ISSN:0975-9646

Inner cluster Data Aggregation for Wireless Sensor Networks

K.B.Ashwini[1], G.T.Raju[2]

[1]*Computer Science Department, Bharathir University, Deeksha Center for Learning*

[2]*RNS Institute of Technology., Bangalore, India*

***Abstract*— Wireless Sensor Networks has wide varity of applications. In this paper we compare different protocols to check the energy-efficiency of the sensor network. We propose an inner-cluster data aggregation scheme, where in a cluster only selected nodes will transmit the data to the cluster head for further data processing. This reduces the energy wasted by many nodes in transmitting the redundent data to base station. It also reduces the energy and time involved in reducing the redundent data.**

***Keywords*— Wireless Sensor Network (WSN), Base Station (BS), Cluster Head (CH).**

I. INTRODUCTION

Wireless sensor networks(WSNs) has received a lot of attention in recent years due to their wide spread applications like military, disaster surveillance, wildlife observation, agriculture smart homes, etc [1]. Sensor nodes are usually deployed randomly in a physical environment to monoter and transmit theit collected data to a remote sink node (base station). The base station is fixed and has continious power supply whereas sensor nodes are powered with limited batteries and cannot be easily recharged once deployed. Therefore energy efficiency and balancing the network is one of the primary challenges to the successful application of WSN. According to the author in paper [2] data transmission it self consumes around 70% of energy of the sensor node. Sensor network contains a lot of data to be processed, efforts are made to combine or aggregate data with in a group of sensor nodes(cluster).

In a densely covered sensor network, the data collected by the nodes is often similar. Transmitting each data individually to the sink is a waste of energy. In clustering the entire sensor network is grouped in to clusters, where the data is aggregated by the cluster head (CH) and transmitted to the sink. During aggregation redundent data in the cluster must be removed which in turn reduces the number of packets transmission to the sink, which results in conservation of energy. The aggregated data has to be transmitted to the sinkin a single hop or multipul hop's. The number of hop's and hop distance have a very important role to play in energy consumption. Aggregation and routing of data inside WSNs is needed very efficiently to save energy of sensor node.

II. RELATED WORK

Several methods of data aggregation methods are dissused paper [3] discusses about centralized aggregation protocol, in which aggregation is done only at the sink. As a result it leads to heavy workload and unnecessary packet drops. In static clustering the clusters are formed in the initial stage and the aggregation is carried on by cluster head. The cluster once formed remains through out the lifetime of the network [4,5]. In dynamic clustering the clusters are formed dynamically followed by aggregation at cluster head [6]. In [7] LEACH a cluster based protocol which utilises random rotation of local cluster heads to evenly distribute the energy load among the sensors in the network is proposed. It incorporates data fusion into the routing protocal to reduce the amount of information that must be transmitted to the base station. Data aggregation is an important paradigm for data compression so that energy of the network is spent efficiently.In [9] the author proposed a scalable and dynamic data aggregation with routing protocol for WSNs. A tree based data aggregation protocol was proposed based on a parent and child association in paper [10].However large transmission delays and poor rate of aggregation makes it unsuitable for dynamic application. READA algorithm is proposed which removes duplicate data in the cluster head before sending the data to the sink [8]. In a cluster-based data aggregation the CH collects data from all the nodes in the cluster. Generally there are redundant data in WSN because neighboring sensors may have same of similar reading. In this paper we propose a data aggregation scheme to reduce inner cluster transmission, which in turn increases the energy efficiency of the network.

The paper is organised in the following manner. In section III direct communication model, routing protocols and clustering protocols are compared. In section IV we propose the problem statement. In section V system model is proposed followed by data aggregation with in the cluster.

III. TRADITIONAL ENERGY EFFICIENT MODEL

The energy consumption model that we use here is called first order radio model [7].

