EFFICIENT CLUSTER HEAD SELECTION SCHEME FOR WIRELESS SENSOR NETWORKS USING ENERGY AND DELAY CONSTRAINTS

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ABSTRACT

Wireless Sensor Network is made up of autonomous sensors for monitoring physical or ecological conditions such as pressure, temperature, etc. Wireless Sensor Networks have limited resources and so it is said as resource constraint network. Since sensor nodes operate on batteries, energy efficiency is a key issue in designing the network. Clustering is one of the important methods for prolonging the network lifetime in Wireless Sensor Networks. Cluster head is elected in each cluster and Cluster head collects all the data from its cluster members and forward the aggregated data to the base station. In this paper, we propose distributed clustering scheme. The network is divided into two parts: border area nodes and inner area nodes. This scheme restricts the cluster head selection only to inner area nodes and thus intra-cluster communication distance is reduced. Network Simulator-2 (ns-2) shows the proposed scheme outputs.

KEYWORDS - Aggregated data, Cluster head, Clustering, Energy efficiency, Wireless Sensor Network

I. INTRODUCTION

Modern Wireless Sensor Networks are made up of autonomous sensors that are networked via low power wireless communication. They are designed and deployed for specific purposes such as environmental monitoring, healthcare, manufacturing, transportation, home appliances, etc. Thus the network design should be taken into account for specific intended application. One of the main design parameter for battery-powered sensor is network lifetime, since replacement of battery is difficult in many applications.

Clusters are formed to improve the efficiency of Wireless Sensor Network. Cluster head collects data from all its members and forwards aggregated data to the sink or base station

directly or through multi-hop communication. The communication should be effective to maximize packet delivery ratio. Hence, Cluster head selection becomes crucial as cluster head requires more energy for transmission of data while comparing other nodes in the network.

As energy is major constraint of Wireless Sensor Networks, various energy efficient routing protocols have been proposed such as LEACH, HEED, etc. The objective of routing protocol is to improve energy efficiency of the network and to establish reliable transmission of aggregated data to its base station. One of the most popular cluster-based routing protocols in Wireless Sensor Network is Low-Energy Adaptive Clustering Hierarchy (LEACH).

LEACH protocol minimizes energy dissipation of sensor networks. It is a cluster based hierarchical routing protocol. In WSNs, optimal number of clusters is found out in order to save energy and enhance network lifetime. In this paper, we propose a modification of LEACH's cluster-head selection algorithm to balance total energy dissipation of sensors. Rest of this paper is organized as follows. Section II describes the related work. Proposed approach is described in Section III. Section IV shows experimental results. Lastly we conclude the paper in Section V.

II. RELATED WORK

In [1], authors have proposed trade-off between energy and delay for data aggregation. Energy Delay Index for Trade-off (EDIT) protocol is used to improve the network scalability by considering two different distances such as Euclidean distance and hop-count. Here, two contradictory parameters namely energy and delay are considered to improve network efficiency. Various cluster head selection algorithms for Wireless Sensor Networks are discussed in [2]. Here, various clustering schemes are discussed to improve efficiency of Wireless Sensor Networks. In [3], performance analysis of LEACH protocol is discussed by considering load balancing, multi-hop communication and remaining energy of nodes as its major factors that are used to improve network lifetime.

The behaviour of improved LEACH protocol is discussed in [4] in which multi-hop communication is used and proved that improved LEACH is more energy efficient than original LEACH protocol. In [5], LEACH-TM is used for establishing multi-path with cluster

heads acting as routers. The concept of Trust is introduced for designing cluster head adjusting procedure. The lifetime of Wireless Sensor Network is increased about 4.81% than original LEACH protocol when the load of the network is same. LEACH's stochastic cluster head selection algorithm is modified by using residual energy of nodes as additional parameter [6]. Thus they have improved network lifetime through load balancing.

