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Review on Clustering and Routing Algorithm to Prolong the Lifetime of Wireless Sensor Network

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Abstract: Wireless sensor network contains the huge number of power constrained sensors, which collect data from other sensors and transmit them towards the base station in a manageable manner. Sensing and transmitting data require high energy. Energy saving is a great challenge in wireless sensor network. Clustering techniques are use to reduce the energy consumption in wireless sensor network. Here we discuss some clustering techniques for heterogeneous and homogeneous wireless sensor network.

Keywords: Energy Consumption, Clustering, Wireless network, Heterogeneous, Homogeneous environment.

I. INTRODUCTION

Wireless sensor network consists of geographically dispersed autonomous devices using sensors to accordingly monitor environmental or physical conditions, such as vibration temperature, sound, pressure, act or pollutants, at remote locations [3]. This network contains a large number of nodes which sense data from an impossibly impassable area and send this data to the center called" sink". Since, sensor nodes are energy-constrained devices, intermittent and long-distance transmissions should be kept to minimum in order to increase the lifetime of wsns. The antenna is very important device to receive the signal which is having good directivity [17]. Therefore, direct communications between nodes and the sink are not determined. One adequate idea is to divide the network into number of clusters; each cluster will select one node as its cluster head. The cluster head collects data from other sensors into the clusters which have low energy and transmitted to the base sink. Therefore, only some nodes are needed to transmit data over a long distance and the remaining nodes will require doing only short-distance transmission. The material of the antenna is also an important parameter for efficient transmission explain in [16].Then, more energy is saved and overall network lifetime can thus be prolonged. Many energy-efficient routing protocols are designed based on the clustering structure where cluster heads are elected periodically.

These techniques can be extremely effective in broadcast and data query. Network Lifetime can be enhanced a lot by using clustering approach. LEACH is one of the protocols based on cluster that forms distributed clusters in which the nodes elect themselves as cluster heads with some probability. Most of the Clustering algorithm based on LEACH protocol [15].

Types of wireless network

There are two types of wireless sensor network, Homogeneous network and Heterogeneous network.

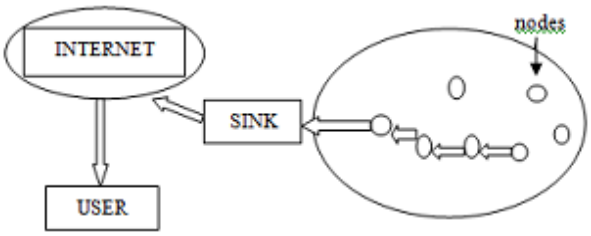

Fig.1 Wireless Sensor Network

Homogeneous Network

In homogeneous networks all the sensor nodes are equivalent in terms of battery energy and hardware convolution [1]. In static clustering (cluster heads elected once and serve for the entire lifetime of the network) in a homogeneous network, it is obvious that the cluster head nodes will be over-loaded with the long distance transmissions to the remote base station, and the extra processing which is necessary for data aggregation and protocol systemization. The cluster head nodes expire earlier than other nodes. However it is captivities to ensure that the battery of all the nodes reduce at the same time, so that very little residual energy is wasted when the system expires. The approach to ensure this is to rotate the role of a cluster head simultaneously and periodically over all the nodes as introduced in LEACH.

Heterogeneous Network

In a heterogeneous sensor network, two or more distinct types of nodes with different battery energy and performance are used [1]. The consideration to construct heterogeneous network is that the more complex hardware and the extra battery energy can be embedded in few cluster head nodes, which reduce the hardware cost of the rest of the network. However fixing the cluster head nodes ensure that rotation of role of cluster head is no longer possible. When the sensor nodes use single hop to reach

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the cluster head, the nodes that are at long distance from the cluster heads always expend more energy than the nodes that are near to the cluster heads. On the other side when nodes use multi-hop to reach the cluster head, the nodes that are close to the cluster head have the highest energy due to broadcasting. Therefore always exist a non-uniform energy reduction pattern in the wireless sensor network.

Thus there are two admirable characteristics of a sensor network is lower hardware cost, and uniform energy drainage [5]. Whereas these features cannot be consolidate in the same network. The motive of this study is to compare these two sensor networks homogeneous and heterogeneous from the point of view of the overall network cost by the criteria of all the energy-hardware trade-off.

