Centralized Clustering Approach for Wireless Sensor Network

Jyoti Devi[1], Mrs. Savita[2]
[1]*M.Tech Scholar CSE Department, RIEM Rohtak*
[2]*Assistant Professor, CSE Department, R.I.E.M, MDU, Rohtak*

Abstract - Wireless Sensor Networks consists of hundreds and thousands of micro sensor nodes that monitor a remote environment by data aggregation from individual nodes and transmitting this data to the base station for further processing and inference. The energy of the battery operated nodes is the most vulnerable resource of the WSN, which is depleted at a high rate when information is transmitted, because transmission energy is dependent on the distance of transmission. In a clustering approach, the Cluster Head node looses a significant amount of energy during transmission to base station. So the selection of Cluster Head is very critical. An effective selection protocol should choose Cluster Heads based on the geographical location of node and its remaining energy.

In this work a centralized protocol for Cluster Head selection in WSN is discussed, which is run at the base station, thus reducing the nodes' energy consumption and in-creasing their life-time. The primary idea is implemented using a fuzzy-logic based selection of Cluster Head from among the nodes of network, which is concluded depending on two parameters, the current energy of the node and the distance of the node from the base station. The protocol is named LEACH-C(ED)-Centralized LEACH based on Energy and Distance, and is run periodically at the base station where a new set of cluster heads are selected at every round, thus distributing the energy load in the network and increasing the network lifetime. The simulation results show that the proposed approach is more effective than the existing LEACH-Centralized protocol.

Keywords - *Wireless sensor networks, Cluster Head, micro sensors, network lifetime, LEACH, LEACH-C, Cluster Head, LEACH-C(ED), ,Quantization,PSNR*

I. INTRODUCTION

Wireless Sensor Networks (WSNs) are networks that comprise of sensors that are distributed in an ad hoc fashion over a defined geographical area, aimed at sensing some predefined information from the surrounding, processing them and transmitting them to the sink station. The sensors work with one another to capture some physical event. The data assembled is then transformed to get important outcomes. Remote sensor systems comprise of protocols and algorithms with self-arranging capabilities. WSNs can be widely divided into two types-Unstructured WSN and Structured WSN. While Unstructured WSN have a large collection of nodes, put up in an ad-hoc fashion; Structured WSN have few, scarcely distributed nodes with pre-planned deployment. The Unstructured WSNs are difficult to maintain, but it is relatively easy to maintain Structured WSNs.

Wireless Sensor Networks mainly consists of nodes known as sensors. Sensors are devices with low energy as they operate on battery, having limited memory and processing ability and are designed to survive extreme environmental conditions. These are mostly due to their small size. They are also featured with self organizing and self healing power. Three basic parts of a SENSOR NODE can be seen as:

- A sensing subsystem that is used for data capturing from the real world.
- A subsystem for processing that is used for local data processing and storage.
- A subsystem consisting of wireless communication to be used to for data receiving and transmission.
  - Object Monitoring
  - Area Monitoring
- Space and objects Monitoring

Object monitoring may be structural monitoring, Eco-physiology based monitoring, condition-based handling, medical diagnostics monitoring and urban terrain mapping. For instance in Intel fabrication plants- sensors collect vibration data, monitor any kind of wear and tear, thus conclude facts in real-time. This reduces the need for a team of engineers and cuts cost in various ways. Monitoring of area may be Environmental and Habitat Monitoring, Precision Agriculture, Indoor Climate Control, Military Surveillance, Intelligent Alarms etc. Interactions between space and objects can be monitored using WSNs such as - Wildlife Habitats monitoring, Disaster man-aging monitors, Health-Care monitors.

