# Energy Aware Zone-based Clustering Algorithm in WSNs

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***Abstract***— **Recent advances in the wireless sensor network introduction many protocols specially designed for sensor networks, different traffic models and energy efficiency techniques in Wireless Sensor Networks (WSN) so far. Most of the clustering protocols planned for the nodes are stationary. But, in applications like habitat monitoring those clustering mechanisms are invalid, so the static environment of sensors is not real. This paper proposes an effective clustering based on 'Energy Aware Zone-based with Splitting and Merging Clustering Algorithm in WSNs EZSMCA' protocol for WSN aiming at energy consumption, reduced traffic. Simulation results also show that EZSMCA outperforms existing LEACH and HEED protocols in terms of network lifetime and energy consumptions.**

***Index Terms***— **WSN; Energy efficiency; Network traffic; Clustering; Split and Merge.**

## I. Introduction

Owing to the developments and growth in Micro-Electro-Mechanical System (MEMS) technology and wireless communication technology, wireless sensor networks (WSNs) are becoming ever more attractive for several application areas, such as disaster management, military, habitat monitoring, medical and health, industrial automation, etc. [1,2]. Thus, WSNs have achieved to establish the connection between the physical world, the computing world and human society. So, wireless sensor networks have collected a great study interest in recent years. Especially, they have advantages in unreachable environments, such as difficult terrains, or on a spaceship [1]. Generally a sensor node consists of sensing elements, microprocessor, limited memory, battery, and low power radio transmitter and receiver. Sensor nodes are usually unattended, resource-constrained, and rechargeable in wireless sensor networks. And thus allocating power consumption to all nodes is a major design factor since the system lifetime of wireless sensor networks is limited [3].

Usually routing protocols on the source of network structure are distributed into three main groups: hierarchical, flat and location-based routing. Now, the hierarchical routing also known as 'cluster-based routing', proposed in wireless sensor network. In direction to maintenance the data collection, complete, effective network group, nodes can be divided into the number of small groups called clusters. In the hierarchical network structure, each cluster has a leader, which is also called the cluster head (CH) [4]. Cluster formation, development eventually leads to a two-level hierarchy everywhere cluster-member nodes of the small level and the cluster head (CH) nodes from the highest level. Cluster-member nodes sometimes transmit their data to the interrelated CH nodes [6]. The CH nodes collective the data and transmit them to the base station (BS) moreover directly or through the intermediate communication with extra CH nodes [7]. But, since the CH nodes send all the time data to higher distances than the cluster-member nodes, they of sequence use energy at higher rates. Overall solution in order to balance the energy consumption between all the sensor nodes is to sometimes reconfirm new CHs in each cluster [5]. Energy consumption in the network can be reduced by forming cluster structures in an efficient way.

Motivated by the past research of the clustering algorithm, the detached of this paper is to study an Energy Aware Zone based Clustering Algorithm in Wireless Sensor Networks, which can understanding with stochastic distribution of sensor nodes. The sensor nodes are uniformly distributed, completed the sensor field, by which the network area is divided into multiple equal zones. In each zone, the range of cluster is calculated based on distance from the base station, distribution, and weight of node such as density of sensors and residual energy of nodes to form cluster head. Also determining the algorithm split otherwise merge clusters. This activity is made by monitoring the size of the clusters in self organized ways.Type Style and Fonts

## II. Related Work

Low-Energy Adaptive Clustering Hierarchy (LEACH) [8] is a first hierarchical clustering protocol. The LEACH has been a creative for many later clustering routing protocols. Leach uses the randomized rotation of cluster heads to uniformly distribute the energy consignment among the sensors nodes in the network. The cluster heads have the charge of gathering data from their clusters, while also to aggregate the collected data for decreasing the amount of messages to be sent the BS, the result in less energy dissipation, to enhance the network lifetime. This protocol is divided into rounds; every round consists of two phases. The first phase is a Set-up phase - organizing the cluster. Another phase is a Steady-state phase - deals with the actual data transfers to the base station.

