Results Evaluation of Newly Proposed Distance based Energy Efficient Clustering Algorithm

Sakshi Wadhwa[1], Harpreet Kaur[2]
[1] *Bahra Group of Institutes, India*

Abstract - The network lifetime is dependent on the battery power as in some applications there is no source of power. Researchers are paying attention to save the power by designing new algorithms. Clustering is a technique which helps us to reduce the energy consumption. The consumption of energy is dependent on the distance between the nodes and the base station. More is the distance more the energy will be consumed. In this paper, we have concluded that energy conservation will increase with the number of sensors.

Keywords - *Clustering; Cluster Head; Energy Saving; Distance Model.*

I. INTRODUCTION

Ever increasing technology have developed many tiny, low power, low cost and multifunctional sensor nodes in wireless sensor networks. A sensor node helps in tracking and conveying the main information to the base station. WSN consists of many sensors which are small in size but they are equipped with many components such as radio receivers, micro processors and power components for sensing, computing and computation. There is limited battery for WSN and this is the main issue. As many researchers are paying attention to save the power. Here we have a motive which is to increase the lifetime of network lifetime and increase the efficiency of energy consumption. The ultimate solution for this is clustering. In this paper, work has been done for the enhancement of network lifetime and to increase the efficiency of energy. Hierarchal clustering is used which helps to reduce the energy consumption. In this nodes are combined to form a cluster and a cluster head is selected which is used to send the data to the base station. Earlier the nodes were very far away from each other so it takes more time to send data but with the help of hierarchal clustering nodes are connected with each other and they easily send data to base station at very less time. In the section II the review of related work is conducted which is followed by proposed work in section III. The Distance base clustering is presented in section IV. In section V the Experimental implementation is done in Matlab and the results are presented. This paper is concluded in the last section.

II. RELATED WORK

Jenq et al. [3] in this paper a new technique REAC-IN which is Regional energy aware clustering with isolated nodes has been taken into account. In this technique cluster head is taken on the factor which is residual energy and regional average energy. This helps the isolated nodes to decide to send data to either cluster head or sink. A comparison has been done among many techniques such as LEACH, HEED, and DEEC in which cluster head is taken on the fact of predetermined probability, residual energy and ration of residual energy to average energy of network respectively. This new scheme REAC-IN improve the life time of network and number of alive nodes which is better than other protocols .It also helps to solve the problem of node isolation.

Chamam et al. [4] in this paper, a centralized mechanism which is based on Tabu algorithm which computes a near optimal network configuration in which each sensor can be activated as a cluster head or it will be in sleep mode. The problem consists of finding optimal state to sensors which helps in maximizing the network time which is called OPT-ALL-RCC. This new technology is based on an example of coverage configuration protocol. In this paper various comparisons have been done such as TABU- RCC with respect to its lower bound CPLEX and TABU- RCC versus EESH. In future they intend to try new heuristic and distributed algorithms to maximize the life time.

Tarhani et al.[5] In this paper a new distributed algorithm which is called scalable energy efficient clustering hierarchy which selects the CH and Relay node separately based on the eligibility of nodes such that the node with high degree is considered as CH and with low degree as Relay. In this paper cluster head and Relay selection is done by using Set up method and Steady Method. In set up method all the information of path and location of nodes are calculated and in steady phase data is collected from nodes and send it to CH or sink directly. This SEECH algorithm is suitable for periodical data gathering applications in harsh and remote environment which have more network life time than LEACH and TCAC protocol. In SEECH algorithm Comparison has been done with LEACH and TCAC protocols which give less network lifetime than SEECH algorithm. It provides better Cluster Head distribution.

Kumar et al. [6] Efficient clustering is used for increasing the life time of network, but a balances clustering is always not possible so In this paper an efficient balanced clustering is used for cluster head Selection/Rotation and data routing to increase the lifetime of network. Balanced cluster head Selection/Rotation helps to achieve the balanced energy consumption. In these paper shortcomings of various algorithms such as LEACH, HEED, TEEN, PEGASIS and ERP-SCDS has been overcome. A virtual concentric circular band based clustering protocol is used which give us the uniform cluster formation. In this cluster formation is done only once and it thus saves energy. The simulation results show that the network life time is increased.