II. LITERATURE REVIEW

A. Distributed energy efficient clustering protocol for wireless sensor network

Author Li Qing, Qingxin Zhu and Mingwen Wang gives the clustering protocol DEEC for Distributed wireless sensor network in which, the cluster head are elect by a probability based on the ratio between residual energy of each node and the average energy of network.[5] In Distributed energy efficient clustering protocol, the possibility of being cluster head for nodes are different according to their initial residual energy, and the node which have high initial and residual energy have more chance to become cluster head. DEEC estimate the ideal value of network lifetime to compute the reference energy that each node should dissipate during each round. In a two-level heterogeneous network, where we have two types of nodes, m. N advanced nodes with initial energy equal to Eo.(1+a) and (1 − m).N normal nodes, where the initial energy is equal to Eo. Here a and m are two variable which control the nodes percentage types (advanced or normal) and the total initial energy in the network Etotal.
The value of Total Energy is given as

$$Etotal = N.(1-m).Eo+N.m.Eo.(1+a)$$

The average energy of rth round is set as follows

$$E(r) = 1/N\ Etotal\ (1-R)$$

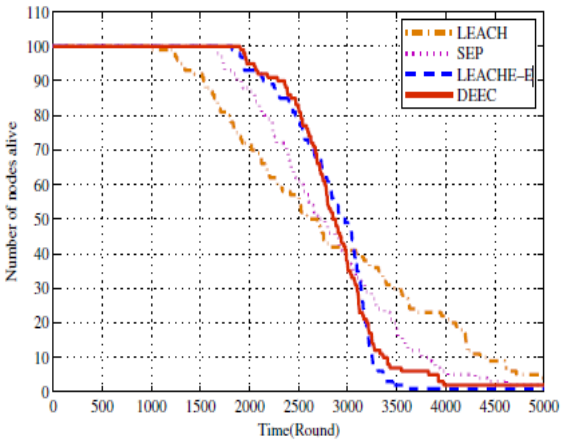

Fig. 2 Performance of DEEC

B. An Efficient Cluster Head Selection and Aggregation for Wireless Sensor Networks

Author P.Varalakshmi, R.Nandakumar, M.Umadevi introduced the clustering protocol ECSHA (Energy efficient cluster head selection and aggregation) to minimize the energy consumption of nodes. Selection of cluster head in ECSHA is based on the number of neighbor, residual energy and distance of a node from the center and they also reduce the number of transmissions. [4] In this protocol nodes are randomly distributed and each node has a unique identifier. Here the position of base station (BS) and sensor nodes are fixed; all sensors are initialized with same energy. Author used RSSI (Received Signal Strength Indicator) to measure the distance between nodes. All sensors sense the environment and they will always have data to send to the BS. The packet sends from node to cluster head and cluster head to base station have the same size. Cluster Head prepares a TDMA slot for its member for collecting data. If the newly collected data falls within the filter setup it will not be transmitted to the base station. Since sensor data are highly correlated and hence we can reduce the number of transmissions. Here ECSHA protocol compare with K Means algorithm, energy dissipation is less in ECSHA in comparison to K Means algorithm.

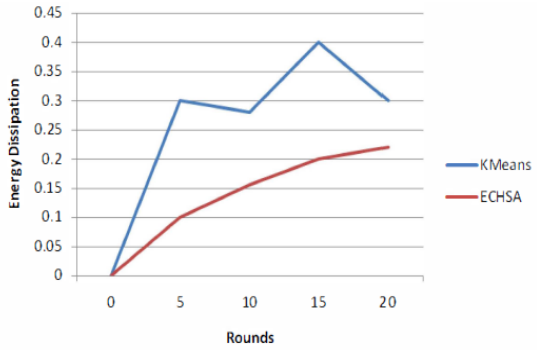

Fig.3 Performance of ECSHA

C. Energy Efficient Clustering Scheme for Prolonging the Lifetime of Wireless Sensor Network with Isolated Nodes

Author Jenq-Shiou Leu, Tung-Hung Chiang, Min-Chieh Yu and Kuan-Wu Su, introduced the algorithm for distributed wireless sensor network (Regional Energy Aware Clustering with Isolated Nodes) REAC-IN [10]. Improperly designed distributed clustering algorithm can cause nodes to become isolated from cluster head. Such isolated nodes communicate with the sink by consuming excess amount of energy. Whereas in REAC-IN cluster head select according to the regional average energy and distance between sensor and the sink are to determine whether the isolated nodes sends its data to a cluster head or to the sink. Previously in LEACH the cluster head select based on the threshold which is calculated by the suggested percentage of cluster heads for whole network, this selection algorithm divided into several rounds .During the first round (r=0),each node has a probability to become a cluster head. The nodes that are cluster head in round 0 cannot be a cluster head for consecutive round.