Grouping calculations for WSNs could be isolated as Centralized cluster calculations and distributed grouping calculations. Distributed clustering systems are again isolated into four sub segments relying upon the sort of cluster, necessity for clusters and parameters utilized for CH determination. The four sub-sections are - Identity based grouping, Iterative, Neighborhood information based and Probabilistic individually [13]. Probabilistic systems for framing clusters in Wireless sensor systems rely on attributed likelihood values for sensor hubs. Low-Energy Adaptive Clustering Hierarchy convention proposed in [14] is such a protocol, giving o set of vitality utilization by arbitrary turn of group heads then ensuring equivalent burden adjusting in one-bounce sensor systems. LEACH-C is focused around transmission of position subtle elements and vitality levels of every sensor hub to base station (BS) and sensor hubs with vitality level above decided beforehand edge are chosen for getting to be cluster heads by the base station (BS) itself [14].

II. REATED WORK AND APPROACH

In designing routing protocols for WSNs, it is necessary to deploy advanced routing algorithm for decreasing the consumption of any node's energy, thus be able to extend network life. Wireless Sensor Network routing algorithms are primarily classified as follows - hierarchical protocols and at routing. While at protocols employee an overhead of delay and management complexity which leads to excess power consumption, in hierarchical protocols-node that is the cluster head is selected, that are responsible towards handling all nodes contained in the cluster and establishing communication with the Base Station. This prolongs the network life [15]. A hierarchical clustering based architecture has many advantages. The network is scalable and components are task oriented. The algorithms are of distributed type, light weight and energy efficient; which makes the network reliable and less granular with clusters. Every node also has data aggregating capability [16]. The cluster membership change is limited to almost two clusters. Thus the clustering algorithm is not processed for entire network. This is an important feature for sensor networks, which will help in scaling the network. Sensor networks, unlike general internet networks, are task specific at a Time. The architecture is based on combining neighbor list information. The task data object helps in choosing the cluster data, based on the task. Thus network performance is optimized for specific task. In this clustering algorithm, the nodes furnish the information, does the complicated computation, while clustering algorithms run on the base station (BS). Also cluster algorithm runs at the start of/updating of the clusters. The architecture of WSNs should to accommodate three features:

A. Scalability

Bigger area based Wireless Sensor Networks depend on hundreds of small sensor nodes for collecting data from the physical world [17]. All the sensor nodes may not be required to be working continuously, so addition of sensors and removal of sensors from the network can be done dynamically [18]. A long term and extensible design enables alteration in the topology with a reduced of updating of transmitted messages.

B. Task Orientation

The WSNs correlate with assigned operations at present stage. The operations of WSN vary from the simple data collection, static nodes to complex collection of data, using mobile-node sensor network [19, 17]. The structure of the program must be made efficient and enhanced, based on specified task-set of every node, to be adjusted to this specification.

C. Light Weighting

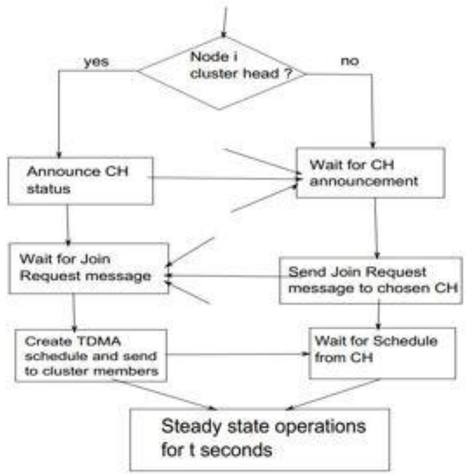
The processing power and memory - which enables storing data for sensor nodes, are very restricted. Tasks like data collection, reducing size of the message, acknowledgement using piggyback, etc. that are lightweight, must be incorporated in the architecture design.

2.1 Design Challenges

- Heterogeneous Nodes: The sensor devices deployed in area maybe of various types and they need to collaborate with each other.
- Distributed Algorithms: The algorithms should be of distributed type as they are executed on different nodes.
- Low Bandwidth Communication: The data should be transferred with least possible bandwidth, between sensor nodes.
- Co-ordinate: The sensors should coordinate with each other and the base station to produce required results.

