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A Novel Approach for Energy Efficient Clustering Cooperative Zone Based Routing Protocol in Wireless Sensor Networks

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Abstract- Wireless Sensor Network are made up of Hundreds and Thousands of small, limited battery operated sensor nodes. WSNs are mainly used to send the sensed information from the sensor nodes to the base station (BS) through wireless links as efficiently as possible, to enhance the network life time. Here the main aspects focused on energy usage of the nodes and network life time. To handle these challenges we are describing a new Energy efficient clustering cooperative zone based routing protocol for heterogeneous network (ZECCRP). According to this we split the whole network into regions called as zones and head of the cluster is selected in each zone based on the cluster head selection process. Based on this approach we can achieve optimal solution with respect to Energy Consumption, packet overhead and Network life time.

Keywords: Wireless Sensor Network (WSNs), Cluster Head (CHs), Zone, Heterogeneous Networks, Energy Consumption, Network Life Time etc.

INTRODUCTION

Latest improvements in the area of electronics and wireless communication have given the concept of wireless sensor networks (WSNs) [15]. The collection of limited energy wireless nodes are called WSN. The WNS's are deployed randomly in a changing infrastructure and dynamic environment for capturing different values like humidity, health monitoring, temperature conditions and vibrations and are considered to be best means of for disaster management, critical health monitoring and other critical applications. But it likewise has few limitations like limited battery life, consumes more power. A huge deployment of sensor nodes results in more energy consumption due to high transmission packet overhead.

So to overcome these drawbacks clustering technique is used in WSN that reduces the energy consumption for each packet data transmission. Clustering offers proper energy utilization as well as load balancing by minimizing the communication between nodes and BS.

In clustering, few nodes are chosen as Cluster Heads (CHs) which are needed to spend more energy within the cluster than other set of the nodes for a particular time allotment. The sensor nodes send information to CHs. The information is then handover to the base station (BS) which is far from the field. In clustering wireless sensor networks, various factors of energy efficiency are examined. The sensor nodes start collaborating while transmitting the information within the cluster. But on the other hand the performance can be increased by maximizing the distance between the clusters.

And while sending the information from cluster head (CHs) [13] to the base station (BS) the signal follows various routes to reach the destination. There are chances of multipath fading in the presences of environmental conditions. To overcome these the use of energy efficient method i.e. cooperative communication scheme comes into picture.
Cooperative [14] communication helps to make the system more study because, in this type of communication each and every node has to send the data as well acts as cooperative node for others for energy efficient data transfer. Here nodes create virtual MIMO (multiple input and multiple output) system which were having single antenna creates a to achieve high transmission rate [15] by utilizing their antenna in a more efficient way.

In a present cooperative communication scheme, when complete data is transmitted to node which is nearby to the base station, the bottle neck problem occurs. At that time the closest node looses energy earlier as compared to other ones because of the overload of the data on it, and can also affect the routing path to sink. The stability period of the network will exhaust and minimized since the energy of the last cluster depletes earlier that cause the complete network disconnection in some era.
(as shown In Figure1) since the transmission range is large between the source and destination, co-operative relay [14] nodes (6, 1) are accomplished for data forwarding instead of direct communication.