Yang et al. [7] in this paper they proposed a new scheme Energy Efficient Clustering Division Scheme for the energy consumption in which cluster is divided into some non-

uniform rings which are concentric thus helps to obtain the optimized thickness of the ring. In this paper various algorithms such as LEACH, PEGASIS, and EACLE is discussed. Two types of sensor nodes are used, one kind is cheap non uniform CH node whose function is sensing and short distant transmitting the data and the other kind is expensive CH node whose function is sensing, data aggregating and long distant transmitting of data. In this Non uniform clustering division scheme they realize the reduced energy consumption and longer lifetime of cluster hierarchy. In this two approaches are used after the cluster expires. One is to continue with the remaining nodes and move it to the appropriate location and other is to deploy new nodes in cluster.

Park et al. [8] in this paper LUCA which is location-based unequal clustering algorithm in which the concept of different size of cluster is taken. Earlier the equal clustering algorithm in which the same size clusters were taken and it determined that the equal cluster far away from sink consumes more energy so on the basis of this concept LUCA was considered. In LUCA each sensor senses the information of cluster based on its location. Random trade off time is used to determine the CH. In this network model is used to get the location of cluster. In LUCA two types of clustering is used one is intra clustering and second one is inter clustering. Firstly nodes send its data to its CH based on location information and then CH aggregates the data and sends it to the sink. In this two modes sleep mode in which the node turn off its radio and saves the energy and in other is wakeup mode in which nodes send the messages when necessary. The simulation results show that the performance of LUCA is better than the equal clustering algorithm.

Heo et al. [9] in this paper, an algorithm Energy Efficient Deployment Algorithm for clusters is proposed in which clusters are combined in a structure. In this the combination helps us to provide increase in local control over entire ROI, each node decides its mode whether it would like to be in clustering mode or peer to peer mode based on its density and remaining energy. The concept of uniformity, coverage and distance is taken to get the best performance to increase the lifetime of network. The performance of algorithm is calculated by the percentage of region covered, deployment time and the uniformity of network. The simulation results show that this algorithm gives a uniform distribution from uneven distribution of efficient energy manner.

Singh et al. [10] in this paper, a new algorithm which is Energy Efficient Homogeneous Clustering Algorithm for WSN is proposed for increasing the lifetime of network and to save power. In this nodes are distributed homogeneously and a new cluster head is taken on the fact of residual energy of existing cluster head, holdback value and nearest hop distance of the node. In this every node in a cluster is a cluster head or a member of cluster. Only cluster head broadcasts their messages so to prolong the lifetime of network. In this paper Limitations of Radio model is discussed. The main objective of this proposed algorithm is to keep sensors operating for as long as possible.

Mukherjee et al. [11] in this paper, a survey has been done on the general approaches of energy conservation. First is Duty Cycling Approach in which sleep and wake mode is taken, when there is no network activity then node should be sent to sleep mode. Second is Data Driven Approach in which unwanted communication is reduced which result in energy consumption. In this technique data is sensed within a range and data compression is done. Last technique is Mobility in which multihop communication is done as more data is loaded over nodes. This scheme is done by two schemes one is Mobile Relay in which hierarchy level of nodes is set in which nodes roam to get the data and it then send to destination and the other one is Mobile Sink in which it focus on energy consumption and network lifetime.

Jin et al. [12] An Energy Efficient Clustering Technique is used for Multihop data delivery scenarios. In this paper, Size of cluster depends upon the hop distance to the data sink to balance the Traffic load and the energy consumption. Cluster head is selected on the base of initial energy levels and the selected CH transmit their advertisement messages and the residual energy.The candidates which have more residual energy than CH becomes the CH. The comparison of EC algorithm has been done with HEED and UCR Algorithms and finds a better result than these algorithms. In EC algorithm effectiveness of EC is evaluated and the main focus is on energy conservation. Performances results show that it provides node equalization instead hop distance to the sink at different locations.

III. PROPOSED WORK

A. Problem description

Algorithm like LEECH,ECHERP,EECP and HEED in which earlier a cluster head is chosen randomly which is based on probability but these algorithms are very complex, many typical formula's have been used because of which it do not give good results. In this paper, attention is paid to reduce energy consumption and to increase the network lifetime. Clustering is used which helps to improve the energy efficiency. Here in this paper Distance based clustering is used in which distance model is used which helps to improve the efficiency of energy and also increase the network lifetime.