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While in REAC-IN the value of p choose based on residual energy and regional average energy of all sensors in each cluster. For prolong delay metrics for ramp input to the more general and realistic non step input we use PERI technology [22]. Here Author used First Order radio model as the power consumption model for the data transmission between the transmitter and the receiver. REAC-IN compared with other distributed clustering protocol HEED, DEEC, LEACH by using four performance metrics including the variance of energy level, the number of nodes alive, number of data received at the sink and the average life time.

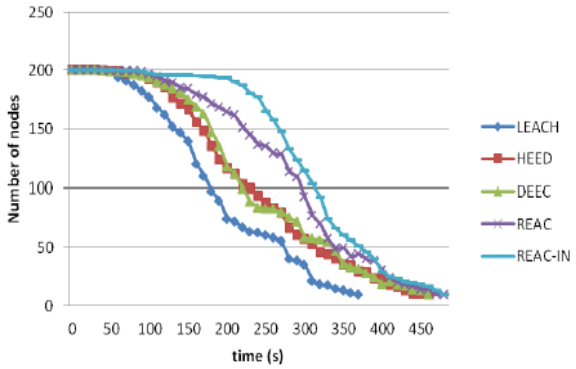

Fig.4 Performance of REAC-IN (Number of nodes alive).

D. Two Energy-Efficient Cluster Head Selection Techniques Based on Distance for Wireless Sensor Networks

Author Tri Gia Nguyen, Chakchai So-In, Nhu Gia Nguyen introduced two energy efficient protocols based on LEACH protocol, DB-LEACH (Distance-Based LEACH) and DBEA-LEACH (Distance based energy aware)[13]. The first approach (distance-based) selects a cluster head node by considering geometric distance between non cluster head nodes to the base station. In this scheme a node is more likely to be selected as a cluster head if the distance of it from the BS is nearly equal to the average distance of the network sensor nodes to the BS. In CH nodes selection phase of DB-LEACH algorithm, each sensor node generates a random number between 0 and 1. Then the random number is compared with improved threshold obtained. While DBEA-LEACH algorithm takes important factors such as position of the sensor node relative to the BS and the amount of residual energy of each sensor node. Similar to DB-LEACH, DBEA-LEACH establishes a new threshold based on distance. In addition, it introduces current energy and initial energy of the node to CH election probability so as to ensure these nodes with higher remaining energy have greater probability to become CHs than that with the low remaining energy. The CH nodes selection directly affects the performance of WSN such as load distribution, energy efficiency, and network lifetime. Here the graph shows the comparison of DB-LEACH and DBEA-LEACH with K-LEACH, LEACH and T-LEACH, DB-LEACH has low number of dead nodes than other three protocols but more than DBEA-LEACH and DBEA-LEACH protocol has the lowest number of dead nodes compared with other protocols .DB-LEACH and DBEA-LEACH algorithm is more energy efficient protocol than LEACH, T-LEACH and K-LEACH.

