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An Efficient Routing Taxonomy for Energy Saving and Enhancing the Lifetime of Wsn

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Abstract**—** Wireless sensor network (WSN) contains large number of tiny sensors that can be used as an effective tool for gathering data in diverse kinds of environments. The ultimate aim of the taxonomy is to outlinecharacters of energy conserving routing protocols and compare their performances. Research workers have recommended many protocols such as LEACH, DEEC and TEEN. Clustering technique is used to conserve energy using multi hop communication of sensor nodes within the same cluster and performing data aggregation and fusion to reduce the amount of transmitted data to the base station. Clusteringtechnique is used to gather information more efficiently and provides an effectual way to prolong the lifetime of the network. A fully distributed load balancing algorithm (DSBCA) is presented to cope with the load unbalance problem. Our algorithm is implemented against a centralized approach in a production system and a competing distributed solution presented in the literature. The simulation results indicate the efficiency in terms of network lifetime, throughput, stability period and number of clusters formed.

Index Terms**—** routing protocols, wireless sensor networks, Cluster head, LEACH, TEEN, DEEC, DSBCA.

I. INTRODUCTION

A Wireless Sensor Network (WSN) is a collection of tinysensor nodes. Sensor nodes [1] are used to sense the environment in different locations like pressure, temperature, sound, motion. WSNs are widely used in different applications as like fire detection, flood detection, military surveillance [2], movement of animals, traffic control, home security system, and health related applications [3] and so on.

In WSN the energy of the sensor node is limited, so the efficient usage of the energy is very important. Sensor nodes can't recharge it frequently so the energy is considered as important resource. At the same time there is more number of nodes presented in WSNs. The energy is spent to send the data from sensor nodes. So we need a specialized energy aware routing protocols with scalability.

Normally grouping sensor nodes is satisfied the scalability issue and increase the network lifetime. In clustering protocols data aggregation and fusion [4] are available, this leads reduced energy consumption. The sensor nodes periodically transmit their data to cluster head and eventually change the cluster heads because of distributed energy usage.

The cluster head acts as like a sink and collects data from the cluster members those data are sent to the base station. An example of the cluster based data communication within a network using single hop intra cluster communication and multi-hop inter cluster communication is further illustrated in Figure 1.

Routing protocols plays an important role in cluster formation process. On what basis they form the cluster and transmit their data to base station is considered by the routingprotocols. Moreover the cluster formation and cluster head election can be repeated as many times as it is needed. To overcome these problems various clustering algorithms were proposed.

The LEACH [5], TEEN [6], DEEC [7] & DSBCA [8] are selected and undergone for performance evaluation process. The rest of the paper is organized as follows. In section 2 there is a review on selected cluster based routing protocols. Section 3 contains simulation results and performance analysis. Finally section 4 concludes the comparison work.

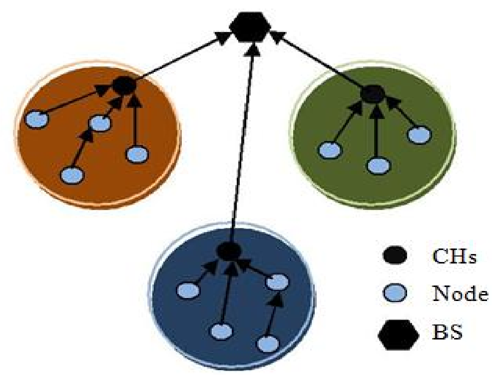

Fig. 1. Hierarchical Clustering Technique.