B. Objective

The main objective of this work is implementation of distance formula so that energy consumption is reduced by using clustering and hierarchical clustering. We have seen that Distance is directly proportional to consumption of energy. More is the distance between the nodes more is the energy consumed. Using clustering and hierarchical, this objective is fulfilled. This clustering will be based on distance formula.

IV. FLOW OF PROPOSED ALGORITHMS

A. *Direct Connection between Nodes and Base Station*

1. Fix the coordinates of base station and specify the locations of nodes.
2. Calculate the distance between nodes and base station. Make a distance matrix. Distance model is used to calculate the distances.
3. Calculate total energy consumed by the network

Etotal $=E_1+E_2+\ldots\ldots\ldots\ldots+E_j$
Where, Ej is the energy of j^{th}node
Ej=Et+Er, T= threshold
if Di >T
then, Et=K*Eelec+K*Eamp*
if Di<T
then, Et=K*Eelec+K*Efs*(
Er=K*Eelec
K is the length of message in bits and Di is the distance between source and destination node.

B. *Distance based Clustering Algorithm*

1. Choose two arrays of x and y coordinates having length 'n'.
2. Fix base station at position (xb, yb). 'n' is total number of nodes.
3. Specify the range 'r' for all the nodes. Calculate distance of all nodes from base station.
4. Pick the node having minimum distance. Connect it to base station.
5. Find the neighbor nodes covered by this node within range 'r'. Connect these nodes to that node.
6. Calculate the number of remaining nodes (RN). If RN is 1, then go to step 7 else go to step 4. If any common is node is there then go to step 8.
7. Connect this remaining node to base station.
8. Calculate distance of this node from both the clusters. Connect to the nearest cluster.
9. Calculate total energy of network.

C. *Distance based Hierarchical Clustering Algorithm*

1. Choose two arrays of x and y coordinates having length 'n'.
2. Fix base station at position (xb, yb). 'n' is total number of nodes.
3. Specify the range 'r' for all the nodes. Calculate distance of all nodes from base station.
4. Pick the node having minimum distance. Connect it to base station.
5. Find the neighbor nodes covered by this node within range 'r'. Connect these nodes to that node.
6. After making the clusters, find the cluster head at minimum distance form base station connect it to base station.
7. Find the distance between cluster heads and the between cluster heads and base stations. Making sets of each connectivity.
8. After the step 7, connect the specific one with the other which is at minimum distance.
9. Calculate total energy of network.

V. RESULT ANALYSIS

There must be at least 7 nodes to perform the clustering. The following experiments are conducted to get the performance of proposed algorithms. We perform experiment with 50 nodes and the message length is 13 bits. Randomly take 50 nodes. All the nodes are connected to the base station. There is one to one connectivity between two nodes. Each node transmits one message of 13 bits. The following diagram gives the representation of nodes connected to the base station.