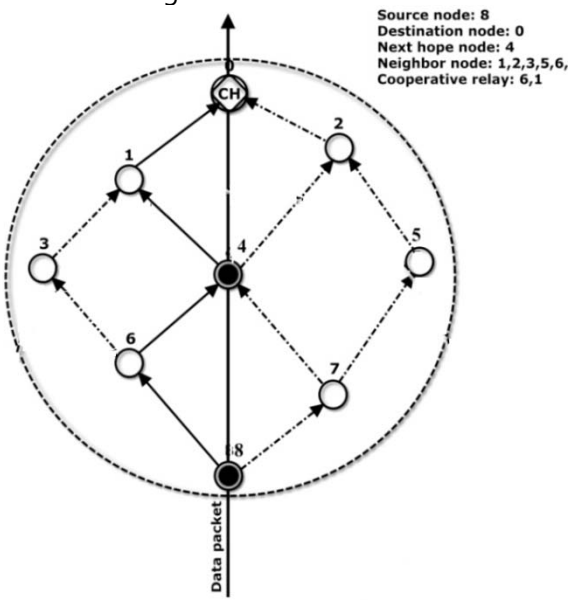

Figure 1: Cooperative communication scheme

In order to achieve the goals a new stable and energy efficient zone based cooperative routing protocol is proposed to increase the reliability of the network and to minimize the total data transmission time by using relay nodes (sub cluster head) so that the load of the network will be partially divided among all the nodes.

The relays in cooperative communication select an appropriate route between the nodes and speed up the communication

The rest of the paper is organized as follows
Section II gives the literature survey; section III illuminates the complete working of proposed scheme. Section IV provides the performance measures. Section V is conclusion. Section VI is the references, finally author's details.

II Literature Survey

E.Thenmozhi and Audi than et. al., [1] proposed energy efficient cluster head selection and data convening in WSNs (EECHDC) in wireless networks. In this paper Cluster head (CH) selection based on residual energy, connection density, capability of the node and the degree of the node. The EECHDC achieves higher energy efficiency compared to the existing schemes.

Cooperative communication with single relay selection is simple yet efficient communication scheme for energy constrained networks which are suggested by Zhong Zhou et. al., [2] has investigated the minimum energy relay selection mechanism jointly with transmission power control can be used. Based on the proposed MAC layer signaling, a set of potential relays determined their needed transmission power to participate in the cooperative communication. And this results confirm significant energy saving and outage improvements of the proposed schemes relative to direct transmission alternatives.

Siva D.Muruganthan et. al., [3] came up with a centralized energy efficient routing protocol(CEERP) for WSNs. Once deployed, the small sensor nodes are usually inaccessible to the user, and thus replacement of the energy source is not feasible. Hence energy efficiency is a key design issues to be enhanced in order to improve the life span of the networks. In this article, he proposed a centralized routing protocol called Based-station controlled dynamic clustering protocol, which distributes energy dissipation among all sensor nodes to improve network lifetime.

Energy efficient cooperative communication (EECC) in clustered wireless sensor networks which is recommended by Reza Aminzadeh et. al., [4]. This paper is based on the study of clustered wireless sensor network, in which sensors within each cluster send the message to another cluster via cooperative communication techniques. Here investigation of how the energy efficient is affected by the transmit power allocation, the total number of sensors in a cluster and the end-to-end packet error rate (PER) is done.

Karanam Ravichandran Dayananda et. al., [5] projected a zone based hybrid approach of clustering (ZBHAC) and data collection in WSNs. The

sensor node constrained by their limited energy supply, so that using this sensor nodes network lifetime can be increased. Clustering protocol is another approach used in this work and it plays vital role. Hybrid algorithm is also proposed in this paper so that selection of cluster head is efficient.

R. Varun Arvin et. al., [6] designed industrial automation using wireless sensor. The advent of wireless sensor networks has revolutionized the field of automation in many ways. This paper presents the implementation of one such WSN useful for industrial application. The establishment of WSN cluster using low cost MSP430 processor and RF transceivers is explained. The WSN cluster can be used for automation of various industries with the possibility of easy modification or expansion in the future.

Now a day's topology issues have received more and more attentions in WSN. Komal Patel et. al., [7] introduced a method to solve these topology issues in wireless sensor network, While application are normally optimized by the given underlying network topology, another trend is to optimize WSN by means of topology control.

A. F. M. Shahen Shan et. al., [8] advised a survey on cooperative communication in WSNs. In this paper, an overview on cooperative communication in wireless networks is presented. We inscribe the benefits of cooperative transmission than non-cooperative communication.