II. RELATED WORKS

A. LEACH

LEACH - Low-Energy Adaptive Clustering Hierarchical algorithm is a cluster based protocol that utilizes the randomized rotation of cluster heads to evenly distribute the energy load among the sensors in the network. This randomized approach does not drain the battery of a individual nodes. In this protocol the cluster heads have the responsibility of collecting data from their clusters and also aggregate the collected data for reducing the amount of data sent to the sink or Base Station, which enhance the network life time. LEACH uses cluster head rotation to enable scalability and robustness for dynamic networks. Data fusion is used here to reduce the amount of same information repeatedly transmitted to the base station. The sensor nodes elect themselves to be CHs at regular time interval with a given probability. The probability

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threshold function is defined as-

Where P is the percent of cluster head nodes in all nodes, n is the number of the node, and r is the number of rounds for the election. r mod (1/ p) is the number of nodes elected as cluster head in a cycle, and G is the set of nodes not elected as a cluster head in previous rounds. Nodes are elected as the cluster head by its randomly generated value is less than probability threshold value T (n).

Thus the above process can guarantee that the nodes are equally elected as the cluster head.

B. TEEN

Threshold sensitive Energy Efficient sensor Network protocol is to enhance efficiency for Wireless Sensor Networks. It is the first protocol developed for reactive networks. Energy consumption in this technique is lower than the proactive protocols because it does not frequently update the sensed information to cluster heads. There are two more thresholds available to conserve the energy

Hard Threshold (HT): This is a threshold value for the sensed attribute. If the amount of sensed information beyond the threshold value then automatically switch on its transmitter and report to its cluster head.

$$T(n)=\begin{cases} \dfrac{P}{1-P*(r \bmod \frac{1}{P})} & \text{if } n \in G \\ 0 & \text{otherwise} \end{cases}$$

Soft Threshold (ST): This is a threshold value of the changes in sensed attribute. If the changes of sensed value is more than ST then triggers the node to switch on its transmitter and transmit the information.

The nodes sense their environment continuously but it does not transmit the sensed data. The sensed value is stored in an internal memory of the node. The nodes will transmit data only when any one of the following conditions is true:

1. The amount of the sensed value is greater than the hard threshold.
2. The current SV of the sensed attribute differs from previously SV is equal to or greater than the soft threshold.

Thus, the hard threshold and soft threshold reduce number of data transmissions but it does not support periodic reports application.

C. DEEC

Distributed Energy-Efficient Clustering algorithm is a design for heterogeneous wireless sensor networks. In DEEC the election of cluster head done by taking probability on ratio of each nodes residual energy and average energy of the network. The probability threshold is used to elect the cluster head. The nodes with higher initial and residual energy will have more chances to be the cluster-heads than the other low energy-nodes. So it is more suitable, effective and achieves better results in heterogeneous environment.DEEC is a variant of LEACH protocol which is suitable for both homogeneous and heterogeneous WSNs. The selection of the cluster head is based upon the ratio of initial and residual energy.

To control the energy outflow of nodes DEEC uses the reference energy. DEEC calculates the average energy of the network by using the reference energy.

III. PROPOSEDALGORITHM(DSBCA)

Load-balanced Clustering Algorithm with Distributed Self-Organization for Wireless Sensor Networks was proposed by Liao et al [8]. The previously proposed clustering algorithms are uniformly distributed WSNs without considering the distance from the base station. In WSNs, the nodes are usually randomly arranged. If the clustering algorithm doesn't consider the distribution of nodes then it may leads to unbalanced topological structure, and some nodes die rapidly because of excessive energy decline.

DSBCA generates more balanced clusters and avoid creating excessive clusters with many nodes. All clusters need to communicate with BS so the long-distance clusters send the data through the nearest one. Energy dissipation based on the distance between the cluster head and base station and also there are too many members in a cluster may lead excessive energy consumption. From the above concerns, DSBCA consider the connectivity density, location of the node to build a more balanced clustering structure.

DSBCA calculate the clustering radius on the basis of connectivity density and the distance from the base station. If any two clusters have the same connectivity density, then long-distance cluster has larger cluster radius. Any two clusters having the same distance from the base station, then high dense cluster has smaller cluster radius.

DSBCA supports both uniform and non uniform distribution. Fig.6 shows DSBCA clustering in uniform distribution. Fig.7 shows DSBCA clustering in non-uniform distribution.