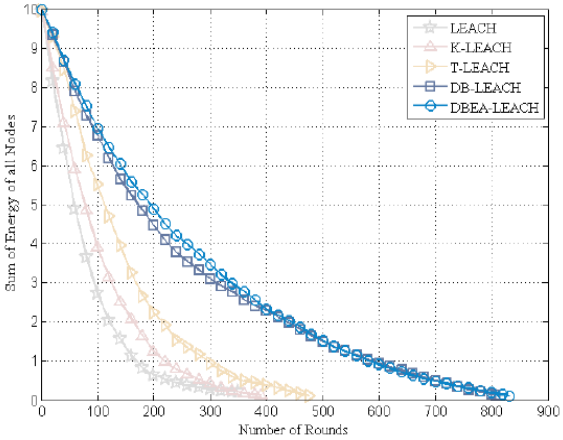

Fig.5 Performance of DB-LEACH and DBEA-LEACH

E. An Extend Vice-Cluster Selection Approach to Improve V -LEACH Protocol in Wireless sensor network.

Author Mrs. Asha Ahlawat, Ms Vineeta Malik introduced the concept of V-LEACH (Vice Cluster Head) [9]. The Vice Cluster head is that alternate cluster head that will perform only when the main cluster head will die. The process of vice cluster head selection is based on three factors i.e. Minimum distance, maximum residual energy, and minimum energy. Once the cluster head will die it will be replaced by it's vice Cluster head. On the basis of received signal strength, each non-cluster head node elect its cluster head, if the signal strength is greater that means the distance between them is shorter and if distance is small then for the transmission, less energy is required .The V-LEACH protocol will improve the network life as never the cluster head will die. As a cluster head will die it will be replaced by it's vice Cluster head. By doing this, cluster nodes data will always reach the BS; no need to elect a new CH each time the CH dies. This will extend the overall network life time. Here the comparison of V-LEACH with original LEACH, the number of alive nodes in V-LEACH is more than the original leach.

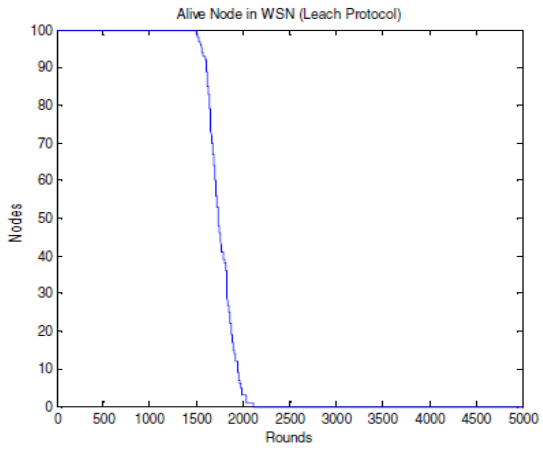

Fig.6 Alive nodes in LEACH Protocol.

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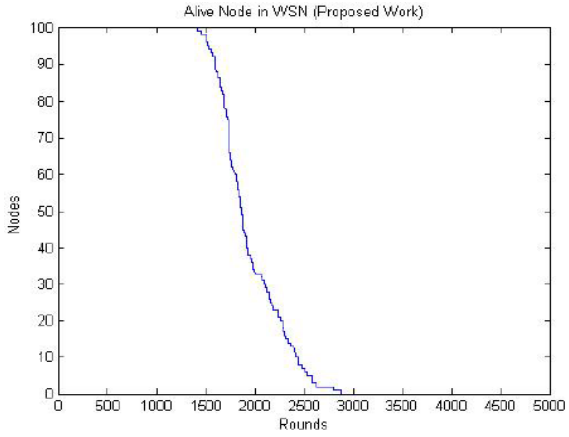

Fig.7 Alive nodes in V-LEACH Protocol

F. A Balanced Cost Cluster-Heads Selection Algorithm for Wireless Sensor Networks

Author Ouadoudi Zytoune, Youssef Fakhri and Driss Aboutajdine introduced an efficient energy aware routing algorithm for the wireless sensor Networks in which rotation selection of cluster heads considering the remoteness of the nodes to the base station, and then, the network nodes residual energy [6]. The cluster-heads selection algorithm is completely decentralized. In this algorithm the cluster head elect according to the distance of nodes to the sink. In each transmission round, to become a cluster-head each node elect itself according to the determined percentage of cluster-heads for the network and the time in which the node has been a cluster-head so far. The percentage of cluster-heads defines the possibility for nodes competition to become cluster-heads for each round. In this protocol the locations of sensors are fixed and a priori known by the base station. The sensors are in direct communication range of each other and can transmit data to the base station and receive data from the base station. The nodes sense the environment periodically and always have data to send to the cluster head in each round of communication. The nodes aggregate the data they receive from the others nodes with their own data, and generate only one packet regardless of how the number of received packets.