The sensor nodes we use are generally battery operated which in most cases uses replaceable batteries instead of rechargeable batteries. In this paper, he proposed opportunistic routing algorithm, where selection of neighboring nodes plays a very crucial role and improves the energy consumption and network lifetime. SK. Baji Baba et. al., [9] determined a method of improving the network life time of WSNs, . To improve the energy efficiency of a WSN integrating progressive sleep scheduling (PSS) algorithm with the opportunistic routing protocol.

Shalli Rani et. al., [10] discussed about energy based chain cooperative routing protocol for WSN. In this paper, she investigated the reduction in total transmission time and the energy consumption of wireless sensor networks using multi-hop data aggregation by forming coordination in hierarchical clustering. One of the major purposes is to collect information from inaccessible areas by using factorization of the area into clusters and appointing cluster head in each of the subarea.

III. Proposed scheme

In this paper, we have proposed an Zone and Energy based clustering cooperative routing protocol for heterogeneous networks for efficient energy management.

1. Network Model for ZECCRP

In WSNs nodes are arbitrarily distributed in a network area (as shown in Figure 2) without any arrangement. Arrangement of nodes in network is very challenging task, yet we can handle the situation by partitioning the whole network into several logical areas.

Network model for ZETC is unlike anything else. The nodes in the network and are stable. Here we have two conditions homogeneous nodes and heterogeneous nodes. All the nodes are homogeneous and have same energy level at the beginning.

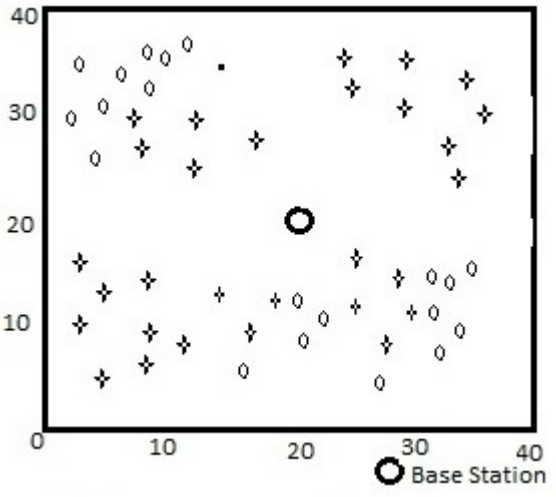

Figure 2:Random deployment of nodes in 40*40area

2. Network model for zone based routing protocol

Later on due to the irregular arrangement of nodes the entire network will be divided into equally radiate multiple zones of nodes in this model (as shown in Figure 3). In this each zone constitutes a cluster having the cluster head with some number of nodes and the count of nodes are not fixed at the beginning, this decision will be made only when the sensor nodes are placed

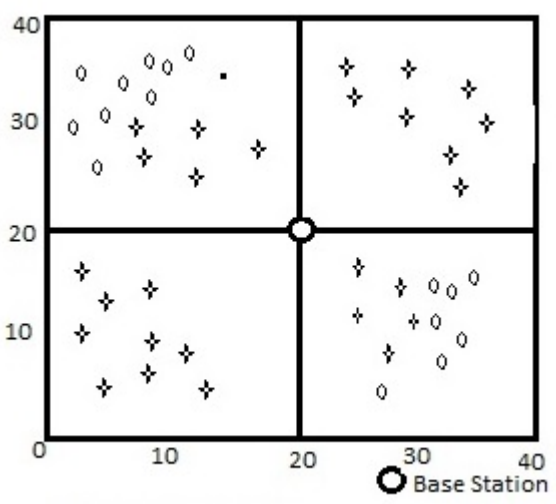

Figure 3: Deployment of nodes in 40*40m area randomly

3. Cluster head selection

In each zone a cluster head is selected with the highest energy efficiency. All nodes will have equal rights to become a cluster head (CH) but (as shown in Figure 4) finally the decision is made such the selected cluster head (CH) should last for a long period of time. Cluster head selection is also made based one the distance from that particular node and the base station (BS). During simulation period the number of cluster heads (CHs) are constant in the network until a complete cluster is dead. The best possible number of CHs are calculated using the following equation in each round:

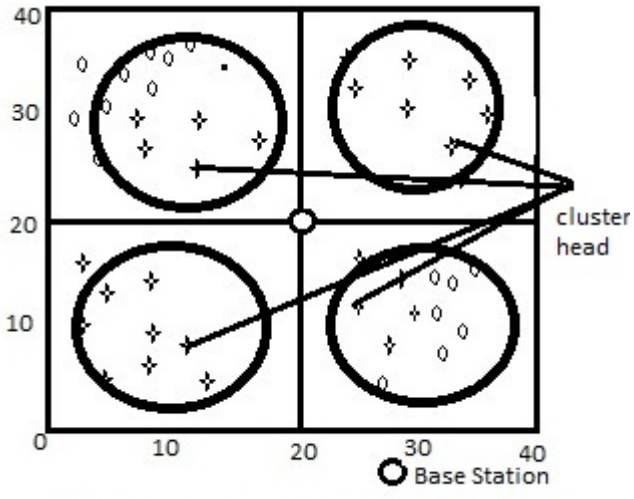

Figure 4:Selection of cluster head

$CH_{OP}=n*P_{OP}$ ---------- (a)

P_{OP} can be calculated as follows "

$P_{OP} = Z_{opt}/n=4/40=0.04$

Substituting the above the value in (a)

$CH_{OP}=40*0.04=4$------ (b)

From the equation (b) minimum number of CHs in each round will be 4. The flow chart of the cluster head selection and the proposed system is shown below (as shown in Figure 5).

4. Zone based cooperative routing protocol

Cooperative communication makes the network more stable in which the node transmitting data acts as cooperative node for nodes that is when the sensor node wants to transmit the data to the Cluster head (CH) it follows a particular path using Cooperative nodes.

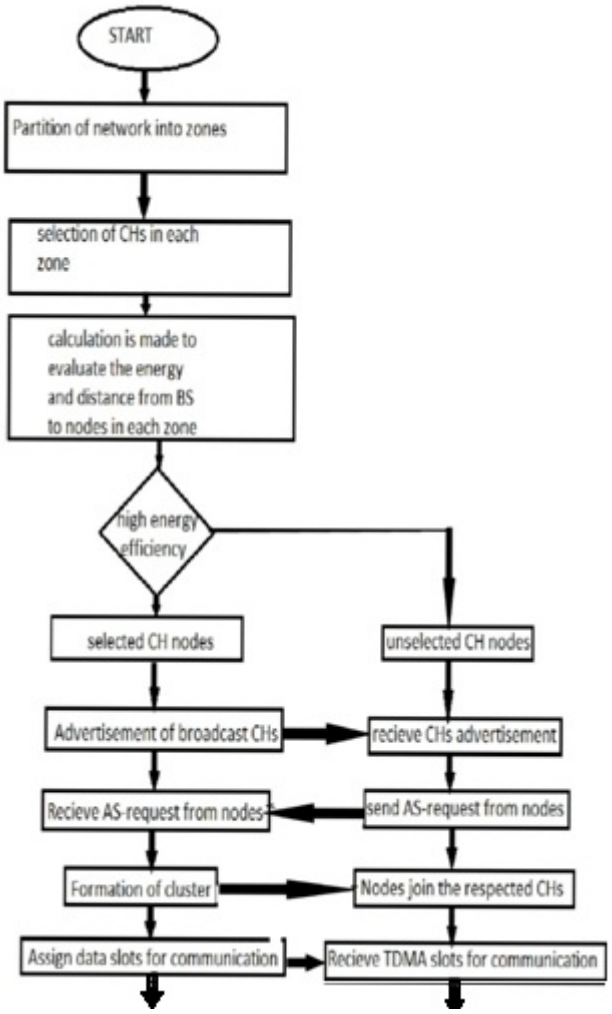

Figure 5: Flow chart of proposed system

So that the distance between the sensor node and the cluster head is minimized using cooperative Node, the Transmission time can be minimized, hence the Energy efficiency can be achieved, this process is Cooperative communication scheme.

