BALANCING THE NETWORK OVERLOAD FOR THE LIFETIME ENHANCEMENT OF WIRELESS SENSOR NETWORKS

P.Rahul Reddy[1], M.Tech, Anil Kumar.G2 M.Tech,

[1]*Assistant Prof, Department of ECE,* **Ramanandatirtha Engineering College, Nalgonda**

[2]*Assistant Prof, Department of ECE, **L.N.B.C.I.E.T, Satara***

Abstract:

Energy efficient techniques play a significant role in saving the energy consumption of the network and to maximize the network lifetime. With the energy constrained nature of sensor nodes, it is very important to make efficient use of power in order to increase the lifetime of network. One of the most important design criteria for wireless sensor networks (WSNs) is energy efficiency. Clustering approach plays an important role for extending the lifetime of the network. In this paper, we analyze a dual cluster head technique for this purpose. The primary & secondary cluster head are chosen based upon the state, including position and energy reserved of neighbors nodes. The primary cluster head collects the data from its member nodes and forwards to the secondary cluster head which transmits the data directly to the sink. This technique balances network load in order to extend the network lifetime effectively.

Index Terms: *Wireless sensor network, Lifetime, energy, clustering*

-- *** --

1. INTRODUCTION

A wireless sensor network is composed of large number of small, low power, inexpensive sensor nodes, which are densely and randomly deployed either inside the area in which a phenomenon is being monitored or very close to it. Recent technological advances have enabled the development of low-cost, low-power, and multifunctional sensor devices. These nodes are autonomous devices with integrated sensing, processing, and communication capabilities [1]. Sensor networks consist of a large number of sensor nodes that collaborate together using wireless communication and asymmetric many-to-one data. Indeed, sensor nodes usually send their data to a specific node called the sink node or monitoring station, which collects the requested information. All nodes cannot communicate directly with the monitoring station, since such communication may be over long distance that will drain the power quickly. Hence, sensors operate in a self-organized and decentralized manner and message communication takes place via multi-hop spreading. To enable this, the network must maintain the best connectivity as long as it is possible. Sensor's battery is not replaceable, and sensors may operate in hostile or remote environments. Therefore energy consumption is considered as the most important resource, and the network must be self-configured and self-organized. The best energy conservation method is to put as many sensors as possible to sleep. The network must be connected to remain functional, so that the monitoring station may receive message sent by any of the active sensors. An intelligent strategy for selecting and updating a set of active sensors that are connected is needed in order to extend the network lifetime. This problem is known as the connected area coverage problem, which aims to dynamically activate and deactivate sensors while maintaining the full coverage of the monitoring area.

In recent years, wireless sensor nodes are used in many applications. Sensor nodes are usually distributed in locations for monitoring. So energy constraint is the vital problem of the WSNs. Clustering is one of the energy-efficient techniques for extending the lifetime of a sensor network. It is often coupled with data aggregation to extend the network lifetime. Some clustering algorithms have been proposed for sensor networks. One of the well known clustering protocols called LEACH [7]. LEACH is a cluster-based protocol that includes distributed cluster formation in which the nodes select themselves as cluster head with some probability. This algorithm is run periodically and the probability of becoming a cluster head for each period is chosen to ensure that every node become a cluster head at least once within 1/P rounds, where P is the predetermined percentage of cluster heads. LEACH organizes its operation into rounds, where each round consists of a setup phase where clusters are formed and a steady state phase that consists of the data communication process. LEACH provides significant energy savings and prolonged network lifetime over conventional multi-hop routing schemes. In Hybrid energy efficient approach [8], the probability for each sensor node for becoming a cluster head is dependent on its residual energy. Sensors that are not covered by any cluster heads double their probability of becoming a cluster head. This procedure iterates until all sensors are covered by at least one head. Finally, sensors join cluster heads that have the lowest cost within their range. This paper analyzes a dual cluster-heads clustering technique. It not only considers the cluster-head optimized selection, but also considers node energy balance. The intra-cluster data transmissions begin after clusters have been formed. The Primary Cluster Head (PCH) receives and aggregates the data from its cluster members. The data after collection & aggregation are sent to the secondary. The Secondary Cluster Head (SCH) transmits aggregated data to the sink directly. PCH does not have direct communication with the sink, which can save energy. The mechanism better balances the network workloads, and clearly prolongs the lifetime of a sensor network.

