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New Compressive Sensing Inter Cluster Data Aggregation Based Ileach Protocol For Homogenious Wsns

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ABSTRACT

In the application based WSNs circumstance, vitality and transmission capacity of the sensors are esteemed assets and vital to consume competently. Data collection at the sink by individual sensor nodes results in flooding of the requests which results in most extreme energy use. To decrease this issue another data aggregation technique has been used in this paper which has enhanced the execution of the iLEACH principle by utilizing the LZW compressive sensing based between cluster based data accumulation; additionally called mixture data aggregation strategy, where gathering of nodes will be carried out on the principle of the available clustering procedures and gathering of cluster heads is likewise done to use the peculiarities to utilizes the cluster head based data aggregation. The proposed technique serves to diminish the energy utilization issue, furthermore transmission of the aggregated data in proficient way. The proposed technique has been designed and implemented in MATLAB by considering various issues of the WSNs. The comparison among the iLEACH and LEACH has shown the effectiveness of the proposed technique.

INDEX TERMS: LZW COMPRESSIVE SENSING, LEACH, INTER CLUSTER, DATA AGGREGATION.

1. Introduction

Modern progresses in digital electronics[2], micro-electro-mechanical system, and wireless communications have empowered the growth of small-sized sensor nodes, which have low-power, low-cost and are multifunctional. These sensor nodes have capability to sense and communicate. Wireless sensor networks[1] are composed of a large number of sensor nodes, densely deployed either inside the region or very near to it. Energy conservation is the major matter in wireless sensor network. Limited power nodes which cannot be replaced can be carried by sensor nodes. In WSN, sensor nodes sense data and transmit it to the base station. Since data from neighbouring sensor nodes[3] may be redundant, it becomes complex for base station to process wide range of data. Moreover, sensor nodes have their own energy. Due to redundant transmissions and loss of energy, lifetime of sensor nodes can decrease. To increase lifetime, data aggregation[3,4] is performed. Data aggregation means to collect and aggregate data[3,5] from multiple sensors to eliminate redundancy and conserve energy. In iLEACH, the organization of nodes is done into clusters for the fusion of data. The fused data is transmitted from various sensors in the cluster to the sink by a selected node called cluster head after performing aggregation of data. Cluster head is more energetic than all of those other sensor nodes in the cluster. This helps in reducing the quantity of data sent to the sink. The fusion of data is done at the cluster heads at regular intervals. iLEACH involves the two necessary phases: the set-up phase and the steady phase. In set-up phase, organization of clusters is done and in steady phase transmission of data from sensor nodes to cluster head and from cluster head to base station takes place.

To evaluate the gaps in existing research; latest published papers of some well-known journals have been evaluated.

1. Data aggregation at the base station by individual nodes causes flooding of the data which consequences in maximum energy consumption.
2. Also most of data aggregation methods are based upon the clustering based approach but the use of additive data aggregation has been ignored by the all the researchers.
3. The use of data compression for efficient communication between base station and cluster head has been ignored in the most of existing research on WSNs.

So using the LZW data compression, additive and divisible data aggregation in homogeneous and heterogeneous WSNs is the main motivation of this research work.

In the application based WSNs situation, energy and bandwidth of the sensors are valued resources and essential to

consume proficiently. Data aggregation at the base station by individual nodes causes flooding of the data which consequences in maximum power utilization. To diminish this problem a new data aggregation technique will be proposed which will improve the performance of the homogeneous and heterogeneous WSNs by using the group based data aggregation also called hybrid data aggregation method also called clusters, where grouping of nodes will be done on the basis of the available data and correlation in the intra-cluster and grouping of some cluster heads at the network level. The proposed algorithm will help to reduce the energy consumption problem and also aggregates and transmit the data in efficient manner. In addition, the additive function will be used at root cluster head and divisible data aggregation functions at base station as in-network processing to minimize power consumption to modify LEACH and iLEACH by using inter cluster data aggregation. Additionally, LZW compression will be applied at the root cluster head that has low complexity and fast speed. Cluster head communicates aggregated information to sink and cluster head nodes communicate data to CH.