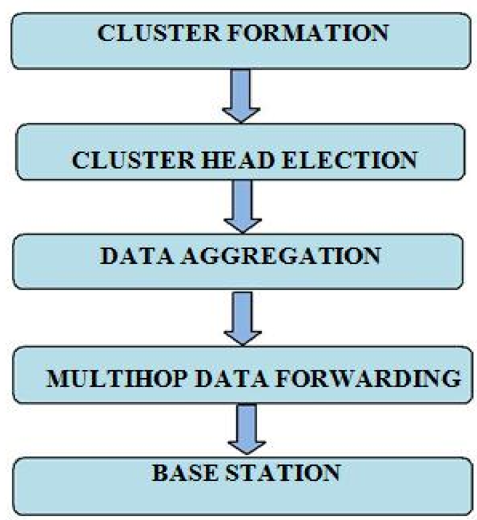

Fig. 5. DSBCA Architectural design

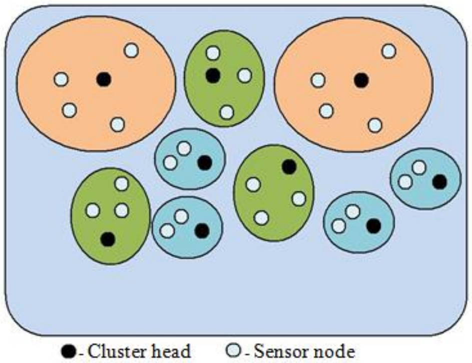

Fig. 6. DSBCA clustering non uniform distribution.

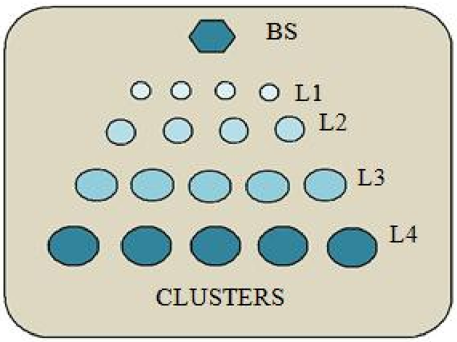

Fig. 7. DSBCA clustering in uniform distribution.

The basic idea of DSBCA [10] is based on the distance from the base station and the connectivity density. DSBCA operation is divided into 3 stages:

CH selecting phase, clusters building phase, and cycle phase.

(i) CH selecting phase: DSBCA selects the random nodes to trigger clustering process first. Then the trigger node *Ut* becomes the temporary CH. follows a distributed approach to build hierarchical structure in self-organizing mode without central control. In this phase, the node with the highest weight in *k*-hop neighbors of *Ut* is elected as cluster head. The weight of the node is calculated by taking the residual energy, connection density, and times of being elected as cluster head of nodes into account. Thus, we can generate clusters more balanced in energy and position.

sets the threshold of cluster size. The number of cluster nodes cannot exceed the threshold to avoid forming large clusters, which will cause extra overhead and thus reduce network lifetime. When the cluster head node receives Join_message sent by the ordinary node, it will compare the size of cluster with threshold to accept new member and update the count of cluster nodes if the size is smaller than threshold, or reject the request. If the rejected node has cluster head already, the clustering process ceases. Otherwise, it finds another appropriate cluster to join.

TABLE. I. SIMULATION PARAMETERS

PARAMETERS	VALUES
Sink Position	50*50
Efs(Amplifier type)	$10*10^{-12}$ j
Emp(Amplifier type)	$0.0013*10^{-12}$ j
EDA(Aggregation Energy)	$5*10^{-9}$ j
Initial Energy Eo	0.5 j
PacketLength	2000bits
CtrPacketLength	100bits
Probability of CHs	0.1
Maximum rounds	8000
Ghama	0.2

(iii) Cycle Phase: The cluster head gathers the weight of all member nodes, and then selects the node with highest weight as the next head node. The clusters that formed have the problem in secure communication. If a node in cluster is compromised or misbehaved, the entire communication link is failed. To overcome this problem, a method to exclude the misbehaved nodes in the cluster fromfurther communication is proposed. Consider A, B, C, D, etc. are neighboring nodes. C and D can monitor B's forwarding behavior themselves.[11] With control packets enabled, C and D can know when A has sent a packet to B although they cannot hear A. Since whenever B tries to receive a packet from A, it must send out CTS first. This can be heard by all its neighbors. If B behaved normally, it should forward the packet to C within certain period, which can also be heard by B's neighbors.