2. MODEL OF THE CLUSTER NETWORK

Let us consider that a total of n sensor nodes are uniformly distributed within the sensing field. Sensed data is collected in round robin manner. Each round consists of the cluster setup phase and a steady state phase. Each round begins with a setup phase at which clusters are formed. Clustering generates a primary cluster-head and a secondary cluster-head. It is followed by a steady state phase in which the data sensed are transmitted to the sink. The primary cluster-head is used for the date collecting and date aggregation. The aggregation dates are sent to the secondary one. The secondary cluster head transmits aggregation data to the sink directly. Following assumptions have been made about the sensor nodes and the underlying model:

a) There is a sink located in the sensing field. Sensors and the sink are stationary after deployment.

b) All nodes are homogeneous and have the same capabilities. Each node is assigned a unique id.

c) Nodes can make use of power control to change the amount of transmission power, which depends on the distance to the receiver.

d) Each node knows its own location through location techniques.

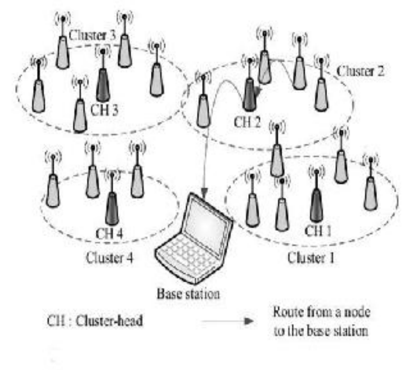


Fig.-1: Basic structure of clustered wireless sensor network.

3. ENERGY UTILIZATION MODEL

Energy utilization model for the sensors is based on the first order radio model .In this model, the transmitter uses energy to run the radio electronics and the power amplifier, and the receiver uses energy to run the radio electronics. The radios can perform power control and hence use the minimum energy required to reach the intended recipients. We follow a typical energy consumption model whose specific details can be found in The energy spent for transmission of an n bit packet over distance r is:

$$E_{TRM}(n, r) = n.E_{dissp.} + n.\epsilon_{FS} r^2 \quad \text{if } r<r_0 \qquad (1)$$

$$E_{TRM}(n, r) = n.E_{dissp.} + n.\epsilon_{TR} r^4 \quad \text{if } r>=r_0 \qquad (2)$$

Where $E_{dissp.}$ is the energy dissipated per bit to run the transmitter or the receiver circuit, ϵ_{FS} and ϵ_{TR} depends on the transmitter amplifier model, and r_o is the threshold transmission distance. To receive this message, the radio expends energy:

$$E_{RV}(n) = n.\ E_{dissp.} \qquad (3)$$

4. ANALYSIS OF NETWORK LOAD ON WSN

We will analyze the cluster head formation of WSN based upon the node residual energy. Cluster heads consume more energy than the member nodes. The average distance between cluster heads and member nodes are considered due to cluster head responsible for collecting data from member nodes. Using this we can define a function G(i) for node i.Function G(i) can be defined as the ratio of the energy level at node i to the total cluster energy level. n is the total no of cluster nodes.H(j) is the energy of node j. Function 2(i) is the total Euclidean distance of cluster nodes to node i, A(i,j) is the distance between node j and node i. The function defined is used to minimize the intra-cluster distance between nodes and their cluster head. According to the function defined above, choose the node with the maximum value of f (i) as cluster head, and it is the optimum.

According to the G (i) function, The SCH also has more energy, and the nearest distance with the PCH. So we simply choose the optimal solution as the SCH. The simulation results show that such choice can achieve good performance.

Each cluster optimally chooses the PCH and SCH. The intra-cluster data transmissions begin after clusters have been formed. Each PCH receives and aggregates the data from its cluster members. Many clustering proposed the use of TDMA scheduling. The aggregation dates are sent to the SCH. The SCH transmits aggregation data to the sink directly. The process is as follows:

(1) All member nodes send information about its current energy level and their locations to its cluster head in each cluster. This cluster head is the initial cluster head.