2. Literature Review

W.Heinzelman et al. [6] in this paper proposed low-energy adaptive clustering hierarchy, which really is a protocol architecture. The ideas of power-efficient cluster based routing and media access control has been combined along with application-specific data aggregation in order to gain high performance. Algorithms for the selection of cluster head, cluster formation and data transmission has been presented. From the results, it has been discovered that system lifetime has been improved.

O. Younis et al. [7] This paper presented a hybrid energy efficient distributed clustering protocol for ad hoc sensor networks. Cluster heads have been chosen at regular intervals on the basis of a hybrid of the remaining power of the node and on the basis of degree of node or its proximity to its neighbors. Independent of the diameter of the network, the protocol terminates in a regular number of iterations. It has been discovered that the protocol increases the lifetime of the network. P. Ding et al. [8] For achieving more aggressive goals as compared to HEED, Distributed Weight-Based Energy-Efficient Hierarchical Clustering (DWEHC) has been proposed. Balanced cluster sizes are generated and the intra-cluster topology is optimized. This approach proceeds in a distributed way and has time complexity of after locating the neighboring nodes in its area, each sensor node computes its weight. The sensor node having the largest weight would be elected as cluster head and all other nodes become members. Here, the nodes are known as first level cluster members as they have direct connection with the cluster head. Using the least power for reaching a cluster head, a sensor node progressively adjusts. Given that every node knows the distance to its neighbors, it can consider whether it's better to live as a first-level member or turn out to be always a second-level one, reaching the cluster head over a two-hop path. By doing so, the sensor node may switch to a cluster head other than its original one. The process proceeds until nodes settles on the most power efficient intra-cluster topology. To bound the number of levels, each and every cluster is assigned a series within which cluster member nodes should set.

L.Qing et al. [9] In this paper, a distributed energy efficient clustering scheme (DEEC) for heterogeneous wireless sensor networks, has been proposed in order to elect cluster heads through a probability on the basis of the proportion between remaining power of each sensor node and the average power of the entire network. For sensor nodes, the ephs of being cluster heads are distinct according to their early and remaining power. DEEC is based on low energy adaptive clustering hierarchy. In order to expend power uniformity the role of cluster head is rotated among all sensor nodes. Here two levels of heterogeneity are considered. A solution for multi-level heterogeneity is attained. For avoiding that each sensor node requires to truly have the entire knowledge of the sensor networks, the ideal value of the lifetime of network is estimated by DEEC that is utilized to calculate the reference power which each sensor node should expend during a round.

Zhou Xin-Lian et al. [10] This paper has presented an inter-cluster and intra-cluster TDMA scheduling algorithm Cluster-based. Each and every round of data gathering time is separated by layers along down the aggregation tree. Initial allocated work time of cluster node and time control of son tree has been presented by each cluster node in the pool tree. On the basis of their own initial allocated work TDMA, the data has been transmitted by nodes without any collisions. It has been demonstrated from the results that the performance of IISA surpasses that of HEED in case of larger nodes density. Muhamad, W. N et al. [11] This paper has presented stable cluster head election(SCHE) routing protocol for wireless sensor network. This protocol is dependant on LEACH design that utilizes clustering procedure. Its objective is to decrease the power utilization of each and every sensor node and thus reducing the overall power dissipation of the entire network. It is a source driven protocol based on well-timed reporting. Hence, the sensor node will constantly have some information to pass on to the base station. It also makes utilization of data aggregation to avoid information overload. It provides n analytical framework to achieve the stable probability for a node to be always a cluster-head to reduce power consumption. It is essential to apply appropriate cluster head election method to diminish power consumption of each and every sensor node that finally results in minimized power dissipation. This protocol was proposed where this system was applied by obtaining the optimum value of possibility for a sensor node to turn out to be always a cluster head and consumes appreciably a smaller amount of power when compared with LEACH. It also minimizes utilization by reducing distance

between head of cluster and sink. Woo-Sung Jung [12] In this paper, a hybrid approach for cluster based aggregation of data in wireless sensor network has been proposed which has improved the efficiency of aggregating data in applications to track several mobile targets. A suitable clustering technique has been adaptively selected by the proposed approach that depends on the position of the entire network. This has helped in raising the efficiency of aggregating data, power utilization and successful data sending proportion.