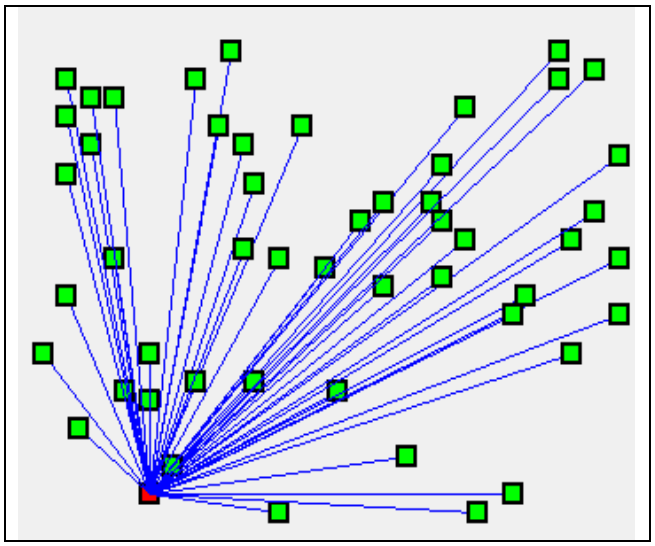

Fig.1: 50 Nodes connected to Base Station

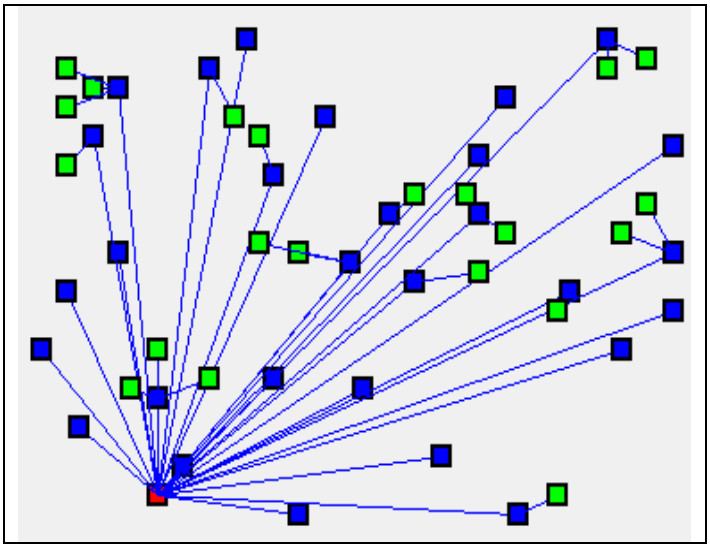

Fig.2: Distance based Clustering Algorithm

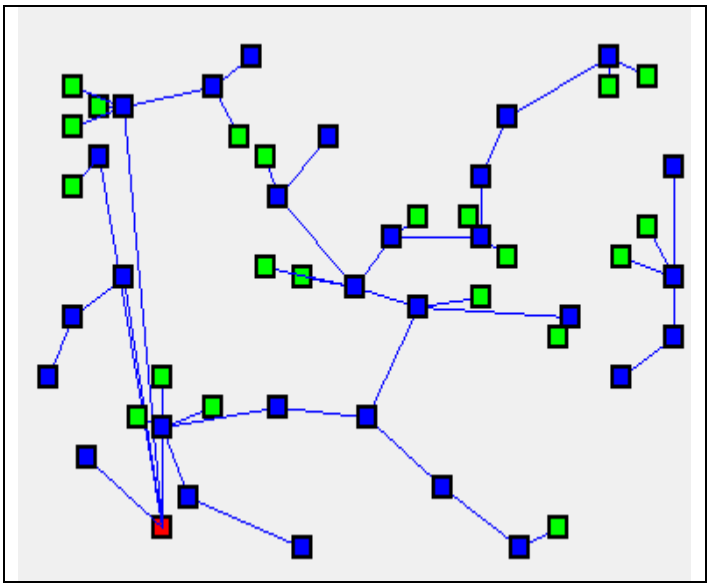

Fig.3: Distance based Hierarchical Clustering

Table 1: Result analysis of 50 Nodes

Algorithm	No. of Nodes	Message Length (in bits)	Saved Energy Percentage
Direct Connection between Nodes and Base Station	50	13	5
Distance based Clustering	50	13	49
Distance based Hierarchical Clustering	50	13	51

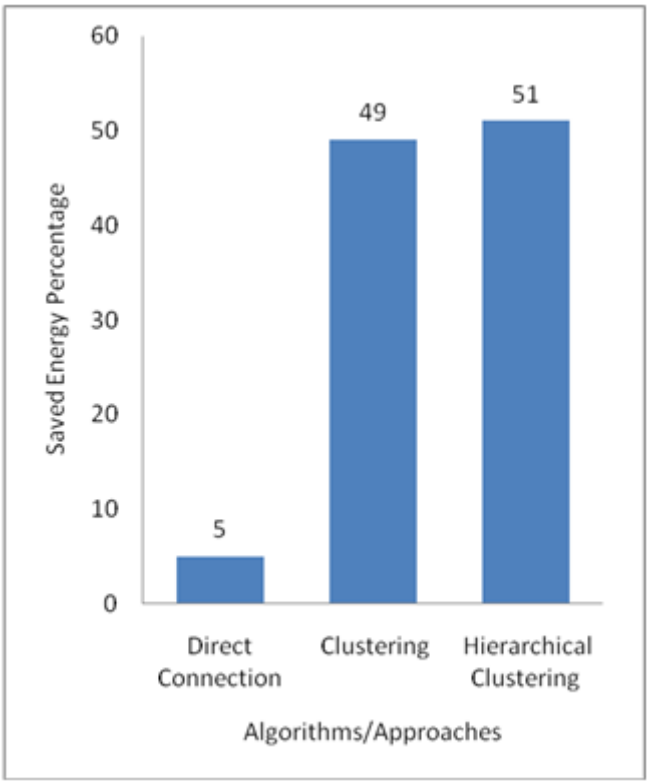

Fig.4: Graphical Representation of Results of 50 Nodes

After taking test results of 50 nodes, we conduct more experiments by varying the number of nodes and collect data of clustering algorithm as well as data for hierarchical clustering algorithm. The collected is managed in the following tables with the graphical representation of data.