The energy expense of a node is dependent on the distance to which the node .Transmits its energy, because when the distance of transmission is greater than a factor d_0 then the energy consumption grows by a factor d. LEACH-C is more energy efficient than LEACH [30], primarily because LEACH does not generate uniformly distributed clusters in every round and does not consider the nodes' distance from BS. In LEACH-C the Cluster Head selection process is run at Base Station, which is assumed to have in finite energy as compared to nodes' energy. Thus any WSN process run at the BS does not generate energy overhead to the network nodes, except the minimal node information that is communicated to BS by node.

To develop an effective selection protocol that chooses Cluster Heads based on the geographical location of node and its remaining energy. The algorithm is a centralized protocol for Cluster Head selection in WSN, which is run at the base station, thus reducing the nodes' energy consumption and increasing their life-time. Improvement on centralized LEACH based on Energy and Distance, which is run periodically at the base station where a new set of cluster heads are selected at every round, thus efficiently distributing the energy load in the network.



III. IMPLEMENTATION & PROCESS

A Wireless sensor network is a set of affordable battery-powered devices- the sensors which are deployed to detect events which are of a predefined manner and sending sensed information to the BS for even more introspection. They have integrated computing, sensing, and wireless communication capabilities [33]. It has been observed that WSNs have huge potentials for quite a range of applications like - military monitoring, monitoring the surrounding, infrastructure and facility diagnosis, etc. [17]. It is expected that WSNs have least possible total energy consumption and that they balance energy consumption for individual sensor nodes. For Wireless Sensor Networks, the most important design task is to increase the life of network without sacrificing sensing and other network goals.

The entire life of a wireless sensor network may be determined as the time started from the first sensor node in the network consumes its energy, because when one sensor node goes off, the sensing capacity of the network begins to degrade [34]. To help maintain maximum life for a network, an energy-efficient routing algorithm has to be utilized for the purpose of communicating data. The algorithm should have these three primary characteristics [35]:

i. minimum usage of total energy
ii. balanced consumption of energy
iii. characteristics in a distributed manner

For energy efficient information collection and transmission, wireless sensor networks (WSNs) use routing techniques, such that networks are partitioned into clusters. This enables the network to have a prolonged life. Clustering approaches that are presently being uses make use of 2 methods: Selection of a CH with more left over energy and rotation of CH periodically so that the energy consumption among nodes is distributed and thus the lifetime of network is extended.

The work done is the output of three observations:

- Firstly the energy expense of a node is dependent on the distance to which the node transmits its energy, because when the distance of transmission is greater than a factor d_0 then the energy consumption grows by d^4, the details of which is in the Radio Energy Dissipation model.
- The second observation is that LEACH-C is more energy efficient than LEACH [13], primarily because LEACH does not generate uniformly distributed clusters in every round and does not consider the nodes' energy and distance from BS.
- The third observation is that LEACH uses dynamic clustering which results in extra overhead such transmission of advertisement and receiving join requests that reduces the energy consumption gain; whereas this overhead is curbed in LEACH-C in which the Cluster Head selection process is run at Base Station, which is assumed to have in finite energy as compared to nodes' energy.
- Thus any WSN process run at the BS does not generate energy overhead to the network nodes, except the minimal node information that is communicated to BS by node.

3.1 The Radio Energy Dissipation Model

This work adopts the first-order radio model to calculate the energy dissipation. For transmitter circuit, when the distance between the transmitter and receiver is less than the threshold value d_0, the free space (fs) model is employed, in which the energy consumption is proportional to d^2. Otherwise the multipath (mp) fading channel model is used, where the energy consumption is proportional to d^4.