The LEACH protocol is improved further by considering remaining energy of cluster node, distance from the base station and number of consecutive rounds in which a cluster node is not elected as cluster head [7]. Here, network lifetime is prolonged by analysing various parameters such as First Node Dies (FND), Half Node Dies (HND) and Last Node Dies (LND). In [8], authors have analysed a distributed CH selection algorithm which considers distance between sensor nodes and base station for balancing energy consumption. The deterministic cluster head selection technique is proposed to improve the network efficiency [9]. Here, predefined cluster head is selected based on remaining energy of sensor nodes. In [10], multiple cluster heads are elected for efficient data transmission which prolongs network lifetime than clusters with single cluster head.

III. PROPOSED APPROACH

Cluster head selection is a vital issue for clustering algorithms as both intra-cluster communication distance and inter-cluster communication distance depends upon the position of cluster head. Critical border surveillance application like military application requires that border nodes should function for long time. In our proposed scheme, sensor network nodes are divided into two parts namely border nodes and inner nodes.

A cluster head node positioned at border of cluster has more intra-cluster communication distance as compared to cluster head role positioned at centre of the cluster. Border area nodes consume more energy and die early. To improve network efficiency, cluster head election is restricted only to inner nodes of the cluster and cluster head is rotated among inner nodes based on residual energy.

Let d is the distance for partitioning of field area. Area starting from boundary of the field up to distance d is border nodes and remaining area is inner nodes. Value of d is very crucial as higher value of d makes inner area very small and as a result very few nodes will be

available for cluster head role. By this, energy consumption of inner nodes increases leading to the failure of inner nodes. Thus, inner nodes are elected as cluster head and various studies are made to improve the network efficiency and packet delivery ratio.

IV. EXPERIMENTAL RESULTS

Lifetime of Wireless Sensor Network is evaluated by electing inner nodes of the cluster as Cluster head and by establishing multi-hop communication. Following are the details of experimental setup and simulation result obtained using Network Simulator-2 (ns-2)

4.1 Experimental Setup

A sensor network topology of 100x100m^2 area having 50 nodes is deployed randomly. The locations of the sensor nodes are deployed by choosing (x,y) locations. The proposed scheme setup is shown in Fig. 1.

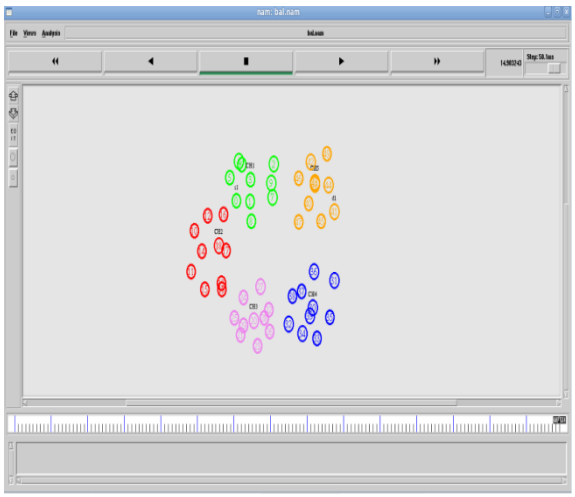

Fig. 1: A Sensor Network Deployed with 50 Nodes

4.2 Result

During simulation process, data transmission is done from source to destination. Proposed scheme outperforms the network efficiency in terms of energy. Fig. 2 shows the improved energy utilization in simulated Wireless Sensor Network.

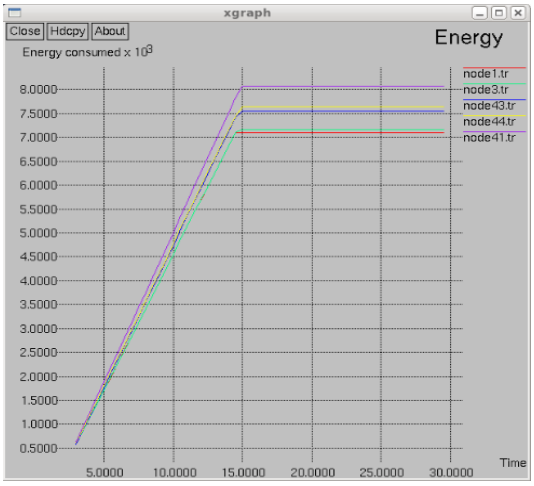

Fig. 2 Efficient Energy Utilization of Sensor Nodes

The packet delivery ratio is calculated to find efficient data transmission. Fig.3 shows the packet delivery ratio of simulated Wireless Sensor Network.

