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An Algorithm for Novel Clustering Wireless Sensor Network

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ABSTRACT

Wireless sensor network (WSN) refers to a cluster of sensor nodes used for observing the physical conditions pf the environment such as temperature, pressure, humidity, moisture and other parameters. The sensors nodes form a network in the deployed area and monitor the conditions they are intended to perform. The collected sensor data is consolidated to arrive at conclusions for various decision-making process. In order to provide a centralized control to the network, the nodes are organized in to various clusters where each cluster will be assigned a cluster head. The member sensors in the clusters will collect the data and send the sensed data to the cluster head. The cluster head aggregates the sensed data and decisions are taken accordingly. This paper discusses about an energy efficient clustering algorithm for wireless sensor network.

Keywords: Wireless Sensor Network, WSN, Clustering, Cluster head.

INTRODUCTION

Wireless Sensor Network consists of small tiny sensor nodes which are spread across the area to be monitored in large numbers. There are varieties of real time applications for which the sensor network is formed like military applications, medical applications, environmental monitoring, crisis management, and also in agriculture for crop monitoring. Drastic improvement on the area of miniaturization led to the innovation of these small tiny sensor nodes which can be spread across large area with minimal cost. These sensor nodes possess the capability of self-organizing themselves to form a wireless network. Sensors are randomly deployed in the area of interest. As the devices are very small and inexpensive, they can be deployed in large numbers for better accurate sensing. They monitor conditions at different locations such as temperature, humidity, pressure, vehicular movement, soil makeup, lightning condition, noise levels, the presence or absence of certain kind of object etc. The most straight forward application of sensor technology is to monitor remote locations without human interruption [1-3]. Applications include military, home, Habitat Monitoring, Agriculture etc.For a vast area to be sensed, it is foreseen that even thousands of thousands of sensor nodes are used due to the possibility of damage during deployment. Operating such a huge and complex network requires scalable architecture and management strategies. Scalability in a sensor network can be achieved by a technique known as Clustering [4] where the sensor

nodes are grouped in to various clusters and each cluster having a cluster head (CH) [4].The cluster heads may be predesigned by the network designer or elected by the sensors in the network.

Clustering algorithms for sensor networks improves network scalability by handling two important problems regarding the size and mobility of the network. Various clustering algorithms have been proposed by the research community. They vary according to the overall network architecture, Node deploying methods and based on the characteristics of the CH node. Number of cluster member will vary according to the application. Usually a cluster head is a node which is very rich in energy resources.

Sometimes cluster heads may form a second tier in the network. CH in such architecture acts as relay nodes [5]. Relay nodes have been proposed in sensor networks for achieving various objectives like data gathering, reduction of transmission range, fault tolerance etc. the communication from the relay nodes and base stations can either be single- hop or multi-hop.[5]. In a single-hop model CHs send their data directly to the base station. Where as in multi-hop CHs send their data through other CHs, thus CHs in such models not only acts as relay nodes for transferring the data to base station, but also collects the data from other relay nodes and transfer the data to the base station.[5]

In this paper we have presented various design issues and challenges that occur with clustering in wireless sensor networks. In Section1 we have given an introduction regarding sensor networks, Section 2 discusses the decision metrics for clustering, Section 3 describes the architecture of a flat sensor network without clustering, drawbacks of the flat network, architecture of a hierarchical networks and its advantages, and Section 4 discusses the various design and implementation issues of clustering in sensor network and in Section 5 we have simulated various clustering schemes in sensor networks. We have analyzed how various types of clustering schemes affect the network performance and its lifetime. Variations in energy consumption of the sensor nodes depending on the clustering schemes is also been depicted by various energy consumption graphs.

RELATED WORK

A.Low Energy Adaptive Cluster Hierarchical (Leach) Protocol

The authors in [8] formulated a clustering algorithm termed as Low Energy Adaptive Cluster Hierarchical (LEACH) routing protocol. In this clustering protocol , in order to enhance the network lifetime , the energy backup of the cluster head is verified at the end of each data collection round. When the energy level of the cluster head falls below a specific threshold then a new cluster head selection process is initiated based on the probabilistic theory. The authors prove that the network lifetime is increased to a significant level since the election of cluster head is based on rotation basis.