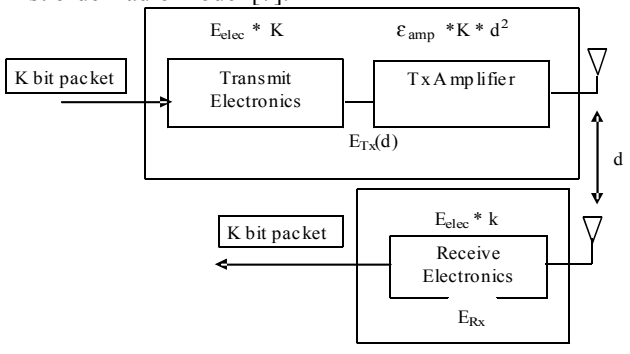


Fig. 1 First order radio model

Each sensor node consumes E_{Tx} amount of energy and transmits m-bit of message over a distance d.

$$E_{tx}(m,d) = m.E_{elec} + m.\varepsilon_{amp}.d^2 \quad (1)$$

E_{Rx} amount of energy to receive this message, the radio expends: $E_{rx}(m) = E_{elec}.m$ (2)

There are several network routing protocals for WSN. In direct communication protocol to the base station. Each sensor node sends its data directly to the base station. It requires a large amount of transmission power for the nodes if the BS is far away from them. In fig2 we have a random 100 nodes network where BS is located at (200,200) every node transmit the data to the BS, 500-bit data packet. In fig3 we see the nodes away from the BS drain off the battery and reduce the system lifetime, because of large amount of transmission power requires for direct communication.

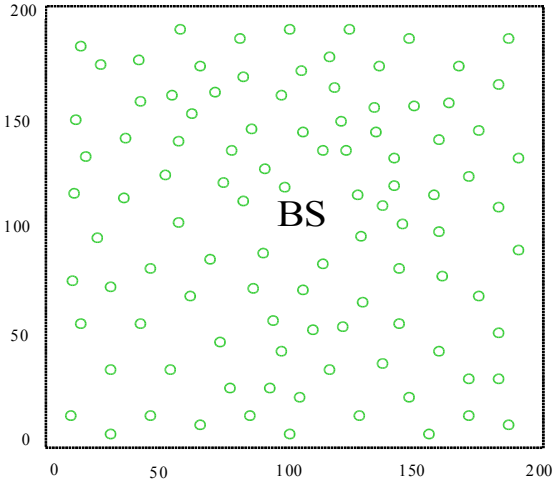


Fig. 2 100 nodes in a random network of 200m*200m

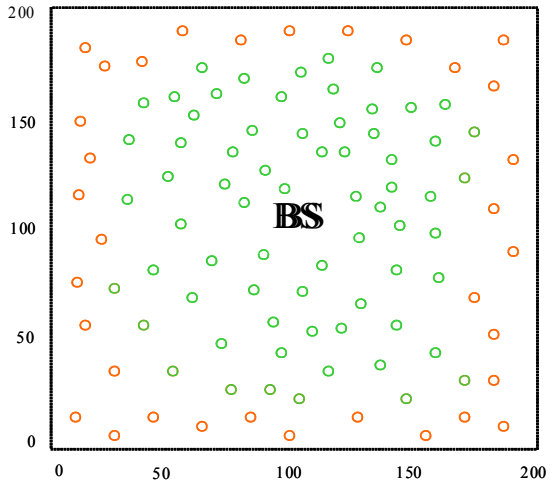


Fig. 3 Sensor nodes in green are alive dead nodes are red in color after direct transmission.

There are several routing protocols, where the nodes route data to the BS. Some nodes act as routers to other nodes in addition to data collection. In this method the nodes near the BS go through n transmissions and n receivers. This leads to draining off the battery and reducing system lifetime of nodes near the BS.

