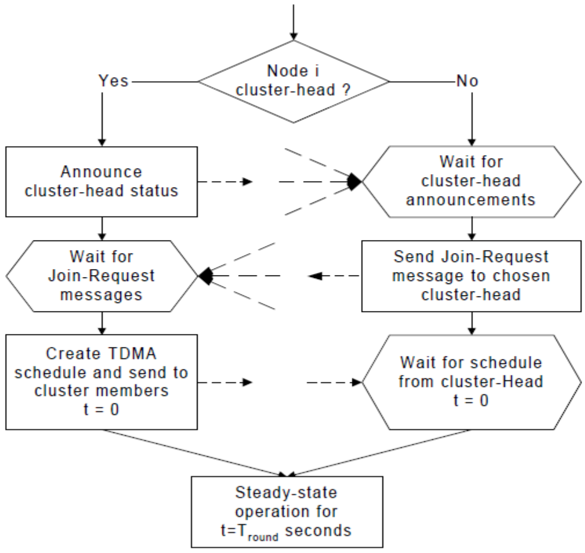

Fig1. Clustering process

Disadvantages of LEACH protocol:

LEACH is able to perform local aggregation of data in each cluster to reduce the amount of data that transmitted to the base station. Although LEACH protocol acts in a good manner, it suffers from many drawbacks such like

- Cluster-Head selection is randomly, that does not take into account energy consumption.
- It can't cover a large area.
- Cluster-Heads are not uniformly distributed; where Cluster-Heads can be located at the edges of the cluster.
- While the distributed algorithm for determining cluster-head nodes ensures that the expected number of clusters per round is k, it does not guarantee that there are k clusters at each round.
- The set-up protocol does not guarantee that nodes are evenly distributed among the cluster-head nodes. Therefore, the number of nodes per cluster is highly variable in LEACH and the amount of data each node can send to the cluster-head varies depending on the number of nodes in the cluster.
- It does not support dynamic operations such as inclusion and exclusion of nodes.
- It is not able to handle orphan node.

IV. Energy Adaptive Approach for Node Inclusion and Exclusion in Dynamic Clustered WSN

A WSN is different from other popular wireless networks like cellular network, wireless local area network (WLAN) and Bluetooth in many ways. Compared to other wireless networks, a WSN has a large number of nodes in a network, also the distance between the neighboring nodes is much shorter and application data rate is much lower. These are the reasons due to which, power consumption in a sensor network has to be be minimized. The communication in cluster network is one of the effective challenges because of different kind of responsibility to different roles of a node. This communication becomes more challenging when the network is dynamic and any node can participate in communication. The proposed approach improves the effectiveness of communication in structured network while including or excluding a new node over the network. In this section, a two level analysis approach is defined to perform the dynamic operations over the network. As a new node is included, it checks for the network respective to the cluster as well as the complete network. The adaptability of a node inclusion is analyzed under different cases such as cluster member identification or the orphan node identification. This node inclusion is also analyzed under cluster density analysis and energy balancing analysis. If the node is selected as the cluster member, it also checks for connectivity vector so that the node can be considered as the cluster head. If the node is not accepted as the cluster member, in such case the node is considered as the orphan node and in such case multihop route is identified to perform the communication with nearest cluster head. The proposed approach also handles the condition of node exclusion by performing a cluster energy analysis so that the cluster reformation can be called, if some high energy node or the cluster head is eliminated over the network. The proposed approach performs different kind of communication in structured clustered network such as broadcasting, aggregative communication and the route formation. The broadcasting is performed between the cluster member and the cluster head. The aggregative communication is performed between cluster heads and the route identification is done to include an orphan node over the network.

A. Proposed Approach

The proposed approach improves the effective dynamic operations on a structured sensor network. The approach is performed on a clustered network for the exclusion and inclusion of new nodes under different network perspective and communication perspectives so that the network life is improved and the energy consumption with different network operations is reduced. The presented approach is divided in three main stages:

Stage 1: Construction of Structured Network

The first step of proposed approach is to design a clustered network under the energy balancing. The cluster head selection is here performed by performing the cluster density and cluster energy analysis. The broadcasting and aggregative communications are defined over this clustered network.