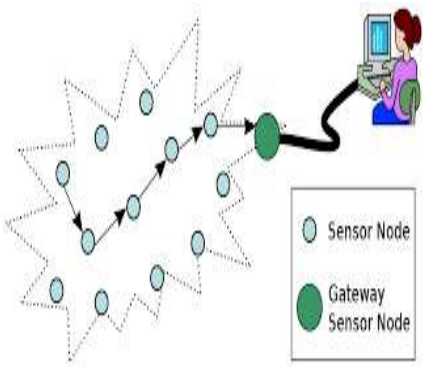


Figure 1: Sensor Network Communication

B.Stable Election Protocol (SEP)

SEP is another clustering algorithm introduced by the author in [9] where the authors categorized the nodes in to two types namely normal and advanced nodes. The Advanced nodes are defined as nodes with high residual energy and are the only nodes eligible for acting as cluster heads. Normal nodes do not possess the capabilities of becoming the cluster heads and they can be used just for forwarding the packets. The nodes with the highest residual energy becomes the cluster head and there is no need for collecting the residual energy of the entire network after the completion of every round.

C.Hybrid Energy Efficient Distributed Computing (HEED) Protocol

This Hybrid Energy Efficient Distributed Protocol (HEED) is designed with the intention of distributing a fair energy consumption across the entire network rather than on a localized areas. Localized energy consumption will decrease the network lifetime to a great extent. The HEED protocol operates on the three main aspects i.e. fair distribution of load across the entire network thereby increasing the network lifetime to a higher level, non-designation of a node as cluster head after a specific number of rounds, and finallythe cluster heads are spread across the network in order to facilitate maximum number of nodes to access the cluster head.

D.Distributed Energy Efficient Hierarchical Clustering (DWEHC) Protocol

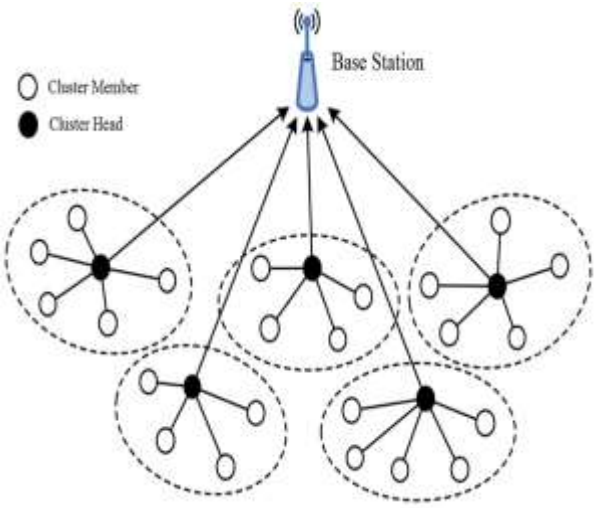
The work discussed in [11] proposed another energy efficient routing protocol called Distributed Energy Efficient Hierarchical Clustering (DWEHC) Protocolwhere balanced equal sized clustered are created across the network for a fair load distribution. This also improvises the energy efficiency of the network and also enhances the intra cluster network topology. The cluster head selection is initiated after the sensors in the network computes its residual energy and a list of its one hop sensor nodes. After the first round the node with the highest residual energy among the one hop sensor nodes will be the next cluster head. A node which has the highest weight in the neighbourhood will be regarded as the CH and other nodes will become the member nodes.

Algorithm for Cluster Head Selection

A. Selection Procedure

The proposed method initiateswith process of selecting the cluster head. At the time of deployment, nodes with high energy levels are deployed with the intention of forming candidate nodes for cluster heads. At the starting of first round cluster heads are selected arbitrarily, for all the nodes possess an equal amount of initial energy. Once the cluster heads are elected, a clustering algorithm is initiated to decide on the cluster members.

The algorithm starts by setting two parameters MyClusterID to 0 and MyHopCount to ∞**.**After this step the nodes designated as heads with high energy levels broadcasts a message incorporating its ID and HopCount where the HopCount is set to 1. This broadcasted message will be received by sensors within whose communication radius the cluster head lies. So All those sensors becomes the first hop sensors for the cluster head. The sensors whorecive this message makes themselves member of the respective head and rebroadcast the same message by incrementing the HopCount. The next set of sensors which receives the message will become the second hop sensors and hence the HobCount will be 2. The above process is repeated until the all the sensors becomemembers of a particularcluster head. And there are also possibilities too forfor one sensor to receive multiple messages from multiple cluster heads. In this scenario, the sensor compares the HopCount of the received messages.



Then it joins with cluster head where the HoPCount is very minimal. In this way overlapping clusters are completely avoided, since a sensor will not be able to join two cluster heads according to the procedures in the algorithm.