5. Energy aware Threshold based routing protocol

The operations of proposed system are divided into rounds like other clustering protocols. Network

designer will finalize and design the time of each round as per the application and also considering the environment of sensor network. Each round in operation is further sub partitioned into two phases i.e. Network Initialization and network transmission phases. Firstly, during network initialization phase clustered head are selected and clusters are created, in network transmission phase the actual communication takes place where the nodes send data to CHs and CHs forward the data to base station(BS) by aggregating as super frame.

IV. Performance Measures

By following the proposed system we can select an energy efficient cluster head, which leads to longer network lifetime and better stability and efficient energy management compared to other distributed clustering routing protocols.

Simulation Setup and Parameters:

The 100 nodes are randomly deployed in and 40m x 40m with base station located at middle. The different simulation setup are used by changing the deployment of nodes. The simulation parameters are data packets size 2000 bits, initial energy of 5J, the transmitter and receiver energy at 50nJ/bit.

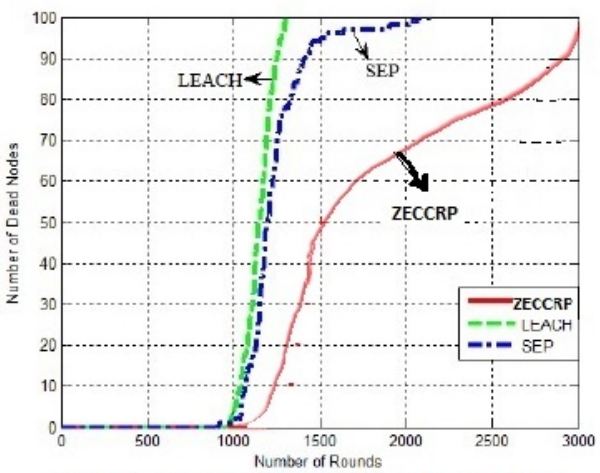

Figure6: Total number of dead nodes for 40m*40m area

Simulation Results:

We use MATLAB to obtain the required results. Our proposed protocol simulated for 3000 rounds and results are recorded for LEACH[16], and SEP[13] to get Alive and Dead states per round and tabulated in the Figure 6. The results shows the improved overall throughput and the lifetime of WSN. The ZECCRP has efficient number of cluster heads and creates equal number of regions. The feature of static clustering and efficient number of cluster heads will increase the throughput of ZECCRP than the other two protocols.

V. Conclusion

In this paper, we have proposed feasible solution for energy management in Cooperative Zone based routing protocol. The main focus of the paper is to enhance the network life time with efficient energy and cluster head selection process by dividing the whole network into multiple zones. In our proposed method the network life time and stability can be optimized. As a future work, we intend to develop simulations to analyze the performance of the proposed solution based on various network parameters like Energy Consumption, packet overhead and Network life time.

References

[1] Thenmozhi E, Audithan S. Energy efficient cluster head selection and data convening in wireless sensor networks. Indian Journal of Science and Technology. 2016 May 9; 9(15). DOI: 10.17485/ijst/2016/v9i15/77749.

[2] Zhong Zhou, Shengli Zhou, Jun-Hong Cui, and Shuguang Cui. Energy efficient cooperative communication based on power control and selective single-relay in wireless sensor networks. IEEE Transactions on Wireless Communications. 2008 Aug; 7(8):3066-78

[3] Siva D.Muruganathans SD, Ma DC, Bhasin RI, Fapojuwo AO. A centralized energy-efficient routing protocol for wireless sensor networks. Communications Magazine. 2005 Mar; 43(3):8–13.