Table 2: Energy Saving for different number of nodes having same message length

Number of Nodes	Message Length (in bits)	Clustering based Saved Energy (%)	Hierarchical Clustering based Saved Energy (%)
20	28	31	65
30	28	35	66
50	28	36	68
70	28	38	70
90	28	43	73
130	28	48	75
180	28	52	77
200	28	63	80

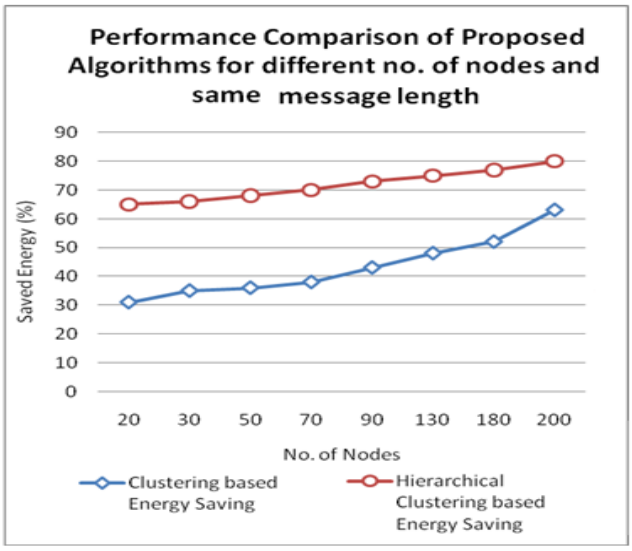

Fig.5: Performance Comparison of Proposed Algorithms

As the data collected for various number of nodes, now we have collected data by vary the nodes count as well as the message length. The tables and graphs are as follows.

Table 3: Energy Saving for different number of nodes and message length

Number of Nodes	Message Length (in bits)	Clustering based Saved Energy (%)	Hierarchical Clustering based Saved Energy (%)
20	28	28	47
30	36	42	58
50	40	48	52
70	57	45	55
90	81	48	58
130	98	52	62
180	155	59	76
200	167	69	81

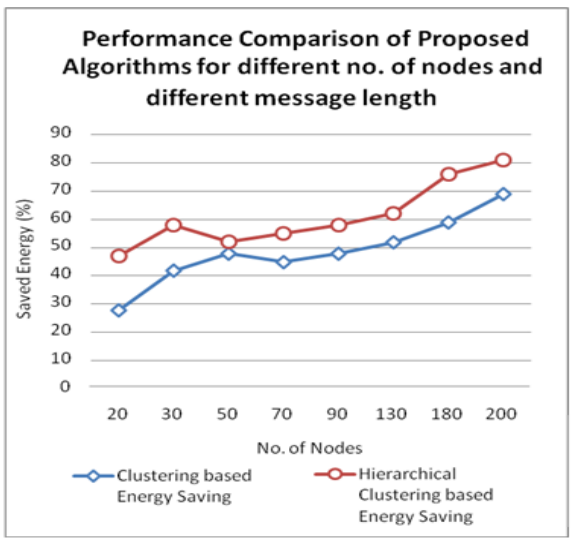

Fig.6: Performance Comparison of Proposed Algorithms

From the above study, we have concludes that the newly proposed techniues are able to save the energy. As the number of nodes increases the energy saving becomes more. The distance based clustering algorithm saves less energy as compare to hierarchical clustering algorithm but still is saves energy more as compare to direct connection between nodes and base station.

VI. CONCLUSION

From the result analysis we conclude that the proposed algorithms give results up to 80 percent. We conduct different tests under different scenarios. In first scenario, we take 50 nodes and same message length of 13 bits. The performance of proposed algorithms for this scenario concludes that the energy saving is up to 50 percent. In second case, the number of nodes varies but the message length remains same. The results conclude that the energy saving increases as the number of nodes increases. To analyze the flexibility of proposed algorithms, we conduct an experiment by taking the different number of nodes and different message length. In this case, we find that the energy saving increases as the number of nodes increases as well as message length varies. From all the experiment study and result analysis, we conclude that the proposed algorithms give better performance. Both the proposed algorithms based on distance are successfully saving the energy. The performance of Hierarchical Clustering algorithm is better than the Clustering algorithm and the clustering algorithm performs better that direct connection between the nodes and base station. In future, we will implement this technique to increase the lifetime of network by improving the energy saving percentage and reducing the energy consumption.