P. Saini et al. [13] In this paper, a threshold distributed energy efficient clustering scheme(TDEEC) for heterogeneous wireless sensor networks, has been proposed. It is assumed that uniformly randomly deployed sensor nodes are location-unaware having same processing and communication capabilities. Nodes have different initial power and some nodes have more power as compared to normal ones. In TDEEC, the threshold is adjusted according to which a sensor node takes decision to be always a cluster head or not, on the basis of proportion of remaining power and average power of that round regarding the optimum cluster heads. Parul Saini, et al [14] In this paper, enhanced distributed energy efficient clustering scheme has been proposed for heterogeneous networks containing three types of sensor nodes in order to improve the stability of the whole network and to prolong the network lifetime. Sensor nodes are introduced that have more power as compared to normal and advanced nodes. Thus, the heterogeneity and power level of the entire network is increased. From the results it may be illustrated that the performance of EDEEC is better as compared to SEP having more stability.

Rajashree. et al. [15] When the diameter of network is enlarged beyond definite level, distance between cluster head and sink is enlarged extremely. In this paper, Multi-Hop LEACH has been proposed.It is another extension of LEACH in order to rise power efficiency of the wireless sensor network. It is also a distributed clustering based routing protocol. Same as LEACH, in Multi-Hop LEACH some sensor nodes elect themselves as cluster heads and remaining nodes associate themselves with elected cluster-head in order to complete formation of cluster in set up phase. In steady phase, collection of data from sensor nodes of a cluster is done by cluster head and cluster head send data directly or through some other cluster head to sink after data aggregation. Inter-cluster and intra-cluster communications are allowed in Multi-Hop LEACH. In Multi-Hop intra-cluster communication, all the nodes transmit their data to the cluster heads of their clusters atsingle hop, and send data directly to base station or through intermediate cluster head. Juxtapose, in Multi-Hop inter cluster communication, where distance is more between cluster head and base station, then all cluster heads transmit their data to leader cluster head to communicate to sink.

LingjunMeng et al .[16] This paper presented a data aggregation transfer protocol based on clustering and data prediction in WSN that is power-efficient. During the initial stage, sink node received messages from the sensor network nodes, after which the entire network was divided into various clusters by the sink node and then for each and every cluster, the sink node chooses cluster head nodes. During the prediction phase, the choice regarding the sending of data was taken on the basis of received predicted data from sensor nodes which were compared with sensed data. During the data aggregation phase, the received sensed data from the cluster member nodes was aggregated by the cluster head nodes and the judgment regarding whether to send it or not to the sink node was taken on the basis of received predicted data. Data prediction could help in reducing the transmission of data and improving the potency of data aggregation.

JiPeng, et al. [17] This paper proposed a data aggregation algorithm, originated from low-energy adaptive clustering hierarchy for reducing power consumption and loss of data of network. Initially the total number of nodes in a particular cluster was computed. The nodes present in the network were separated into two layers and were invented to cluster with low energy adaptive clustering hierarchy based method. On the basis of clustering design it has been explored that for saving the power and controlling the accuracy of data, sensed data could be aggregated by cluster head selection criteria using these strategies.

Siva Ranjani et al. [18] This paper proposed an energy efficient cluster based data aggregation scheme for sensor networks. Four states has been shown: Cluster Formation Phase, Cluster Head election Phase, Data aggregation Phase and Maintenance Phase. For the forming of clusters, a novel approach was used and a correct node as a cluster head was chosen for performing the aggregation. The sensing region was divided into various layers and k clusters were formed with the help of k-means clustering method from each layer. In each cluster, a sensor node was voted as a cluster head. Data was transferred to corresponding cluster heads by cluster members. The data aggregation was performed by the cluster head which eliminated redundancy and passed the aggregated data to the sink with the help of other cluster heads. The reduction in power consumption and enhancement of the network lifetime has been illustrated.