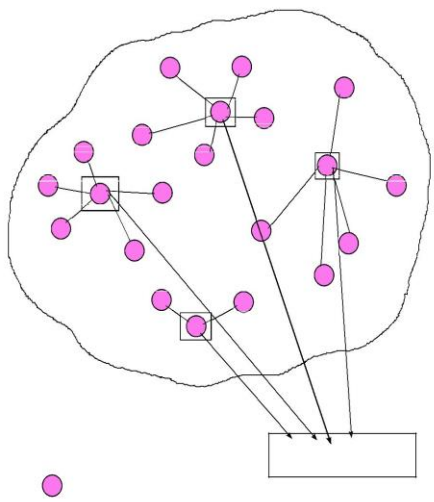


Fig.3.1: Topology Structure for LEACH-C(ED

3.2 System Assumptions

We consider WSN implementations in where sensor nodes are put up in a random order so that the environment is monitored continuously. The data accumulated by sensor nodes is transmitted to a BS situated in exterior of the chosen area. Every sensor node can function either in sensing mode to check the surrounding and send it to the allotted CH or in Cluster Head mode to collect data, squeeze it and send it to the BS. The additional presumption is as follows:

- The sensor nodes and BS are immobile.
- All the nodes possess the equal energy initially.
- All nodes are given unique identifier.
- The distance among nodes is calculated depending on the received strength of signal.
- All nodes have ability to compute their respective distance from base-station, based on GPS or other location detection scheme.

All nodes are part of event driven WSN model.

Algorithm 3.3: The Proposed Cluster Head Selection Algorithm

Input:

N : the wireless sensor network

Nn : the total number of nodes in N

K: the expected number
of clusters for each round
a: a node in N
T: a randomly selected value for becoming a CH candidate
Chance (a): the chance of the node to be CH, calculated based on current Energy
and distance from BS
probability(a): true for the node which has chance(a) value above threshold
bucket(a) : the node a is a member for random selection of CH
candidate(a): a is a candidate for cluster head

Output:
cluster(a): the CH of the node, which is a node from among nn nodes

Function:
Broadcast (data, range of distance);
Send (data, receiver);
Fuzzy logic (current Energy, distance);
Find MinDist(nodesX1[], nodesY1[], nwSize1, nodesX2[], nodesY2[], nwSize2,
Node Index, cluster Index) ;
/* FOR EVERY CLUSTERING ROUND */
/* SET-UP Phase */
/* AT NODE */

IV. ANALYTICAL STUDY

As in LEACH and LEACH-C, this proposed cluster head selection method configures clusters in each and every round. The algorithm outlines a new cluster head selection technique, which will be executed at the base station, on receiving the data of nodes' energy and distance from BS. The pseudo code for the Set-up Phase is described in the Algorithm. The Steady Phase will be same as LEACH or LEACH-C. For a given static WSN-N, having nn number of nodes, the expected number of clusters is k. The chance (a) of a node of becoming cluster head is evaluated based on fuzzy logic rules. If the chance of a node is greater than the de need threshold value T, then probability of a node to be CH is true. All the nodes with probability true are put together in the array named bucket. Then k number of nodes is randomly selected from the bucket. These are the elected CHs. Using the function nd MinDist(); which takes as parameter the location co-ordinates of nodes and elected CHs, the cluster head for each of the nn node is decided. The CH for each node is that elected CH, the distance to which from the node is the shortest. Then the sum of distances of all the nodes to their respective CHs is calculated in this function and this sum is returned as the cost. This process is repeated for predefined number of times and the minimum cost cluster is saved. Here cluster (a) is an array that stores the CH index of the node a from the minimum cost cluster already found. This Cluster Head information is broadcasted in the network by the BS. In the Steady-Phase, as in LEACH and LEACH-C, the CH implements the TDMA schedule for the cluster's member nodes; receives data, aggregates and compresses them and transmits to the sink (BS).

Here in simulation and results section, we present the output of experimental simulations to prove the effectiveness of the proposed approach. The proposed clustering algorithm LEACH-C(ED), is compared with the basic Centralized Cluster-Head se-lection algorithm LEACH-C. The simulation results prove that the approach selected in the work reveals better performances

V. SIMULATION & RESULT

5.1 Simulation Environments

This simulation was deployed using the MATLAB 2013a software. There are 100 nodes. They are spread in a random order in a 100 x 100 area. The values that are used in the first order radio model are shown in Table 5.1.