Initially, when clusters are being created, each node selects to become a cluster-head for the current round based on the given threshold value.

The threshold value calculated by

$$T(n) = \begin{cases} \frac{P}{1-P[\,r^{*}mod\left(\frac{1}{P}\right)]} & if\ n \in G \\ 0 & otherwise, \end{cases} \quad (1)$$

Where n is the given node, P is the prior probability of a node being elected as a cluster head, or is the current round number and G is the set of nodes that have not been elected as cluster heads at the end 1/P rounds. Each node during the cluster head selection will generate a random number between 0 and 1. If this number is lower than the threshold (T (n)) the particular node will develop into a cluster head. The LEACH algorithm only studies the probability for each node to become the cluster head. Leach randomly select cluster head, which may result faster death in few nodes. Highly dynamic clustering brings extra overhead. Additionally, LEACH allows building single-hop routing within the cluster and a large number of clusters might be formed consequently, causing greater energy consumption of communications.

Hybrid energy efficient Distributed Clustering (HEED) [9] algorithm overcomes the shortcoming of unevenly distributed cluster heads as enjoyed by the LEACH algorithm It is a multi-hop clustering algorithm for wireless sensor networks. The most important of HEED is the method of cluster head selection. Cluster head is chosen based on two important parameters. One parameter rest on the node's residual energy, and the other parameter is the intra-cluster communication cost as a function of cluster density. HEED algorithm is distinguished from the LEACH in cluster head selection mechanism. Meanwhile, the speed of clustering in the HEED algorithm is also improved and the cost of communication within the cluster has been taken into account.

Power-Efficient Gathering in Sensor Information Systems (PEGASIS) [10], a near best chain-based protocol that is an improvement over LEACH. The PEGASIS is for each node to receive from and transmit to close neighbors and take turns being the leader in transmission to the BS. It will be distributing the energy load evenly among the sensor nodes in the network. It is a data-gathering and near-optimal chain-based algorithm that establishes the design that energy conservation can outcome from nodes not directly forming clusters. This protocol is able to better than LEACH for different network sizes and topologies.

Power-efficient zoning clustering algorithm (PEZCA) [11] algorithm is a wisely organizes the network via unequal clustering and multihop clustering algorithm for wireless sensor networks. PEZCA divides its network into multiple fan-shaped regions and all regions are numbered from 1 to N placing BS at the center. Each region is considered as a cluster. Then, CH to CH data communication data to BS. To extend the network lifetime by minimizing energy consumption.

## III. PROBLEM OUTLINE

### *3.1. Network model*

We assume that the sensor network consists of a number of sensor nodes. To make the network model, the following expectations are made about sensor nodes [12].

- The locations of all sensor nodes in the Network.
- The deployment of sensor nodes is randomly distributed.
- In this field, the broadcasting range of EZSMCA is set to 10m.
- The data packet size is 1,000 bits, and also the signal packet size is 50 bits.
- All sensor nodes have an initial energy of 100.
- The test utilized the normal of the performances of 10 different deployments of sensor nodes in the sensor fields.
- In the experiments, the number of sensor nodes is 150, except for scalability experiments.

### 3.2 *Energy consumption model*

We use the same energy consumption model used in EZSMCA. The energy spent for transmitting a l-bit message over distance d is where Eelec is the energy dissipated per bit to run the transmitter or the receiver circuit, εfs or εmp, is the energy dissipated per bit to run the transmit amplifier. To receive this message, the expended energy is

$$E_{Rx}\,(1) = E_{elec} \times 1 \quad (2)$$

The consumed energy of grouping m messages with l-bit is

$$EA(m,1)=m\times 1\times EDA \quad (3)$$

Where EDA is the energy dissipated per bit to aggregate message signal.

### *3.3 Problem statement*

In the cluster-based WSNs in which the CHs transmit data to BS from one-hop communication, there are three reasons leading to unbalanced energy dissipation:

- A CH often spends more energy than a member.
- The amounts of receiving data of CHs are different.
- The distances of transmitting data of CHs in different regions are different.