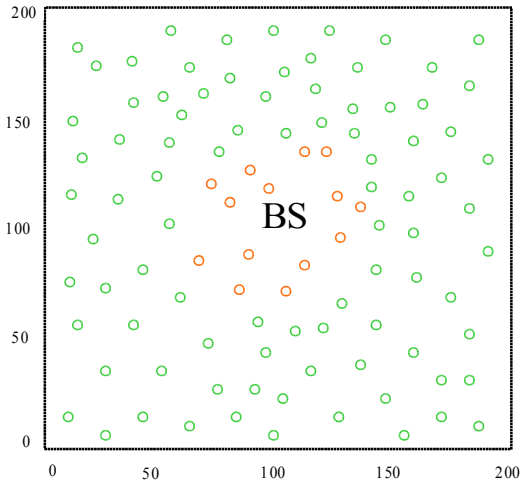


Fig. 4 Sensor nodes in green are alive dead nodes are red in color after routing protocol

Data aggregation is one of the most efficient method for energy saving. In culster based data aggregation nodes organize themselves into clusters, and one node is selected as CH. Initialy all the nodes in the network have similar energy and transmission capicity. Each node is one hop away from the CH. The data collected by the node is transmitted to the CH, it aggregares the data into a single message. The energy of the network is conserved through reduction in the number of messages being exchanged among nodes.

IV. Problem Statement

Cluster based data aggregation consists of two parts: data aggregation with in the cluster and transmitting the aggregated data to the BS. The lifetime of the sensor network is constantly faced by stringent energy consumption. Generally, there are redundant data in WSN because neighboring sensors may have similar or same readings. In most of the aggregation all the nodes with in the cluster transmit the collected data to the CH for further processing. This again leads to a significant number of redundant data reaching the CH.

V. Proposed In Cluster Data Aggregation Model

For the proposed within the cluster data aggregation model. The nodes will be organised into clusters where one node in each cluster will be selected as CH. Nodes are selected within the cluster and only those nodes transmit their data to the CH, to reduce redundend data transmission.

VI. System Model

Initially the clusters are created. All the sensor nodes have the same communication radius r, and same initial energy. Each sensor node determines to which cluster it wants to belong to by choosing the CH that requires minimum communication energy. In a cluster the node that has maximam energy is selected as the CH, on rotation basis. In fig5 we have a CH that is one hop away from the nodes in the cluster. All the nodes in the cluster collect data at regular time intervel and transmits the data to CH. Therefore each sensor node consumes E_{Tx} amount of

energy and transmits m-bit of message to the CH. Redundent data will be send to the CH becausing neighboring nodes may have same data.

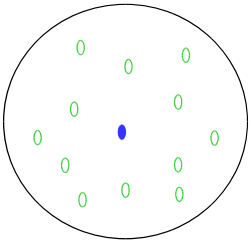


Fig. 5 A cluster with 12 nodes and CH(blue)

VII. DATA AGGREGATION WITH IN THE CLUSTER

A huge amount of energy is wastes in transmitting data and eliminating redundent data from the cluster. Therefore only a few nodes must be selected and only these nodes should transmit the data to the CH. Applying the proper deployment of the sensor nodes discussed in paper [11], which reduces the complexity of WSNs and improve the performance of the network.

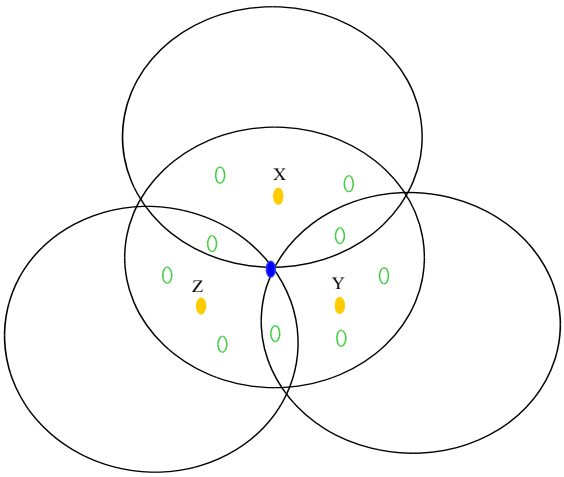
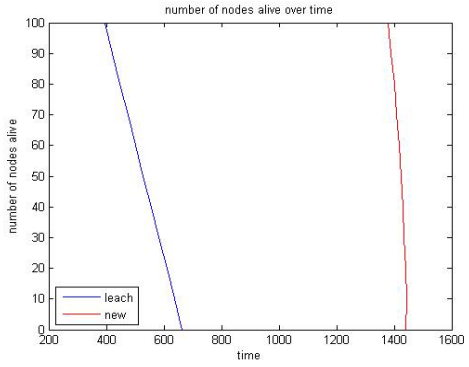