5.2 *Simulation Results*

Given a fixed Base Station and a 100 nodes fixed topology of Sensor nodes, the number of nodes alive during the time of simulation is compared for LEACH-C and LEACH-C(ED) in the following Fig.5.1 and Fig.5.2. Fig.5.2 also shows similar characteristics of LEACH-C(ED) in comparison to LEACH-C in Fig.5.1, when BS is at (100,175). In Fig.5.1, at any point of time during the simulation, the number of nodes alive for LEACH-C(ED) network is more than that of LEACH-C network. It can also be observed that the network for LEACH-C(ED) and LEACH-C die at almost same time

Type	Parameter	Value
Network topology	Number of nodes	100
	Expected number of clusters	5
	Network coverage	(0, 0) (100, 100) m
Radio Model	Startup energy	2 J
	E_{elec}^{Tx} / E_{elec}^{Rx}	50 nJ/bit
	ϵ_{fs}	10 pJ/bit/m^2
	ϵ_{mp}	0.0013 pJ/bit/m^4
Application	Packet header size	25 bytes
	Data packet size	500 bytes

Fig.5.1: Configuration Parameters used

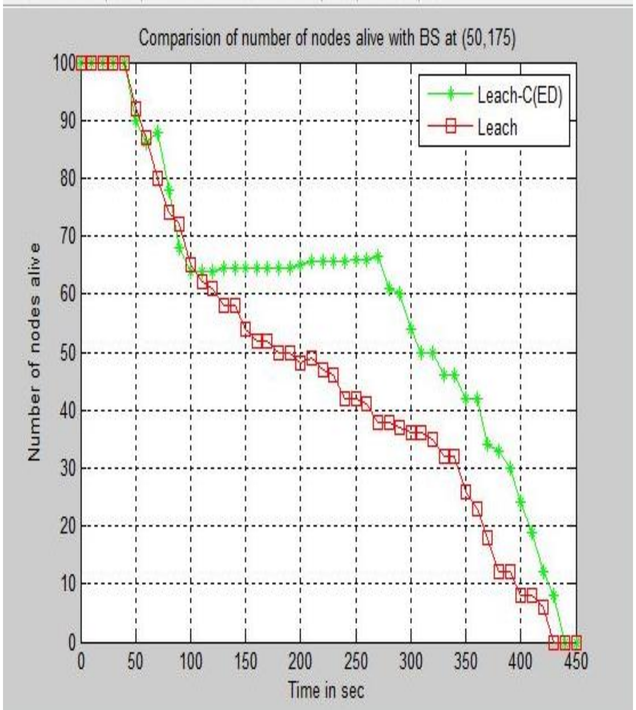


Fig.5.2: Nodes alive when BS is at (50,175)

Handy et al. [37] in their paper have proposed a metric called Half of the Nodes Alive (HNA) that describes an approximate value for time by when fifty percent of the nodes deplete their full energy content and die. The metric is quite useful for