Stage 2: Inclusion of Dynamic Node

The next step of the proposed approach is to include a new node over the network. This node inclusion is performed under three main vectors called, cluster member analysis, orphan node analysis and the cluster head analysis. As a new node is included, at first the node is checked for the nearest cluster head. If the node is not adaptive to a cluster member, the node is handled as the orphan node and a dynamic route is identified to perform communication with nearest node. If the node is adaptive to the cluster member, the node is checked for the acceptability as the cluster head.

Stage 3: Removing a Node

Another dynamic operation included in this approach is the node exclusion from the network. As a node is removed, it checks for energy effectiveness over the network. With the node exclusion, the energy balancing over the network is analyzed and the network reconstruction is called.

B. Proposed Algorithm

The detailed description of proposed scheme is presented by following algorithm.

```
/*A Network is defined with N Nodes Distributed Randomly over the network*/
{
1. Define the Nodes with Energy Constraints such as initial energy, forwarding energy, transmission energy and receiving Energy
2. Define the distance Range Partition to separate the internal and external cluster nodes
3. Define the Limit Constraint for Cluster head selection i.e. EThreshold, ClusterThreshold, ClusterMemberThreshold
4. For round=1 to MAX_ROUNDS
[Perform the Communication for Defined Number of Rounds]
{
5. For i=1 to N
[Analyze all network nodes with each communication round]
{
6. if(Energy(Node(i))>EThreshold )
[If node is energy adaptive it can be set as cluster head]
{
7. Perform the Node Count in Sensing range of Node (i)
8. if (Count(Node(i))>ClusterMemberThreshold)
[If node is having the Specific Number of Nodes in Sensing Range]
{
9. if(Distance(ClusterHead,Node(i))>Sensing Range)
[If no other node present in same coverage range]
{
10. Set Node As cluster Head
11. Identify the Cluster Member for node(i)
        }}
12. if (Energy(Node(i))=0)
        {
13. Dead=Dead+1
        }}
14. Identify the Node not exist in coverage range of any Cluster Head
15.     Generate the Adaptive path under energy, distance and communication range analysis to identify the effective route between clusterhead and node
16.     Perform the Communication analysis on each node under energy and residual energy analysis to restrict the energy consumption on each node
17.     Perform the Network Analysis in terms of Network Life and Packet Communication
}}
```

V. RESULTS

In this section, we present the performance evaluation of our proposed approach. Simulation of the network is performed using Matlab. The analysis is carried out under different parameters such as energy consumption, network life etc. In figure 2, blue colored nodes represent cluster head, red nodes represent dead nodes and green colored nodes represent cluster members. Fig shows that no two cluster heads are very closely located. They are distributed uniformly so that effective clusters are formed and load balancing is achieved.

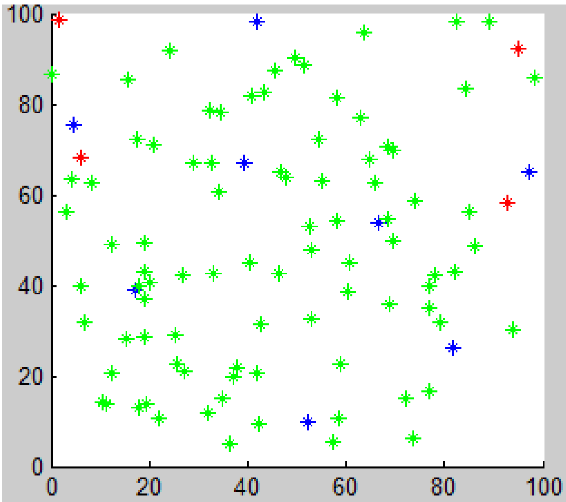

Fig2. Load balancing

Following simulation results show comparison between existing approach and our proposed approach using various parameters.