Fig. 6 A cluster with 12 nodes CH(blue), transmitting nodes X,Y,Z

As shown in fig 6 at a particular time select X,Y,Z such that distance between (X,Y) is greater than the radius r. Similarly (Y,Z) and (Z,X). In this case energy transmission of nine nodes can be reduced and energy wasted on redundent data elimination is reduced. It increases the cluster life by four times.



VIII. CONCLUSIONS

In this paper we proposed a cluster based data aggregation. The CH will be selected dynamically, and three nodes with in the cluster were selected to transmit the collected data to the CH at a time interval. This saves lot of energy used in data transmission. It also reduces a lot of redundent data at the BS.Thus lowers the communication overhead and prolongs network lifetime.

REFERENCES

[1] Akyildiz, I.F, Su, W.Sankarasubamaniam, Y. Cayirci, E. Wireless sensor networks: Asurvey. Comput. Netw. 2002, 38,393-422.

[2] H. C, am, S. O¨ zdemir, P. Nair, D. Muthuavinashiappan, and H. O. Sanli, "Energy-efficient secure pattern based data aggregation for wireless sensor networks," *Computer Communications*, vol. 29, no. 4, pp. 446–455, 2006.

[3] Xiong N, Svensson P (2002) Multi-sensor management for information fusion: issues and approaches. Inf Fusion 3(2):163–186, Elsevier

[4] Ghiasi S, Srivastava A, Yang XJ, Sarrafzadeh M (2004) Optimal energy aware clustering in sensor networks. Sensors J 2(7):258–269

[5] Srinivasan SM, Azadmanesh A (2008) Data aggregation in static Adhoc networks, 3rd IEEE international conference on industrial and information systems., pp 1–6, 8-10 December 2008

[6] Wang X, Li J (2009) Precision constraint data aggregation for dynamic cluster-based wireless sensor networks. 5th International Conference on Mobile Ad-hoc and Sensor Networks., pp 172–179, 14-16 December 2009

[7] Maui, Hawaii.Energy-Efficient Communication Protocol for Wireless Microsensor NetworksCopyright 2000 IEEE. Published in the Proceedings of the Hawaii International Conference on System Sciences, January 4-7, 2000.

[8] Kavi Khedo, Rubeena Doomun, Sonum Aucharuz READA: Redundancy Elimination for Accurate Data Aggregation in Wireless Sensor Networks 2010, 2, 300-308 doi:10.4236/wsn.2010.24041 Published Online April 2010 (http://www.SciRP.org/journal/wsn)

[9] L. A. Villas, D. L. Guidoni, R. B. Ara´ujo, A. Boukerche. "A scalable and dynamic data aggregation aware routing protocol for wireless sensor networks", in 13th ACM international conference on Modeling, analysis, and simulation of wireless and mobile systems, USA, IEEE Society Press, 2010: 110–117.

[10] Castelluccia C, Chan AC-F, Mykletun E, Tsudik G (2009) Efficient and provably secure aggregation of encrypted data in wireless sensor networks. ACM Trans Sensor Netw 5(3):1–3

[11] Ram Shringar Raw, Shailender Kumar, Sonia Mann and Sambit Bakshi Comparison and Analysis of Node Deployment for Efficient Coverage in Sensor Network Intelligent Computing, Networking, and Informatics, Advances in Intelligent Systems and Computing 243, DOI: 10.1007/978- 81-322-1665-0_4, Springer India 2014