Procedure Cluster Formation ()

{1. Every sensor nodes sets two parameters
MyClusterID = 0
MyHopCount = ∞
2. Each Cluster head broadcast a **(Cluster ID, HopCount =1)** message to the next level sensors.
3. Each sensors in the next level after receiving the message
4. Checks if **HopCount is less than MyHopCount** then sets the following
{**MyClusterID = ClusterID;**
MyHopCount -= HopCount
Next _Hop = Sensor from which
the messagewas received
HopCount = HopCount +1
Broadcast the message **(Cluster**
ID, HopCount,) to the next level sensors
Else Sensors ignore the message}}

SIMULATION RESULTS

The efficiency of the proposed algorithm is compared with various existing algorithms where the cluster head is placed at various random locations such as at the center of network, periphery of the network and multiple cluster heads. Simulations parameter for experiments are following; BS is Cluster head is deployed in a heterogeneous network N = 100 100m×100m field size.

TABLE I SIMULATION PARAMETERS
Network Dimensions 100m * 100m
Number of Nodes 100
Initial Energy .5 joules
Percentage of CHs .1
Data Aggregation 50pj/bit j
Pcket size 4000 bit
Transmitter Electronics 50 nj/bit
Receiver Electronics 50 nj/bit
Transmit amplifier 100 pj/bit/m2

Four types of cluster head placement is experimented i)static cluster head, ii) multiple cluster heads randomly deployed in the network, iii) cluster head deployed at the periphery of network and iv)cluster head deployed according to the proposed algorithm .The lifetime of the network for all the four categories are identified. The following graph depicts the lifetime of sensor network for all the four categories(Figure). Theproposed clustering algorithm shows a significant improvement in terms of network lifetime over other three categories.

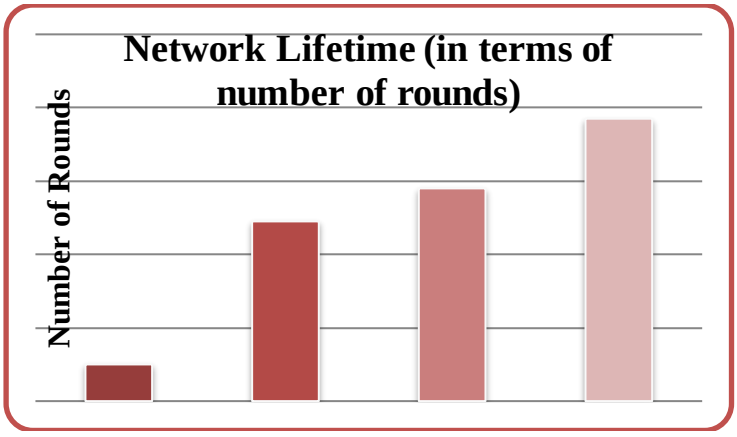
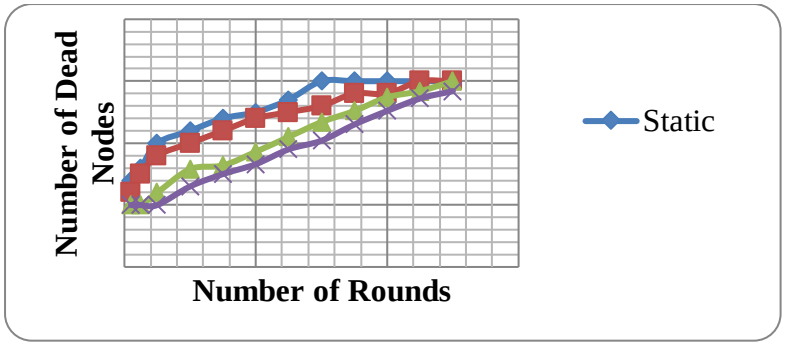
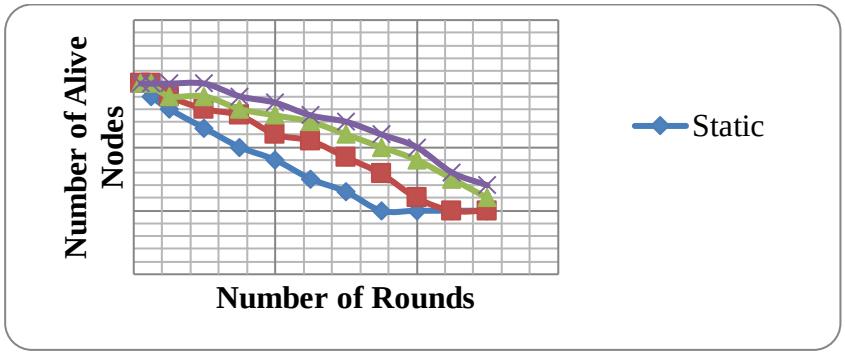


Figure : Network Lifetime in terms of number of rounds

Also number of dead nodes and alive nodes are observed after a specific number of rounds.the following graphs(Figure and Figure) indicates that there are less number of dead nodes in the proposed algorithm when compared to the other categories. Similarly the number of alive nodes are also very high in the proposed scheme when compared to the other algorithms.