*3.4 Proposed*

It is a leading fact that the energy-efficiency and lifetime of WSNs is extremely influenced by self-organization and clustering process. The possible applications of clustering algorithms (such as LEACH, HEED, PEGASIS, PEZCA, etc.), proposed previously, are in evenly distributed WSNs without considering the distance from the base station and It can't cover a large network. However, in the practical application of WSNs, the nodes are usually randomly arranged. Other importantly, in cluster-based hierarchical sensor networks, energy efficiency is more pretentious by the distance between sensor-nodes and base-station, the amount of data aggregated and forwarded to the base-station. To address this important issue, new Energy Aware Zone-based with Splitting and Merging Clustering Algorithm in WSNs (EZSMCA) is proposed to self organize the network into clusters in an energy-efficient way. Also reducing the clustering and increase network lifetime.

*A. Initialization*

The two main key elements considered in the design of EZSMCA are zoned-formation and hierarchy of nodes, Network area can be divided into n-zone (nine zones division). A zone is a geographical division of the network area. For the design purposes, network area is initially divided into nine zones by considering the network size. The number of zones is fixed at the initial setting; however, depending on the network size and node density, each zone can be additional divided into sub-zones. Then Each zone is a subset of clusters, and each cluster is a subset of cluster-member nodes.

Zone-formation is made by Cartesian Co- ordinate System (CCS) and describe the area in which sensor nodes are placed as X-Y plane.

$$XY=[xm/3,ym/3] \tag{4}$$

Eq (4) Divide X & Y axis into 3 equal parts generating zones.

Each zone represents a cluster and every zone will get some amount of nodes. This amount is not fixed and cannot be judged before the placement of the sensor nodes.

The number of partitions of network area is done with an approach that the network traffic is powerfully managed. Dividing the total distribution area into similarly distributed clusters/ zones help us to balance the network traffic and to reduce traffic load. All sensor nodes from a cluster send data to their particular CH and CH in a transfer that data to the BS. The clusters (zones) are heterogeneous; that is, in each zone there may have different number of nodes. In this protocol the balanced cluster heads achieved by using in the algorithm. Each zone selects one CH in each round. The number of CHs is fixed throughout the simulation until a complete cluster is alive.

*B. Cluster Head Selection*

A distributed approach to create a hierarchical structure in self-organizing method without central control. Then the nodes St calculates its connected density and distance from the base station to decide cluster radius k, and to develop the temporary cluster head.

$$K=Pi[\beta D(St)/Dk(St)+M(s) \tag{5}$$

Where D (S) is the distance from the base station of s, Dk (S) is the connectivity density of node s, β is the sensor parameters determined by particular applications of WSNs, Pi is the calculation of rounding. M (u) is, the less mobility.

D(s) can be calculated as follows.

$$D(s)=10|RSSI-A|/10.n \tag{6}$$

Where RSSI is received signal strength indicator, and A is the signal strength with 1 meter distance from the base station.

*C. Cluster formation*

To decrease the communication cost, the algorithm systematizes boundary sensors into several clusters. At the clustering process, the process splits and merges constant, to balance clusters and decrease the costs of clusters. The clustering has set the threshold of cluster size. If a cluster is larger than the maximum cluster size, the cluster is split into two clusters. If a cluster is smaller than the minimum cluster size, the cluster is merged into the another cluster. However, that paper presents the concept of splitting and merging to achieve the load balancing. When the cluster head node receives Join_Message sent by the ordinary node, it will match the size of the cluster with threshold to larger than the maximum clusters size the cluster divided into two clusters that is splitting. If the number of cluster member of a cluster is less than the threshold to small then the minimum cluster that is merging cluster. To merge small clusters into large *clusters*. The actual process of splitting and merging is not addressed. The energy-balanced communication algorithm focuses on the energy efficiency problem of transmitting sensor nodes to event areas. To decrease the energy consumption of dispatching sensor nodes, the algorithm assigns each transmitting sensor node to each cluster. To reduce the energy consumption of CHs and CMs, and also adjusts the size of the clusters and prolongs the network lifetime.