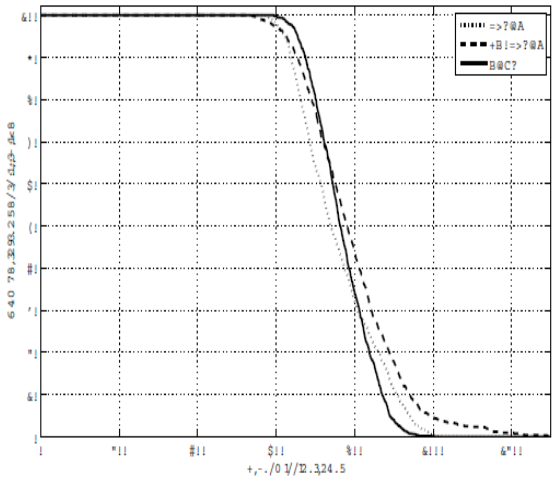

Fig.8 Maximum Packet transfer.

G. Distance Aware Intelligent Clustering Protocol for Wireless Sensor Networks

Author Navin Gautam and Jae-Young Pyun introduced the clustering algorithm, Distance aware intelligent clustering protocol (DAIC), with the key concept to divide the network into tiers and select the high energy Cluster Head at the nearest distance from the Base station[8]. Here the number of CHs in the network is set dynamically to avoid maintaining unnecessarily large number of CHs in the network. The major focus of this protocol is that the network is divided into a number of tiers and CHs are selected in each tier and gateway CHs are selected in each tier except the one furthest from the BS. Here the process flow in phases as typical hierarchal clustering algorithm, the network setup phase consist CH selection, cluster setup, routing path formation from non-CH nodes to the CH nodes, and schedule creation for transmission of data in each cluster, in routing path construction phase the BS constructs a routing path by connecting all the CH nodes in the secondary tier with gateway CHs in the primary tier, so the burden of routing distributed evenly among the CHs in the primary tier by selecting CHs near to BS. In schedule creation phase the TDMA slots determine by each node of cluster, TDMA slots reduce the possibility of collision and increase the life of nodes, Data transmission occurs in the steady-state phase of protocol operation. The major activities in this phase are data sensing and gathering, data fusion and compression, and data routing. DAIC protocol is a proactive routing protocol, i.e., the sensor nodes sense the environment periodically and transmit the sensed data to their respective Cluster Head or Base station. Figure shows the number of nodes alive in DAIC Protocol when Base station placed at center.

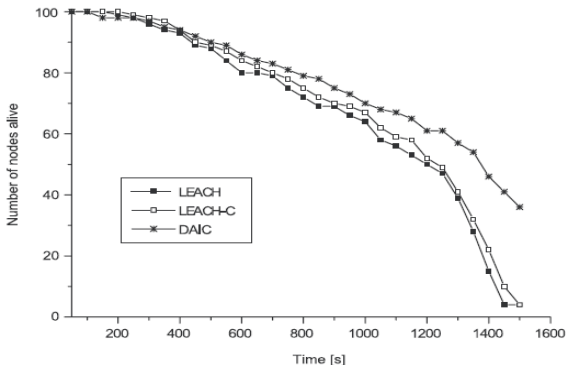

Fig.9 Number of Alive nodes in DAIC.

H. A Hybrid Clustering Algorithm for Optimal Clusters in Wireless Sensor Networks

Author Gaurav Kumar, Himanshu Mehra, Akshat R Seth, Pooja Radhakrishnan N.Hemavathi S.Sudha gives a clustering and routing protocol for wireless sensor network by using the features of hierarchal and K-Means algorithm[7]. The k-means method is numerical, unsupervised, non-deterministic and iterative. According to this algorithm, there are always 'k' clusters with at least one node in each cluster. While hierarchal clustering involves grouping the two closest clusters recursively until a single cluster arrives. The distance between clusters is

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determined by their similarity. The proposed hybrid clustering protocol select the cluster head for each cluster by computing average distance of nodes to the base station, merge two closest cluster and compute the frequency of different cluster formed during merging. In this protocol the optimal number of cluster compute by using K-Means algorithm. Compute centroid of each cluster and then declared the cluster head for each cluster is the node closest to the centroid. Here the figure shows the Hybrid hierarchal K-means clustering, distance between nodes be considered.