REFERENCES

[1] Vivek Katiyar, Narottam Chand, Surender Soni, "Clustering Algorithm for Heterogeneous Wireless Sensor Networks : A Survey", International Journal of Wireless and Mobile Netwroks , 2010.

[2] Vinay Kumar, Ganjeev Jain, Sudarshan Tiwari, "Energy Efficient Clustering Algorithms in Wireless Sensor Networks: A Survey", International Journal of Scientific & Engineering Research, 2011.

[3] Dipak Wajgi, Dr. Nileshsingh V. Thakkur, "Load BalancingAlgorithms in Wireless Sensor Networks", International Journal of Computer & Wireless Communication,Vol 2, No4, August 2012.

[4] D.J. Dechene, A. El Jardali, A. Sauer, "A Survey of Clustering Algorithms for Wireless Sensor Networks", International Journal of Computer & Wireless Communication, Vol 4, No2, Decemebr, 2013.

[5] B. Revathy, G.Rekha, "Latest Algorithms in Wireless Sensor Networks for Energy Conservation A Survey", International Journal of Engineering Research & Technology, Vol 3 , Issue 10, October 2014.

[6] Gaurav Kumar Nigam, Chetna Dabas, "A Survey on Protocols and Routing Algorithm for Wireless Sensor Networks", Proceedings of the World Congress on Engineering and Computer Science, Vol 2, 201

[7] Mohini Kumrawat, Manoj Dhawan, "Survey on Clustering Algorithms of Wireless Sensor Networks", International Journal of Computer Science & Information Technologies, Vol 6(3), 2015.

[8] W. Rabiner Heinzelman and H. Balakrishnan, 2000. Energy-Efficient communication Protocol for Wireless microsensor networks, IEEE, Proceeding of the 3rd Hawali International Conference on System Science.

[9] W. Heinzelman, A. Chandrakasan, and H. Balakrishnan, 2002. An application specific protocol architecture for wireless microsensor networks, IEEE Transactions on Wireless Communications.

[10] I.F. Akyildiz et al., Wireless sensor networks: a survey, Computer Network.

[11] Georgios Smaragdakis and Ibrahim Matta, 2004. SEP: A Stable Election Protocol for Clustered
[12] Heterogeneous Wireless Sensor Networks., 2012.
[13] O. Younis, S. Fahmy, "HEED: A Hybrid, Energy-Efficient, Distributed clustering approach for Ad Hoc sensor networks, IEEE Transactions on Mobile Computing, 2004.
[14] P. Ding, J. Holliday,. A. Celik, Distributed energy efficient hierarchical clustering for wireless sensor networks, In: Proceedings of the IEEE International Conference on Distributed Computing in Sensor Systems (DCOSS'05), 2005.
[15] Xiaojiang Du and Fenging Lin,. Designing Efficient Routing Protocol for Heterogeneous Sensor Network, IEEE, Performance, Computing and Communication conference, 2005.
[16] L. Qing, Q. Zhu, M. Wang,. Design of a distributed energy-efficient clustering algorithm for heterogeneous wireless sensor networks, In ELSEVIER, Computer Communications, 2006. G. Eason, B. Noble, and I. N. Sneddon, "On certain integrals of Lipschitz-Hankel type involving products of Bessel functions," Phil. Trans. Roy. Soc. London, vol. A247, pp. 529–551, April 1955. (references)
[17] Pradeepa, K., W. Regis Anne, and S. Duraisamy. "Design and implementation issues of clustering in wireless sensor networks." International Journal of Computer Applications 47.11 (2012).
[18] Pradeepa, K., W. Regis Anne, and S. Duraisamy. "Improved sensor network lifetime using multiple mobile sinks: A new predetermined trajectory." 2010 Second International conference on Computing, Communication and Networking Technologies. IEEE, 2010.
[19] Pradeepa, K, . "Energy efficient positioning of mobile base stations to improve wireless sensor network lifetime." International Journal of Sensor Networks 20.2 (2016): 92-103.