As soon as a cluster head is selected for a cluster, all the cluster members of that area send the collected or sensed data to the cluster head. Then cluster head performs the transmits this collected data and compression on data and sends it to the base station which completes is called the Steady State Phase.

The cluster is stable for a but until the process of a re-electing cluster head. The cluster head collects the weight of all member nodes, and at that time selects the node with highest weight as the next cluster head node. In this approach, the communication costs are reduced. The re-electing of cluster head monitors in the 'same' cluster, so the transmission of temporary head and the consistent responses of all the k-hops neighbours are unnecessary.

## IV. SIMULATION RESULTS

In this paper, the network size considered as 1500*1500m, maximum transmission range are set to 150m and density of nodes are 100, 200, 300 for finding the lifetime of CH. From Fig-1 we evaluate the throughput of EZSMCA with various existing algorithms like LEACH and PEZCA. The error decreases when we increase the zone size and the number of zones and when we number of nodes with the zone radius. When we increase the radius of the zones the number of received packets are also increasing.

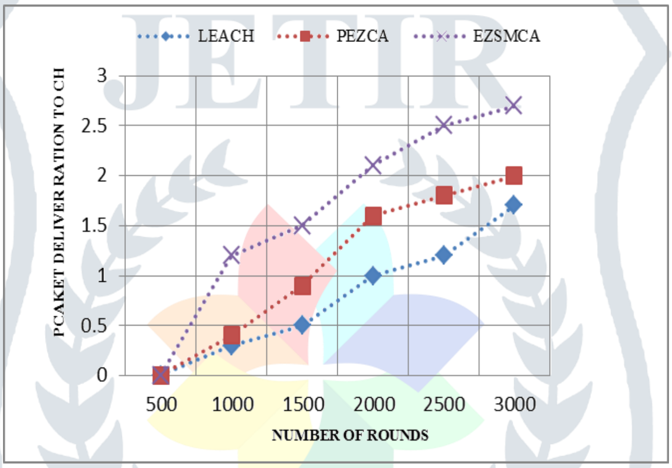


*Fig. 1. Comparative throughput (Number of packets to the CH)*

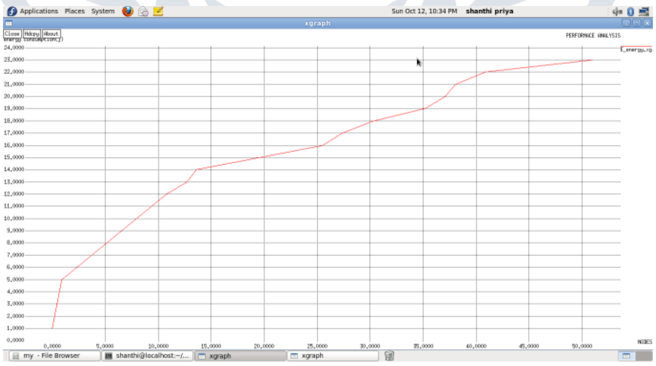

*Fig.2. Energy consumption of nodes for cluster selection*

we evaluate the amount of energy consume by sensor-nodes for sending the sensing data to the base-station in EZSMCA.