If the packet is not sent out after that period, B must have dropped it. When a node's dropping rate reaches a threshold, it's regarded as malicious. When the presence of a *suspicious* node message reaches a Cluster Leader, it isolates *B,* therefore any message originated from *B* is discarded by its neighboring nodes hence isolating node *B* from the network.

IV. SIMULATION RESULTS

Here 100 x100 areas used to deploy the sensor nodes. Deployment takes place on different amount of nodes such that 150, 200, 250, 300 to check the protocol efficiency under various numbers of nodes. The Parameters of the network settings are followed.

In this section there are number of experiments carried out and used them for the comparison of LEACH, DEEC, TEEN and DSBCA for various performance metrics. Simulation results on MATLAB depict that DSBCA has better network lifetime and more packet delivery to Base station. Figure 8 shows that the TEEN has more

alive nodes for long time because TEEN is reactive protocol.

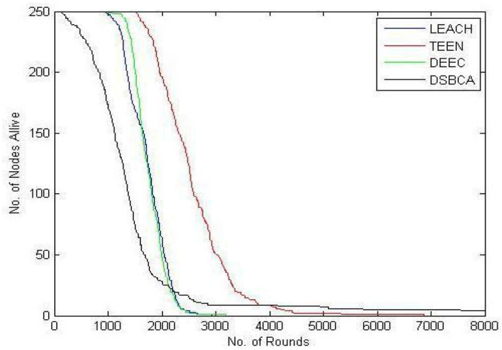

Fig. 8. Allive nodes vs rounds.

From the figure 10 it is clear that the network lifetime of TEEN and DSBCA are better than others but TEEN is a reactive protocol so DSBCA is better than others.

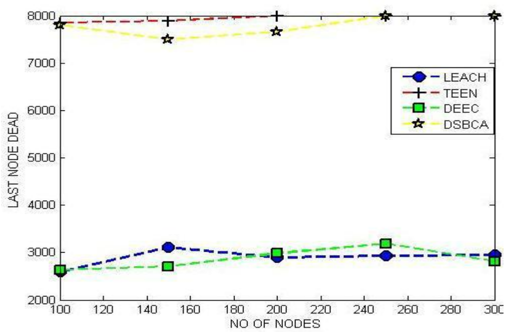

Fig. 10. Network Lifetime.

Figure 11 shows that the throughput of DSBCA is comparatively higher than the DEEC and LEACH because DSBCA send more data through the cluster head.

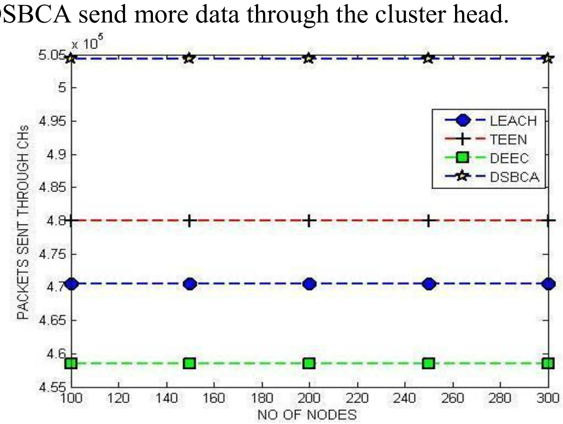

Fig. 11. Throughput.