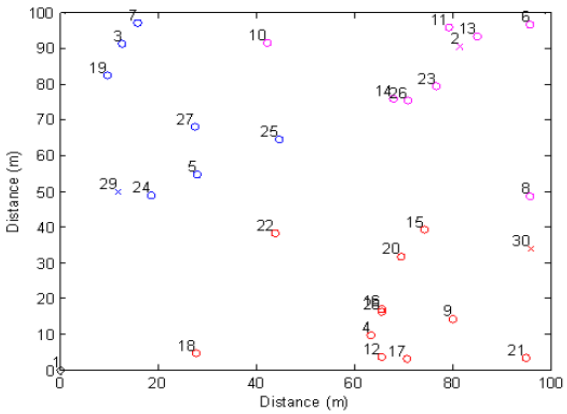

Fig.10 Selection of cluster head based on K-Means Protocol.

I. Grouping of clusters for efficient Data Aggregation in Wireless Sensor Network

Author Dnyaneshwar Mantri, Neeli R Prasad, Ramjee Prasad introduced an algorithm GCEDA (Grouping of cluster for efficient Data Aggregation in Wireless Sensor Network) [11]. The GCEDA algorithm perform in three phases Cluster formation phase, inter-cluster phase and intra-cluster phase aggregation with group of nodes and Cluster Head for communication of aggregated data packets to Base Station. In First phase, the systematically distributed node construct into the number of (n) clusters. It selects cluster head based on highest energy, minimum distance to Base Station calculate using Euclidean distance and the maximum number of neighbor nodes. In the second phase, Cluster Head is important for aggregation of data packets produced by the source nodes within a cluster.

In intra-cluster aggregation, CH sends the broad cast message and collects the data packets from different nodes at a periodic interval. It performs the aggregation of data packets based on the additive and divisible aggregation functions by forming a group of nodes. This phase runs recursively for all the clusters within the network. In the third phase, CH groups according to available data from each CH to perform the further aggregation for communicating to sink. Grouping of nodes in intra-cluster and grouping of CH at inter cluster reduces the data packet count at the sink. It reduces the effective energy required, which prolongs the network lifetime.

The enumerates an approach for adjusting and fitting the moments of the impulse response to probability density functions so as to determine the delay accurately at a very early stage. [23]

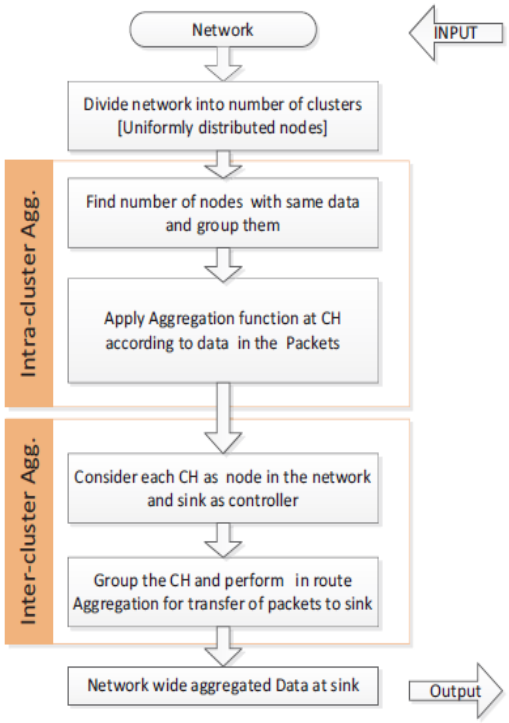

Fig.11 Work flow of GCEDA Protocol.