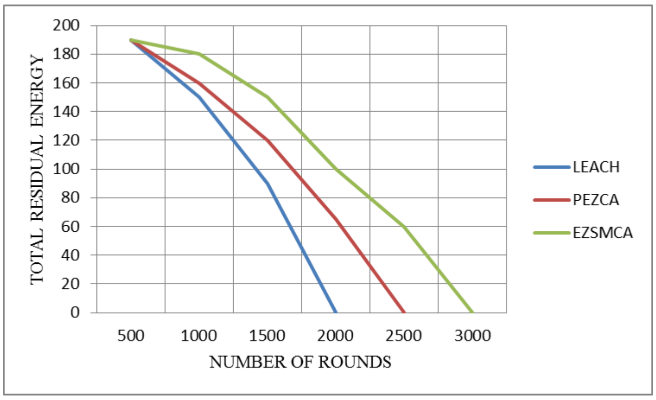


*Fig.3. The total residual energy comparison with rounds*

*Fig.3* shows the amount of energy at all sensor nodes in network lifetime. This plot shows that our patterns have more desirable energy expenditure than those of LEACH and PEZCA. Thus the distance required for data transmission is closer than that of LEACH. Consequently, the short transmission distance in our schemes allows less energy consumption at all sensor nodes.

## V. CONCLUSION

This paper has proposed an energy-efficient and traffic control clustering model, called EZSMCA. The proposed model is challenged to maximize the network lifetime and maintain traffic through the selection of CHs and by resizing clusters finished combined techniques of benefits of cluster-based routing. Since the simulation results, the proposed routing protocol distributes the load uniformly with the proper cluster formation through the network and enhances the sensor network lifetime. This algorithm is feasible and has superior performance.

## REFERENCE


[1] Akyildiz, W. Su, Y. SankaraSubramanian, E. Cayirci, "Wireless Sensor Networks: A Survey" Elsevier Computer Networks, vol. 38 pp. 393-422, Dec- 2002.

[2] Sridhar Sharma "A Survey of Hierarchical Routing Protocols in Wireless Sensor Networks" International Journal of Advanced Research in Computer Science and Software Engineering, pp. 140-146, Dec – 2013.

[3] PavlosPapageorgiou,"*Literature Survey on Wireless Sensor Networks*" Jul-2003

[4] Katayoun Sohrabi, Jay Gao, Vishal Ailawadhi and Gregory J Pottie, "Protocols for self-organization of a wireless sensor network", IEEE Personal Communications, Vol. 7, pp. 16–27, 2000.

[5] Rex Min, Manish Bhardwaj, Seong-Hwan Cho, Eugene Shih, Amit Sinha, Alice Wang " Low power wireless sensor networks", In Proceedings of International Conference on VLSI Design, Bangalore, India, Jan- 2001.

[6] Ossama younis, Marwan Krunz, and Srinivasan Ramasubramanian "Node Clustering in Wireless Sensor Networks: Recent Developments and Deployment Challenges" , University of Arizona IEEE networks June – 2006.

[7] M. Sangeetha, A. Sabari, T. ShanthiPriya " A Review: Comparative Study of Enhanced Hierarchical Clustering Protocols in WSN" International Journal of Computer, Information, Systems and Control Engineering Vol.8 No.8, Aug 2014.

[8] W. Heinzelman, A. Chandrakasan, and H. Balakrishnan, "Energy Efficient Communication Protocols for Wireless Sensor Networks", In Proceedings of the 33rd Annual Hawaii International Conference on System Sciences (HICSS), Big Island, Hawaii, USA, pp. 3005-3014, Jan-2000.

[9] O. Younis, S. Fahmy," HEED: A hybrid, energy-efficient, distributed clustering approach for adhoc sensor networks", IEEE Trans, Mobile Comput, pp. 366–379, Dec-2004.

[10] Stephanie Lindsey, Cauligi Raghavendra, Krishna M. Sivalingam. "Data gathering algorithms in sensor networks using energy metrics", IEEE Trans, Parallel Distrib., pp. 924–935, Sep-2002.

[11] F.-E. Bai, H.-H. Mou, and J. Sun, "Power-efficient zoning clustering algorithm for wireless sensor networks," in Proceedings of the International Conference on Information Engineering and Computer Science (ICIECS '09), pp. 1–4, December 2009.

[12] Shen Bo, Zhang Shi-yong, Zhong Yi-ping. Cluster-Based Routing Protocols for Wireless Sensor Networks[J]. Journal of Software, 2006,17(7):1588-1600.