DnyaneshwarMantri et al. [19] In this paper, the group based data aggregation technique has been proposed and evaluated. On the basis of existing data and association in the intra-cluster level, nodes have been grouped. At the network level, cluster heads have been grouped. These would help in reduction of power utilization. Moreover, additive and divisible functions have been used at cluster head as in-network processing for reducing power utilization. Aggregated information has been transmitted to sink by cluster head and data has been sent to cluster head by cluster

member nodes. Increase in the network lifetime has been indicated by the reduction in power consumption in transmission of aggregated information.

DnyaneshwarMantri et al.[20] This paper presented the mobility and heterogeneous aware bandwidth efficient cluster based data aggregation(MHBCDA) approach. The nodes have been distributed randomly. The mobile sink based aggregation of data packets has been considered for heterogeneous WSN. To aggregate data at cluster head, a predefined region has been used for minimizing the cost of communication and computation. This approach is bandwidth and power efficient .by varying the generation rate of data packets, the correlation of packets of data generated has been exploited.

3. Proposed Algorithm

The proposed algorithm will function in following stages i.e. Cluster formation(Selection of cluster head), intra-cluster aggregation(grouping of nodes for transmission of packets to cluster heads for aggregation), inter-cluster aggregation(grouping of Cluster heads for transmission of aggregated data packets to the relay node) and compression of data.

Step 1.Initialize WSNs: The randomly distributed sensor nodes will be categorized into the 'n' number of clusters.

Step 2.Select CHs using iLEACH:The cluster head will be selected in each cluster according to the methods used by iLEACH.

Step 3.Apply Intracluster Data aggregation:CH will be responsible for aggregation of data packets produced by the sensor nodes within that cluster. In intra-cluster aggregation, CH will transmit the broad cast data and collect the data packets from several sensor nodes at periodic breaks. It will perform the aggregation of data packets using equations used in iLEACH. This step will come in action recursively for all the clusters within the WSNs.

Step 4.Apply intercluster data aggregation using additive functions: CH assemblies according to the obtainable data from each CH to achieve the additional aggregation for transmission with the base station. A relay node will be selected by the cluster heads on the basis of distance. Then, inter-cluster data aggregation will be applied using additive function at the relay node.

Step 5.Apply Compression on main CH: LICiLEACH compression will also be used to compress the data.
Maximum compression ratio of LICiLEACH=9.42
Compressed packets size (CPS) is defined as $CPS = \frac{APS}{9.42}$
where APS is the actual packet size.
Therefor new energy dissipation for compressed data will be as:

$$S(i).E = S(i).E - ((Tx_{energy} + EDA) * CPS + AMP * CPS * d^4 : if d > d_o$$

$$S(i).E = S(i).E - ((Tx_{energy} + EDA) * CPS + EMP * CPS * d^2 : if d < d_o$$

Here S(i).E - the energy of i^{th} node
EDA- effective data aggregation cost.
Tx_{energy}- Transmitter energy
AMP- multipath fading channel cost
EMP- Free space channel cost
d- is the evaluated distance between the cluster head and the base station.
$d_o$is the minimum allowed distance.
Step 6.Transmit Compressed data to base station and evaluate energy dissipation:After applying LICiLEACH compression, data is transmitted to base station by relay node and energy dissipation is evaluated.

Step 7.Extract data using decompression and apply divisible data aggregation:The data is extracted using LICiLEACH decompression. Divisible data aggregation will be applied on this data at the base station.
Assemblage of the sensor nodes in intra-cluster and assemblage of CH at inter cluster will reduce the data packet count at the base station. It will reduce the actual energy essential, which will result in increase in the network lifetime.

4. Results and Discussions

In order to implement the proposed algorithm, design and implementation has beendone in MATLAB. Table 1 shows the parameters used in the implementation along with their values.