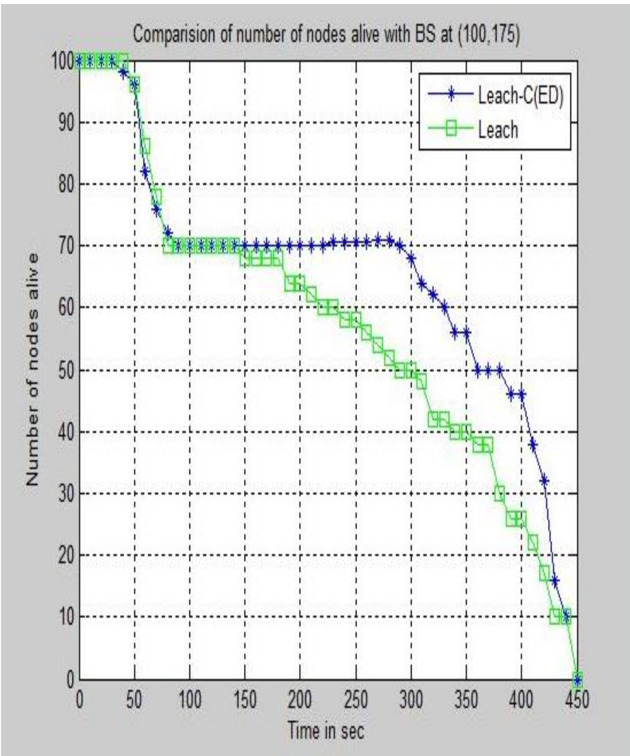


Fig.5.3: Nodes alive when BS is at (100,175)

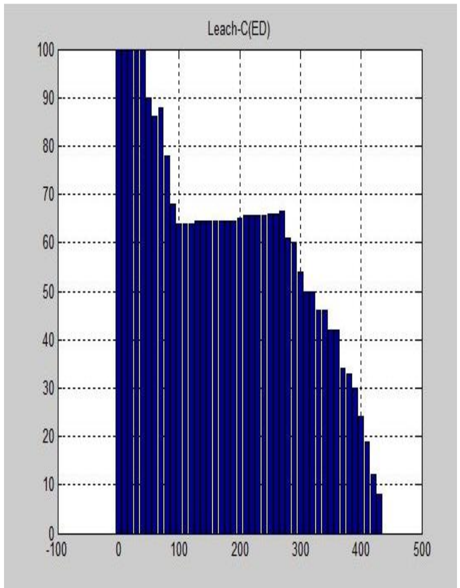


Fig.5.4: Node Alive (NA) in the Network under LEACH-C(ED) Protocols

Evaluating sensor networks and comparing WSN algorithms. As shown in Fig.5.3, the proposed LEACH-C(ED) method performs better than LEACH-C. When the BS is at (50,175) the HNA (Half Node Alive) efficiency of LEACH-C(ED) is 41.71 % more than LEACH-C, and when the BS is at (100,175) the HNA efficiency of LEACH-C(ED) is 20.27 % more than LEACH-C; whereas the total energy consumption of the network under each of the two protocols is almost equivalent. Fig.5.5 shows that the Half Node Alive(HNA) status of a network under LEACH-C(ED) is always better than LEACH-C, when compared on basis of increasing average distance of Base Stations from the sensor nodes of network.

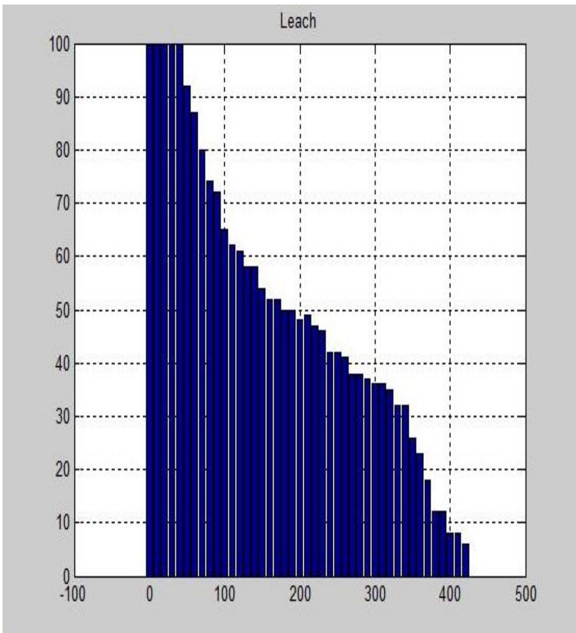


Fig.5.5: Node Alive (NA) in the Network under LEACH-C Protocols

VI. CONCLUSION & RESULT

The network life-time, which is dependent on energy remaining in the sensor nodes, is a major factor to be considered when designing WSNs. For energy efficient WSN, many WSN architectures and clustering algorithms have been proposed among which Leach is a mile-stone. LEACH makes use of the probabilistic model for distributing energy consumption of the CHs among the nodes. The protocol does not guarantee for the placement and count of number for CH nodes. Thus a poor cluster if set-up for a round, may affect the all over performance [38]. LEACH-C is a centrally controlled protocol and produces better cluster forms by spreading the CH nodes all through the network. Along with determining better clusters, the BS also ensures that energy distribution is equally divided among all the sensor nodes.