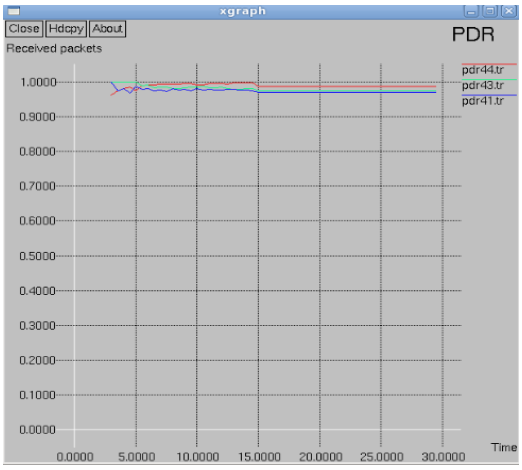

Fig. 3 Packet Delivery Ratio of Sensor Nodes

V. CONCLUSION AND FUTURE WORK

The objective of maximizing the lifetime of Wireless Sensor Network is achieved by electing inner nodes of cluster as its cluster head. Intra-cluster communication distance is reduced during data transmission to balance energy consumption among cluster nodes. Packet delivery ratio is increased by efficient multi-hop communication. Simulation results outperform the efficiency of existing network and data gathering rate. In future, multiple cluster heads may be elected among inner nodes of the cluster for further improvement of network efficiency.

REFERENCES

[1] Ankit Thakkar, Ketan Kotecha, "*Cluster Head Selection for Energy and Delay Constraint Applications of Wireless Sensor Network", IEEE Sensors Journal, Vol. 14, No. 8, August 2014.*

[2] Ramesh.K, Somasundaram.K, "*A Comparative Study of Cluster Head Selection Algorithms in Wireless Sensor Networks", International Journal of Computer Science & Engineering Survey, Vol.2, No.4, November 2011.*

[3] Xiaoyan Cui, *"Research and Improvement of LEACH Protocol in Wireless Sensor Networks", IEEE International Symposium on Microwave, Antenna, Propagation and EMC Technologies for Wireless Communication, 2007.*

[4] Wei Bo Hu Hang-ying Fu Wen, *"An Improved LEACH Protocol for Data Gathering and Aggregation in Wireless Sensor Networks, International Conference on Computer and Electrical Engineering, 2008.*

[5] Wang Weichao, Xu Qijian, Du Fei, *"An Improvement of LEACH Routing Based on Trust for Wireless Sensor Networks", Chinese National Programs for High Technology Research and Development, No.2009AA01Z204, 2009.*

[6] Ma Chaw Mon Thein, Thandar Thein, *"An Energy Efficient Cluster-Head Selection for Wireless Sensor Networks", International conference on Intelligent systems, Modelling and Simulation, ISDN-978-0-7696-3973-7, 2010.*

[7] Anindita Ray, Debashis De, *"Energy Efficient Cluster Head Selection in Wireless Sensor Network", 1st International Conference on Recent Advances in Information Technology, ISDN-978-1-4577-0697-4, 2010.*

[8] Sang H.Kang, ThinhNguyen, *"Distance Based Thresholds for Cluster Head Selection in Wireless Sensor Networks", IEEE Communication Letters, Vol. 16, No. 9, September 2012.*

[9] Akramul Azim, Mohammad Mahfuzul Islam, *"Deterministic Cluster Head Selection for Wireless Sensor Networks", 25th IEEE Canadian Conference on Electrical and Computer Engineering, ISDN-978-1-4673-1433-6, 2012.*

[10] Vaibhav V.Deshpande, A.R. Bhagat Patil, *"Energy Distributed Clustering for Improving Lifetime of Wireless Sensor Networks", International Journal of Emerging Science and Engineering, ISSN: 2319-6378, Vol. 1, Issue 7, May 2013.*