(2) Based on this information, the initial cluster head select the primary cluster head and secondary cluster head using. This is main step, and the basic steps are as follows:

a) Find the individual and global best position for each node

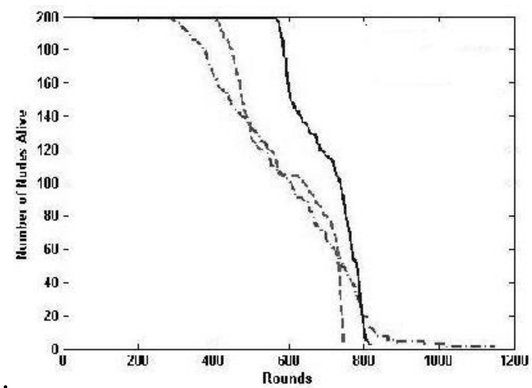
b) Update the each node's position .Map the new updated position with the closest coordinate.

c) Repeat steps until the maximum number of iterations is reached. Select the global best as PCH, and the global best of the previous iterations as SCH. The initial cluster head transmits the information that contains the PCH and SCH to all nodes in the cluster.

(3) The PCH sets up a TDMA schedule for its members to avoid collisions among data messages, allowing the radio devices of each member to be turned off at all times, except during their transmission time. Once the cluster head finishes receiving data from its entire members at the end of each frame, the cluster head performs data aggregation and sends the aggregated data to the SCH. The SCH sends the aggregated data to the sink.

5. EXPERIMENTAL RESULTS

We ran the simulations using OMNET++ network simulator for 200 nodes with equal initial energy. The performance of this method was compared with the clustering protocols for WSNs.The simulation compares their lifetime and residual energy respectively. The main simulation parameters are transmitter energy level, energy level per bit, initial energy level, data packet size, control packet size, network coverage and sink location. Based on the simulation results, we can say that the network lifetime significantly improved as compared to other algorithm. This is because of better network partitioning with minimum intra-cluster distance and also cluster head that are optimally distributed across the network. Thus, the energy consumed by all nodes for communication can be reduced since the distances between member nodes to their cluster head are shorter



.

Fig. - 2: Node life vs Time

6. CONCLUSION

In this paper, we analyzed a dual cluster-head method. We have taken into account the minimum distance between the member node and its cluster head, and the residual energy of nodes in the cluster-head selection. In order to balance the network load, we make use of the dual cluster head method. The simulation result shows that the analyzed method gives optimized network lifetime as compared to other algorithm.

REFERENCES

[1]. Akyildiz et al. Georgia Institute of Technology. "A Survey on Sensor Networks". IEEE Communication Magazine, August 2002.

[2]. R. Krishnan and D. Starobinski. "Efficient clustering algorithms for self-organizing wireless sensor networks". in Journal of Ad-Hoc Networks, Jan 2006, pp.36-59.

[3]. M.Mallinson, P. Drane, and S. Hussain, 'Discrete Radio Power Level Consumption Model in Wireless Sensor Network, Mobile Ad-Hoc and Sensor Systems', IEEE International Conference, 2007, pp-1-6.

[4]. N. M. A. Latiff, C. C. Tsimenidis, and B. S. Sharif, "Performance comparison of optimization algorithms for clustering in wireless sensor networks," in Proceedings of the

 ISSN-2320-7884

IEEE International Conference on Mobile Ad Hoc and Sensor Systems (MASS), 8–11 Oct. 2007, pp. 1–4.

[5]. M. Cardei, D. MacCallum, X. Cheng, M. Min, X. Jia, D.Li, and D. Z. Du, "Wireless sensor networks with energy efficient organization," in Journal of Interconnection Networks , 2002, pp. 213–229.

[6]. AI Karaki JN, Kamal AE, "Routing techniques in wireless sensor networks: A survey", IEEE Wireless Communications,
2004, 11(6): pp 6-28.

[7]. W. R. Heinzelman, A. P. Chandrakasan, H. Balakrishnan,"Energy-efficient communication protocol for wireless microsensor networks", Proceedings of the 33rd Hawaii International Conference on System Sciences (HICSS-33), January 2000.

[8]. O Younis, S Fahmy, "Distributed Clustering in Ad hoc Sensor Networks: A Hybrid, Energy-Efficient Approach", In Proc. IEEE INFOCOM 2004, Hong Kong, China, March, 2004.

[9]. Liang ying, Yu Haibin, Zeng Peng, "Optimization of cluster-based routing protocols in wireless sensor network using PSO", Control and Decision, 2006, 21: pp 453-456.

[10]. Jia Fu-li, Li Feng, Zhang Rui-hua, "RSSI localization based on core in WSN", Computer Engineering and Applications, 2008, 44(30): pp 118~120.