Table 1 WSNs characteristics

Parameter	Value
Area(x,y)	100,100
Base station(x,y)	150,150
Nodes(n)	100
Probability(p)	0.1
Initial Energy	0.1J
transmiter_energy	$50 * 10^{-9}$J/bit
receiver_energy	$50 * 10^{-9}$J/bit
Free space(amplifier)	$10 * 10^{-13}$J/bit/m^2
Multipath(amplifier)	$0.0013 * 10^{-13}$ J/bit/m^2
Effective Data aggregation	$5 * 10^{-9}$J/bit/signal
Maximum lifetime	4000
Data packet Size	4000 KB
m (fraction of advanced nodes)	0.2
a (energy factor between normal and advanced nodes)	1
LZW compression	9.42

It is the amount of time that a Wireless Sensor Network would be fully operative. It is the time interval from the start of the operation until the death of the last alive node.

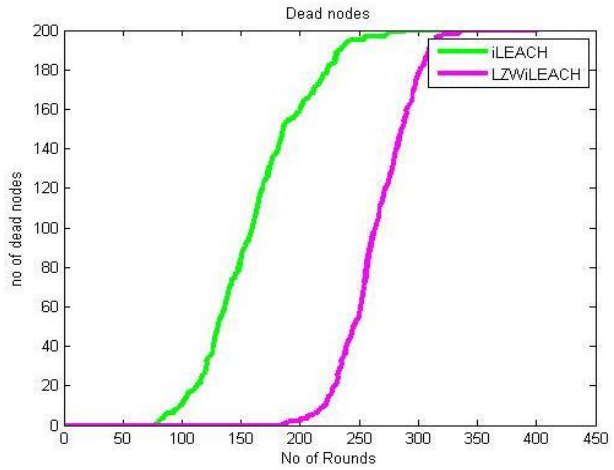

Fig 6 Dead nodes during network lifetime

Figure 6 shows the comparison of total number of dead nodes of iLEACH protocols. X-axis represents the total number of dead nodes. Y-axis represents the total number of rounds. It clearly depicts that the PROPOSED is most efficient than iLEACH in terms of network lifetime.

It is measured by the total rate of data sent over the network, the rate of data sent from cluster heads to the sink as well as the rate of data sent from the nodes to their cluster heads. Throughput= Total amount of data received from sender/ Time takes for the receiver to get the last packet (bits/sec).

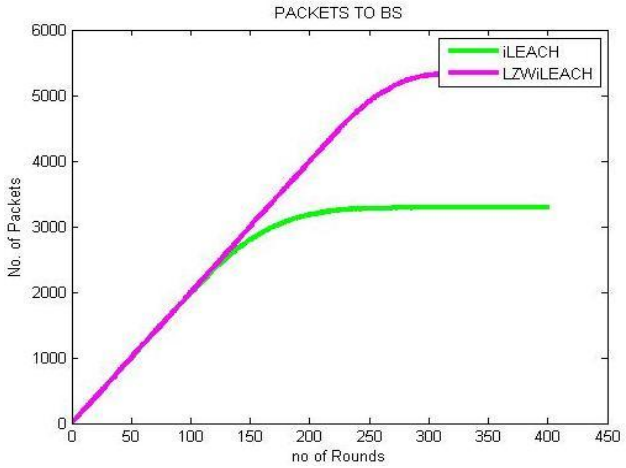

Fig 7: Total number of packets sent to base station

Figure 7 shows the comparison of throughput of iLEACH and PROPOSED protocols. X-axis is representing packets sent to base station. Y-axis is representing the total number of rounds. It depicts that data sent to base station is more for PROPOSED than iLEACH. Thus this figure clearly shows that the PROPOSED is most efficient than iLEACHin terms of packet sent to base station.