.

VII. REFERENCES

[1] F.L.Lewis,"Wireless sensor networks," To appear in Smart Environments: Technologies, Protocols, and Application. D.J. Cook and S.K. Das, John Wiley, New York, 2004.

[2] J. Yick, B. Mukherjee, D. Ghosal, "Wireless Sensor Network,"Elsevier Department of Computer Science, University of California, Davis, CA 95616, United States,April,2008.

[3] J.S. Leu, T.H. Chiang , M.C. Yu, K.W. Su, "Energy Efficient Clustering Scheme For Prolonging The Lifetime Of Wireless Sensor Network With Isolated Nodes," Doi 10.1109/Lcomm.2014.2379715, IEEE Communications Letters.

[4] A.Chamam, S. Pierre, "On The Planning Of Wireless Sensor Networks: Energy-Efficient Clustering Under The Joint Routing And Coverage Constraint," IEEE Transactions On Mobile Computing, Volume-8, Issue-8, August 2009.

[5] M. Tarhani, Y. S. Kavian, S. Siavoshi, "Seech: Scalable Energy Efficient Clustering Hierarchy Protocol in

Wireless Sensor Networks," IEEE Sensors Journal, Volume-14, Issue-11, November 2014.

[6] A. Kumar, V. Kumar, N. Chand, "Energy Efficient Clustering Scheme for Wireless Sensor Networks," IJACSA, Volume-3, Issue-5, 2011.

[7] Y. Jin, L. Wang ,Y. Kim, X.Z. Yang, "Energy Efficient Non-Uniform Clustering Division Scheme In WSN," Wireless Pers Commun (2008) 45, Springer Science+Business Media, ISBN: S11277-007-9370-4, Page No (31-43), Llc. 2007.

[8] S. Lee ,H. Choe , B. Park,Y. Song, C.K. Kim, "Luca: An Energy-Efficient Unequal Clustering Algorithm Using Location Information For Wireless Sensor Networks," Wireless Pers Commun (2011) 56, Springer Science+Business Media, ISBN: S11277-009-9842-9, Page No (715-731), Llc. 2009.

[9] N. Heo, P. K. Varshney,"An Intelligent Deployment and Clustering Algorithm for A Distributed Mobile Sensor Network", IEEE, ISBN: 0-7803-7952-7, 2003.

[10] S. K. Singh, M. P. Singh , D. K. Singh., "Energy Efficient Homogenous Clustering Algorithm for Wireless Sensor Networks," International Journal of Wireless & Mobile Networks (IJWMN), Volume-2, Issue-3, August 2010.

[11] R. Mukherjee, A. Mukherjee, "A Survey on Different Approaches for Energy Conservation in Wireless Sensor Networks," International Journal of Advanced Computer Research (ISSN (Print): 2249-7277 ISSN (Online): 2277-7970) Volume-3, Issue-1, 8 March 2013.

[12] D. Wei, Y. Jin, S. Vural, K. Moessner and R. Tafazolli, "Energy-Efficient Clustering Solution For WSN," IEEE Transactions On Wireless Communications, Volume-10, Issue-11, November 2011.

[13] S. Kumar, M. Prateek , B. Bhushan, "Energy Efficient (EECP) Clustered Protocol for Heterogeneous Wireless Sensor Network," IJARCSSE, Volume- 3, Issue- 7, July 2013.

[14] P. Patil, U. P. Kulkarni, "Energy Efficient Aggregation with sink placement for wireless sensor networks," Ad hoc, Sensor & Ubiquitous Computing (IJASUC), Volume-4, Issue.-, April 2013.

[15] S.Taruna, S. Shringi, "Routing Protocol based on clustering for Prolonging Network Lifetime in Heterogeneous WSNs," IJRARCSSE, volume-4, Issue-4, April 2013.

[16] Sakshi Wadhwa, Harpreet Kaur, "Distance based Clustering Approach for Energy Conservation of Sensor Networks," IJRECE, Volume-3, Issue-2, pp. 5-9, April-June 2015.