[4] Reza Aminzadeh, Fred Kashefi. Energy Efficient Cooperative Communication in Clustered Wireless sensor Networks.

[5] Karanam Ravichandran Dayananda, Jeremy Straub.Zone based hybrid approach for clustering and data collection in wireless sensors networks.

[6] R. Varun Arvin, Raj RR, Prakash NK. Industrial Automation using Wireless Sensor Networks. Indian Journal of Science and Technology. 2016 Mar 10. 9(11). DOI: 10.17485/ijst/2016/v9i11/88455.

[7] Komal Patel. Topology issues in wireless sensor network. International Journal of innovation research in technology and science.

[8] A. F. M. Shahen Shan, Islam MS. A survey on cooperative communication in wireless networks. International Journal of Intelligent Systems and Applications. 2014 Jun 1; 6(7):66.

[9] SK. Baji Baba, Rao KM. Improving the network life time of a wireless sensor network using the integration of progressive sleep scheduling algorithm with opportunistic routing protocol. Indian Journal of Science and Technology. 2016 May 16; 9(17).DOI: 10.17485/ijst/2016/v9i17/93011.

[10] Shalli Rani, Malhotra J, Talwar R. Energy efficient chain based cooperative routing protocol for WSN. Applied Soft Computing. 2015 Oct 31; 35:386–397.
[11] S. Taruna, Jain Kusum Lata, Purohit G.N.Zone Based Routing Protocol for Homogeneous Wireless Sensor Network. International Journal of Ad hoc, Sensor and Ubiquitous Computing Vol.2, No.3. September 2011.
[12] Suri P, Bedi RK, Gupta SK. Various clustering protocols used in Wireless Sensor Network (WSN). 2015 International Conference on Electrical, Electronics, Signals, Communication and Optimization (EESCO); 2015 Jan 24. p. 1–4.
[13] Zain ul Abidin jaffri and Yueping Cai. Zone And Energy Threshold based Clustering Routing for wireless sensor networks. 978-1-4799-3572-7/14/$31.00 2014 IEEE.
[14] Spriti Thakur and Gurleen kaur Shergill. A stable and energy efficient zone based cooperative routing protocol for wireless sensor network. Indian Journal of Science and Technology, Vol 9(26), Dol:10.17485/ijst/2016/v9i26/95357, July 2016.
[15] Prabhat Kumar, Jyothi Prakash Singh, Deepak Kumar and M. P. Singh. Energy efficient multi-hop routing based on improved LEACH-CE for wireless sensor network.978-1-4799-8641-5/15/$31.00 2015 IEEE.
[16] Sadek A. K., Yu, W., and Lui, K. J. R. On the energy efficiency of cooperative communication in wireless sensor networks.ACM Trans sensor network.Vol. 6, No. 1, Article 5, December 2009.DOI=10.1145/1653760.1653765.
[17] Juanfesi Shi, Anna Calvers, Ye Cheng and kai liu. A novel power efficient location-based cooperative routing with transmission power-upper-limit for wireless sensor networks. Sensors 2013, 6448-6476; doi: 10.3399/s130506448.
[18] Shilpa P. Kamble, Mrs. N. M. Thakare, Mr. C.R. Pote. Energy efficient routing based on clustered with hybrid protocol in wireless sensor network. International Journal of Advanced research. Vol 4, Issue 4, April 2014.
[19] S. A. Sahaaya Arul mary, Gnandurai jasmine beulah, Dr. D. Y. Patil. A zone based clustering protocol for wireless sensor networks.ISBN: 978-1-61804-276-7.
[20] Xiao Chen, Zanxun dai, Wenzhong li, Hongehi shi. A layer -based routing protocol for heterogeneous wireless sensor networks.IEEE ICC 2012 - Ad-hoc and sensor networking symposium.

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