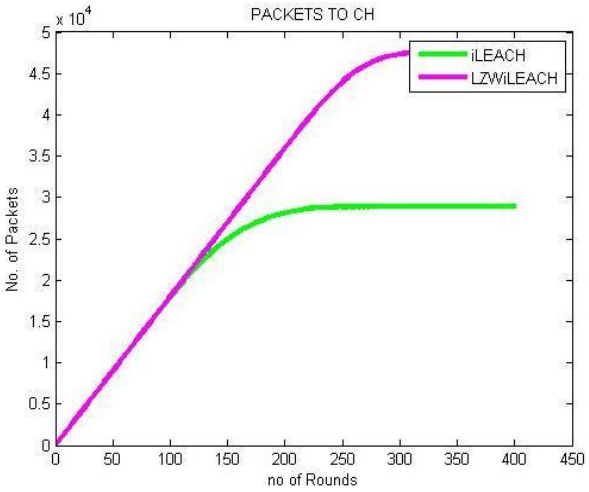

Fig 8 Total number of packets sent to cluster head

Figure 8 shows the comparison of total number of packets sent to cluster head of iLEACHand PROPOSED protocols. X-axis is representing packets sent to cluster head. Y-axis is representing the total number of rounds. It depicts that data sent to cluster head is more for PROPOSED than iLEACH. In this figure PROPOSED shows best throughput than iLEACH.

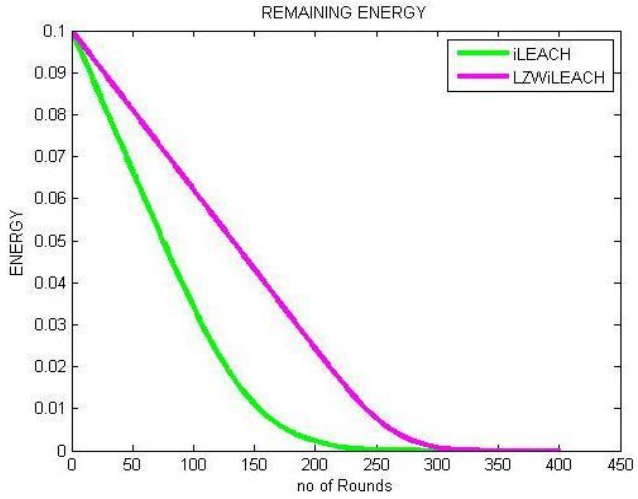

Fig 9: Remaining Energy

Figure 9 shows the comparison of remaining energy of iLEACH and PROPOSED protocols. X-axis is representing remaining energy. Y-axis is representing the total number of rounds. It shows that PROPOSED has more remaining energy than iLEACH. Thus this figure shows that the PROPOSED is most efficient than iLEACH in terms of remaining energy.

5. Conclusions and Future Scope

In the application based WSNs situation, energy and bandwidth of the sensors are valued resources and essential to consume proficiently. Data aggregation at the base station by individual nodes causes flooding of the data which consequences in maximum energy consumption. To diminish this problem a new data aggregation technique has been proposed which uses inter-cluster data aggregation and LZW based compression. It has improved the performance of the homogeneous and heterogeneous WSNs. The proposed algorithm has reduced the energy consumption problem and

also aggregates and transmits the data in efficient manner. In addition, the proposed technique has used the additive and divisible data aggregation function at cluster head (CH) as in-network processing to reduce energy consumption. Cluster head communicates aggregated information to sink and cluster head nodes communicate data to CH. The proposed algorithm has been designed and simulated in the MATLAB tool. The comparative analysis has shown that the proposed LZW based data aggregation based LEACH protocol outperforms over the available protocols. In near future Ant colony based data communication strategy {will also be|may also be|is likewise} used to enhance the results further.

References

[1] P.N.Renjith and E.Baburaj, "An Analysis on Data Aggregation in Wireless Sensor Networks," International Conference on Radar, Communication and Computing(ICRCC), SKP Engineering College, Tiruvannamalai,TN.,India. pp. 62-71, Dec. 2012.

[2] I.Akyldiz, W.Su, Y.Sankarasubramanian and E. Cayirci, "Wireless Sensor networks: a survey," IEEE Computer, vol. 38, no. 4, pp. 393-422, 2002.