From the figure 12 it is clear that the TEEN is more stable than the DEEC and LEACH as the first node dead in DEEC shows stability period of DEEC is prolong than others.

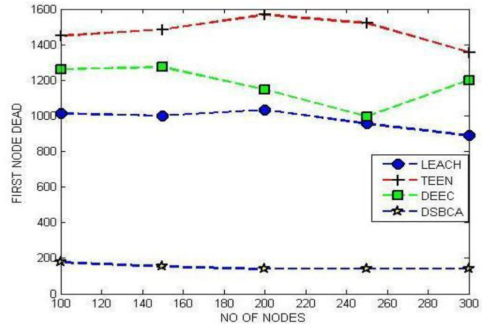

Fig. 12. Stability Period.

V. CONCLUSION

In this paper, we propose a balanced clustering algorithmwith distributed self-organization for WSNs of both non-uniformdistributions and uniformdistributions, with more balanced energy and avoid creating excessive clusters with many nodes, thus it overcomes the problems from other existing clustering algorithms. Compared with traditional clustering algorithms, the proposed algorithm can form more stable and reasonable clusterstructure, and also improve the network life time extensively.

The energy efficient load balancing algorithm can be formulated by combining the weight factor update of distributed load balanced clustering algorithm. The results in extended lifetime of the sensor network till 80% of nodes are dead and the packet loss with highly developed environment can be balanced resulting in improved packet delivery ratio up to 90%. The simulation result shows that the algorithm is feasible andhas superior performance.

REFERENCES

[1] Zhao Han, Jie Wu, *Member, IEEE*, Jie Zhang, Liefeng Liu, and Kaiyun Tian, "A General Self-Organized Tree-Based Energy-Balance Routing Protocol for Wireless Sensor Network", IEEE TRANSACTIONS ON NUCLEAR SCIENCE, VOL. 61, NO. 2, APRIL 2014.

[2] S. Tilak, N. B. Abu-Ghazaleh, and W. Heinzelman, "A taxonomy of wireless micro-sensor network models," Mobile Comput. Commun. Rev.,vol. 6, no. 2, pp. 28–36, 2002.

[3] Bekmezci and F. Alagöz, "Energy efficient, delay sensitive, fault tolerant wireless sensor network for military monitoring," Int. J. Distrib.Sensors Netw., vol. 5, no. 6, pp. 729–747, 2009.

[4] B. Koo and T. Shon, "Implementation of a WSN-based structural health monitoring architecture using 3D and AR mode," IEICE Trans.Commun., vol. 93, no. 11, pp. 2963–2966, 2010.

[5] Fasolo, M. Rossi, J. Widmer and M. Zorzi, "In-Network Aggregation Techniques for Wireless Sensor Networks: A Survey", IEEE Wireless Communications, vol.14, no.2, pp.70-87, Apr. 2007.

[6] W. Heinzelman, A. Chandrakasan, and H. Balakrishnan, "An application-specific protocol architecture for wireless microsensor networks," IEEE Transaction on Wireless Communications, 2002, vol. 1, no. 4, pp. 660–670.

[7] Arati Manjeshwar and Dharma P. Agrawal, "TEEN: A Routing Protocol for Enhanced Efficiency in Wireless Sensor Networks",0-7695-0990-8/01/(C) 2001 IEEE

[8] Qing, Li, Qingxin Zhu, and Mingwen Wang. "Design of a distributed energy-efficient clustering algorithm for heterogeneous wireless sensor networks." Computer communications 29, no. 12 (2006): 2230-2237.

[9] Ying Liao, Huan Qi, and Weiqun Li, "Load-Balanced Clustering Algorithm With Distributed Self-Organization for Wireless Sensor Networks", IEEE SENSORS JOURNAL, VOL. 13, NO. 5, MAY 2013.

[10] Bagci H. and Yazici A (2010), 'An energy aware fuzzy unequal clustering algorithm for wireless sensor networks,' Proc. IEEE Int. Conf. Fuzzy Syst., pp. 1–8.