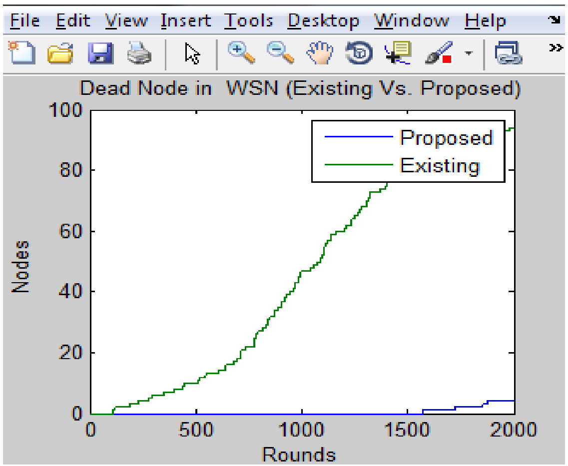

Fig3(a). dead nodes in WSN

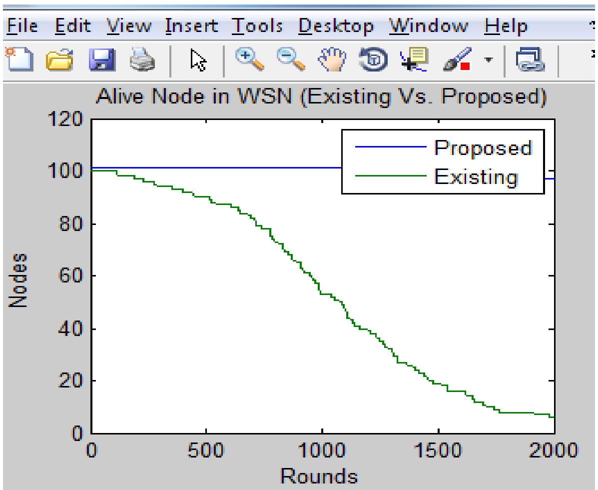

Fig3(b). alive nodes in WSN

Figure 3(a), 3(b) shows no. of dead and alive nodes over each round using proposed and existing approaches. It clearly depicts that that there is increase in no. of alive nodes and decrease in no. of dead nodes in case of proposed approach as compared to existing approach.

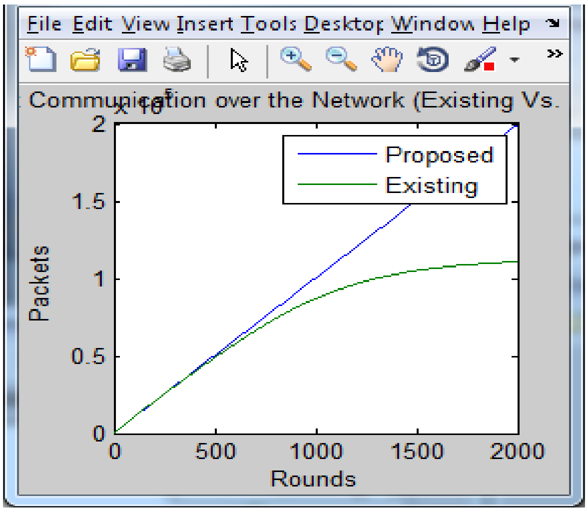

Fig 4. Communication over n/w

Figure 4 shows overall communication in the network i.e., total no. of packets transmitted over network in case of proposed and existing approaches. There is gradual increase in no. of packets transmission in case of our proposed approach. Figure 5 shows energy remaining in WSN. It can be seen that energy consumption in case of proposed approach is less as compared to existing approach. This means that increase in network life is achieved through proposed approach.

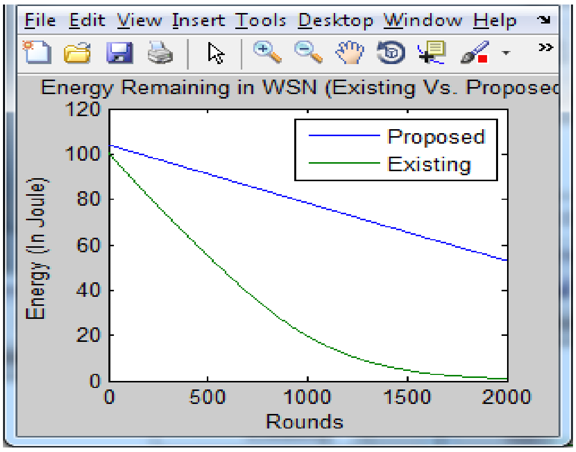

Fig 5. Energy remaining

VI. CONCLUSION

In this paper, we have suggested an "Energy Adaptive Approach for Node Inclusion and Exclusion in Dynamic Clustered WSN". It is a two level analysis approach that perform the dynamic operations over the network. The proposed approach is able to include a node effectively over the network so that network energy balancing is achieved. It greatly reduces the energy consumption for different network operations such as communication, energy loss etc. Simulation results show an overall improvement in network life under proposed scheme.