[3] R.Rajagopalan and P.Varshney, "Data-Aggregation Techniques in Sensor Networks: A Survey," IEEE Comm. Surveys Tutorials, vol. 8, no. 4, pp. 48-63, Oct.-Nov. 2006.

[4] S.Madden, M.J.Franklin, J.M.Hellerstein, and W.Hong, "TAG: A Tiny Aggregation Service for Ad-Hoc Sensor Networks," Proc. Fifth Symp. Operating Systems Design and Implementation, 2002.

[5] S.Tilak, N.Abhu-Gazhaleh, W.R.Heinzelman, "A taxonomy of wireless micro-sensor network models," ACM SIGMOBILE Mobile Comp. Commun. Rev. , vol. 6, no. 2, pp. 28-36, Apr. 2002.

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

[7] O. Younis and S. Fahmy, "HEED: a Hybrid, Energy-Efficient Distributed Clustering Approach for Ad Hoc Sensor Networks", IEEE Trans. Mobile Computing, vol. 3, no. 4, Dec. 2004, pp. 366-79.

[8] 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, Marina Del Rey, CA, June 2005.

[9] L.Qing, Q.Zhu, M. Wang, "Design of a distributed energy-efficient clustering algorithm for heterogeneous wireless sensor network", ELSEVIER, Computer Communications 29, 2006, pp 2230-2237.

[10] Zhou Xin-Lian and XuJian-Bo, "IISA: An Inter-cluster and Intra-cluster Scheduling Algorithm cluster-based for Wireless Sensor Network", IEEE, Wireless Communications, Networking and Mobile Computing, 2008. WiCOM '08, 4th International Conference, 12-14 Oct. 2008.

[11] Muhamad, W. N. W., Dimyati, K., Mohamad, R., Haron, M. A., Sarnin, S., Wahab, N., & Aziz, N. H. A., "Evaluation of Stable Cluster Head Election (SCHE) routing protocol for wireless sensor networks", In RF and Microwave Conference, 2008. RFM 2008. IEEE International , pp. 101-105, Dec. 2008.

[12] 14.Woo-Sung Jung, keun-Woo Lim, Young-BaeKo, Sang-Joon Park, "A hybrid approach for clustering-based Data Aggregation in Wireless Sensor Networks", IEEE, 3rd International Conference on Digital Society, pp. 112-117, 2009.

[13] P. Saini and A.K.Sharma , "Energy Efficient scheme for clustering protocol prolonging the lifetime of heterogeneous wireless sensor networks," International Journal of computer applications(0975-8887), vol. 6, no. 2, pp. 30-36, Sep. 2010.

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

[15] Rajashree. V.Biradar, Dr.S.R.Sawant, Dr.R.R.Mudholkar, Dr.V.C.Patil, "Multihop Routing in Self-Organizing wireless sensor networks " International Journal of Computer Sciences Issues, vol. 8, issue 1, Jan 2011.

[16] LingjunMeng, Huazhong Zhang, Yun Zou, "A Data Aggregation Transfer Protocol based on Clustering and Data Prediction in Wireless Sensor Networks", IEEE, 2011.

[17] JiPeng, Li Yupeng, Jiang Jingqi, Wang Tianbao, "A Clustering Protocol for Data Aggregation in Wireless Sensor Network", IEEE, International Conference on Control Engineering and Communications Technology, 2012.

[18] Siva Ranjani. S, Radha Krishnan. S, Thangaraj. C, "Energy- efficient cluster based data aggregation for wireless sensor networks", International Conference on Recent Advances in Computing and Software Systems, pp. 174-179, 2012.

[19] DnyaneshwarMantri, Neeli R Prasad and Ramjee Prasad, " Grouping of clusters for Efficient Data Aggregation (GCEDA) in wireless sensor network", IEEE, 3rd International Advance Computing Conference, pp. 132-137, 2013.

[20] DnyaneshwarMantri, Neeli R Prasad and Ramjee Prasad, "MHBCDA: Mobility and Heterogeneity aware Bandwidth Efficient Cluster based Data Aggregation for Wireless Sensor Network", IEEE, 2013.