J. Enhanced Clustering Technique to Improve the Network Lifetime of Wireless sensor network.

Author J.Surekha, T.Tamizharasi introduced a protocol ECATCH. The ECATCH is divided into two phases. Steady State and change state [12]. In Steady State We first create three clusters in an environment with number of sensor nodes. We provide some energy then limited necessitate for two cluster head, which we going to perform further. By electing two high-energy nodes that perform as cluster head and named as primary head (PH) and secondary head (SH) in single cluster, the primary node is declared as cluster-head for the initial task. Then, the Primary Head assumed as Leader and it sends join request message to all sub nodes except Secondary Head. The status of Primary Head is idle that has to communicate with Base Station. The status of Secondary Head is in sleep mode. Data transmission is beginning from node to Primary Head then it sends data from Primary Head to Base Station. In Change State, the energy of Primary Head decrease from the defined range then swapping is made at the convenient time constrain as Primary Head to Secondary Head. Now leader of the cluster-head act as Secondary Head and join message is taken place and data are routed to Secondary Head in the next round meanwhile by doing this we can reduces the work load of single cluster and multiple cluster head extends the lifetime of network. Primary Head and Secondary Head collect data from its cluster and transmit it to Base Station. If Secondary Head energy limit also goes down, then create two cluster-head with the existing node within the cluster based on high energy availability.

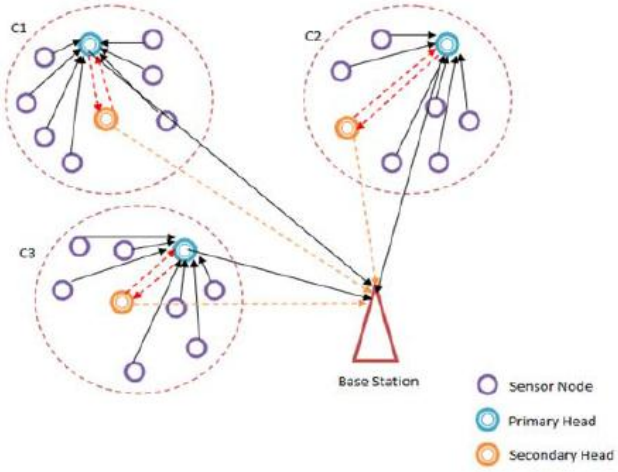

Fig.12 Performance of ECATCH (Cluster head selection and Data Transmission).

III. CONCLUSION

This paper discussed on wireless sensor network and their different aspects and clustering in WSNs. The key issue of clustering in wireless sensor network is periodic selection of cluster head among all the nodes of the network or between members of associated cluster. Optimal clustering in term of energy efficiency should eliminate all overhead associated not only with cluster head selection process, but also with nodes associated to their respective CHs. Clustering leads to hierarchical routing and data gathering, efficient scalability, data aggregation, reducing the total amount of transaction and increase the life of wireless sensor network

REFERENCES

[1] Vivek Mhatre and Catherine Rosenberg, "Homogeneous versus Heterogeneous Clustered Sensor Networks: A Comparative Study," School of Electrical and Computer Eng., Purdue University, West Lafayette, IN 47907-1285.

[2] Mansi Panwar and S.D. Samantaray," An Improved E- DEEC Protocol using Periodic and Threshold-Sensitive Data Transmission in Heterogeneous Wireless," at International Journal of Computer Science Engineering (IJCSE) July 2015.

[3] Brahim Elbhiri, Saadane Rachid, Sanaa El fkihi, Driss Aboutajdine, "Developed Distributed Energy-Efficient Clustering (DDEEC) for heterogeneous wireless sensor," IEEE communication 2010.

[4] P.Varalakshmil, R.Nandakumar and M.Umadevi,"R. Nicole, "An Efficient Cluster Head Selection and Aggregation for Wireless Sensor Networks," at IEEE International Conference on Communication and Signal Processing, April 3-5, 20 14.

[5] Li Qing *, Qingxin Zhu, Mingwen Wang, "Design of a distributed energy-efficient clustering algorithm for heterogeneous wireless sensor networks," ELSEVIER Computer Communications 29 (2006) 2230–2237.

[6] Ouadoudi Zytoune, Youssef Fakhri and Driss Aboutajdine," A Balanced Cost Cluster-Heads Selection Algorithm for Wireless Sensor Networks," International Journal of Electrical and Computer Engineering 4:1 2009.

[7] N.Hemavathi, S.Sudha," A Hybrid Clustering Algorithm for Optimal Clusters in Wireless Sensor Networks,"IEEE Conference on Electrical, Electronics and Computer Science 2014.

[8] Navin Gautam and Jae-Young Pyun," Distance Aware Intelligent Clustering Protocol for Wireless Sensor Networks," Journal of Communication and Networks, VOL. 12, NO. 2, April 2010.