VII. REFERENCES

[1] I. Akyildiz, W. Su, Y. Sankarasubramaniam, and E. Cayirci. Wireless sensor networks: A survey. *Computer Networks*, 38(4):393–422, 2002.

[2] Pratik Biswas, Tzu-Chen Lian, Ta-Chung Wang, and Yinyu Ye. Semidefinite programming based algorithms for sensor network localization. *ACM Transaction on Sensor Networks*, 2(2):188–220, 2006.

[3] Xiuzhen Cheng, Andrew Thaeler, Guoliang Xue, and Dechang Chen. TPS: A time-based positioning scheme for outdoor wireless sensor networks. In *Proceeding of Joint Conference of the IEEE Computer and Communications Societies (INFOCOM '04)*, volume 4, pages 2685–
2696, 2004.

[4] L. Doherty, K. Pister, and L Ghaoui. Convex position estimation in wireless sensor networks. In *Proceedings of the IEEE INFOCOM*, pages 22–26, 2001.

[5] W. Du, L. Fang, and P. Ning. LAD: Localization anomaly detection for wireless sensor networks. In *Proceedings of the 19th IEEE International Parallel and Distributed Processing Symposium (IPDPS)*, 2005.

[6] Tian He, Chengdu Huang, Brian M. Blum, John A. Stankovic, and Tarek F. Abdelzaher. Range-free localization and its impact on large scale sensor networks. *Trans. on Embedded Computing Sys.*, 4(4):877– 906, 2005.

[7] C. Karlof and D. Wagner. Secure routing in wireless sensor networks: Attacks and countermeasures. *Elsevier's Ad Hoc Networks Journal, Special Issue on Sensor Network Applications and Protocols*, 1(2–3):293–315, September 2003.

[8] L. Lazos and R. Poovendran. HiRLoc: High-resolution robust localization for wireless sensor networks. *IEEE Journal on Selected Areas of Communications*, 24(2):233–246, February 2006.

[9] L. Lazos, R. Poovendran, and S. Cˇ apkun. ROPE: Robust position estimation in wireless sensor networks. In *Proceedings of Information Processing in Sensor Networks (IPSN)*, pages 324–331, 2005.

[10] Z. Li, W. Trappe, Y. Zhang, and B. Nath. Robust statistical methods for securing wireless localization in sensor networks. In *Proceedings of Information Processing in Sensor Networks (IPSN)*, pages 91–98, 2005.

[11] D. Liu, P. Ning, and W. Du. Detecting malicious beacon nodes for secure location discovery in wireless sensor networks. In *Proceedings of the 25th IEEE International Conference on Distributed Computing Systems (ICDCS)*, pages 609–619, 2005.

[12] S. Misra, S. Bhardwaj, and G. Xue. ROSETTA: Robust and secure mobile target tracking in a wireless ad hoc environment. In *Proceeding of the Military Communications Conference (MILCOM)*, pages 1–7, 2006.

[13] D. Niculescu and B. Nath. Error characteristics of ad hoc positioning systems (APS). In *Proceeding of ACM MobiHoc*, 2004.

[14] A. Perrig, R. Canetti, D. Tygar, and D. Song. The tesla broadcast authentication protocol. *Cryptobytes*, 5(2):2–13, 2002.

[15] A. Savvides, C. Hans, and M. Srivastava. Dynamic fine-grained localization in ad-hoc networks of sensors. In *Proceeding of ACM MobiCom*, pages 166–179, 2001.

[16] S. Cˇ apkun and J. Hubaux. Secure positioning in wireless networks. *IEEE Journal on Selected Areas of Communications*, 24(2):221–232, February 2006.