[9] Asha Ahlawat and Vineeta Malik,"An Election of Vice Cluster Selection Approach To Improve V LEACH Protocol in Wireless Network," IEEE International Conference on Advanced Computing & Communication Technologies 2012.

[10] Jenq-Shiou Leu, Member, IEEE, Tung-Hung Chiang, Min-Chieh Yu, and Kuan-Wu Su,"Energy Efficient Clustering Scheme for Prolonging the Lifetime of Wireless Sensor Network with Isolated Nodes, "at IEEE Communication 2014.

[11] Dnyaneshwar Mantri, Neeli R Prasad and Ramjee Prasad," Grouping of Clusters for Efficient Data Aggregation (GCEDA) in Wireless Sensor Network," at IEEE Communication 2012.

[12] J.Surekha and T.Tamizharasi," Enhanced Clustering Technique to Improve the Network Lifetime for Wireless Sensor Network," International Journal of Computer Science and Information Technologies, Vol. 6 (1), 2015, 322-325.

[13] Tri Gia Nguyen, Chakchai So-In and Nhu Gia Nguyen,"Two Energy-Efficient Cluster Head Selection Techniques Based on Distance for Wireless Sensor Networks," International Computer Science and Engineering Conference (ICSEC) 2014.

[14] Geon Network Yong Park, Heeseong Kim, Hwi Woon Jeong, and Hee Yong Youn," A Novel Cluster Head Selection Method based on K-Means Algorithm for Energy Efficient Wireless Sensor Network," at IEEE 2013 International Conference on Advanced Information Networking and Applications Workshops 2013.

[15] Vaibhav V. Deshpande and A.R Bhagat Patil "Energy Distributed Clustering for Improving Lifetime of Wireless Sensor Network", IEEE journal of emerging science and engineering, vol.1 May 2013.

[16] Sucheta Yadav and Vimal Kishore Yadav, "Design and analysis of printed rectangular microstrip antenna on ferrite material", "IEEE International Conference on Soft-Computing and Network Security (ICSNS 2015)", Feb 2015, SNSCT, Coimbatore, India.

[17] Sucheta Yadav and Vimal Kishore Yadav, "Constrained Parameter Analysis of Microstrip Antenna", "IEEE International Conference on Soft-Computing and Network Security (ICSNS 2015)", Feb 2015, SNSCT, Coimbatore, India.

[18] Vimal Kishore Yadav, Pratiksha Singh Gaur, Sucheta Yadav, "Impending Form Interpretations for Delay to Ramp and Step Input On-Chip VLSI RLC Annex ", "International Journal of Advanced Research in Computer and Communication Engineering (IJARCCE)", vol. 3, Issue 11, ISSN (Online) : 2278-1021,ISSN (Print) : 2319-5940,2014.

[18] Attapol Adulyasas, Zhili Sun, and Ning Wang, "An event driven clustering based technique for data monitoring in WSN" 10th Annual IEEE CCNC,2013.

[19] F. Akyidiz, Y. Sankarasubramaniam W. Su, and E. Cayirci,"A survey on sensor networks", IEEE Communication, August 2002.

[20] Parul Saini, Ajay K. Sharma, "E-DEEC- Enhanced Distributed Energy Efficient Clustering Scheme for heterogeneous WSN" 2010 1st International Conference on Parallel, Distributed and Grid Computing (PDGC-2010).

[21] Satyajeet R. Shinge and S.S. Sambare," Increase the Lifetime of Wireless Sensor Network using Clustering and Compression", International Journal of Computer Applications (0975 – 8887) Volume 123 – No.16, August 2015.

[22] Vimal kishore yadav, pratiksha singh gaur, Sucheta yadav "Impending Form Interpretations for Delay to Ramp and Step Input On-Chip VLSI RLC Annex", "International Journal of Advanced Research in Computer and Communication Engineering (IJARCCE)", vol. 3, Issue 11, ISSN (Online): 2278-1021, ISSN (Print): 2319-5940, 2014.

[23] Vimal Kishore Yadav**,** Priyanka Thapak, Sucheta Yadav, , **"**Effect of Ramp Input on RLC Interconnect In Modern VLSI Design**",** International journal of scientific research engineering and technology (IJSRET), volume 3 Issue 8, ISSN 2278-0882, 2014.