This work, named LEACH-C(ED) proposes a centralized approach for Cluster Head selection based on fuzzy rules for energy and distance. The main aim of the proposed algorithm is to extend the lifespan of the Wireless Sensor Network by uniforming dividing and spreading the load and to improve the NP hard annealing algorithm, to reduce the execution time at the base-station. To accomplish this target, we have concentrated on predicting the set of nodes eligible for CH selection based on current energy and distance of node from BS, thus reducing the number of iteration and random CH selection steps in LEACH-C algorithm.

At any point of time, the overall number of nodes not dead in the WSN of LEACH C(ED) is greater than number of nodes not dead in LEACH-C, for a fixed Base Station. The Half Life of Network under LEACH-C(ED) is much better than LEACH-C. For a network of 100 nodes with Base Station at (50,175), LEACH-C(ED)'s efficiency is 42.72 % better than LEACH-C, when HNA is compared. It is also observed the while the HNA status of LEACH-C(ED) is much better than LEACH-C, the total energy consumption of both the networks is equivalent. The comparison of HNA Status of LEACH-C(ED) with LEACH-C shows that LEACH-C(ED) performs better than LEACH-C for various Base Station locations taken into consideration. Thus the simulation outputs present that the proposed LEACH-C(ED) is more efficient than the centralized algorithm LEACH-C.

This LEACH-C(ED) algorithm is developed and designed for the Wireless Sensor Networks having stationary sensor nodes. As a future work, this protocol can be extended for dealing mobile sensor node networks. Also, future improvements for this work is to integrate this Cluster Head selection approach with multi hop Leach[30] which overcomes the scalability limitation of LEACH and LEACH-C. The Algorithm may require improvement for an event driven network scenario, in which the frequency of event is very low..

VII. REFERENCES

[1] Y.G. Iyer, S. Gandham, and S. Venkatesan. Stcp: a generic transport layer protocol for wireless sensor networks. In Computer Communications and Networks, 2005. ICCCN 2005. Proceedings. 14th International Conference on, pages 449-454, Oct 2005.

[2] Yangfan Zhou, M.R. Lyu, Jiangchuan Liu, and Hui Wang. Port: a price-oriented reliable transport protocol for wireless sensor networks. In Software Reliability Engineering, 2005. ISSRE 2005. 16th IEEE International Symposium on, pages 10 pp.-126, Nov 2005.

[3] Chiehyih Wan and Shane B. Eisenman. Coda: Congestion detection and avoidance in sensor networks. Pages 266-279. ACM Press, 2003.

[4] V.C. Gungor and O.B. Akan. Dst: delay sensitive transport in wireless sensor networks. In

Computer Networks , 2006 International Symposium on, pages 116-122, 2006.

[5] Chiehyih Wan, Andrew T. Campbell, and Lakshman Krishnamurthy. Pump slowly, fetch quickly (psfq): a reliable transport protocol for sensor networks. In IEEE Journal on Selected Areas in Communications, pages 862-872, 2005.

[6] O.B. Akan and I.F. Akyildiz. Event-to-sink reliable transport in wireless sensor networks.

Networking, IEEE/ACM Transactions on, 13(5):1003-1016, Oct 2005.

[7] R. A. Santos, A. Edwards, O. Alvarez, A. Gonzalez, and A. Verduzco. A geographic routing algorithm for wireless sensor networks. In Electronics, Robotics and Automotive Mechanics Conference, 2006, volume 1, pages 64-69, Sept 2006.

[8] Rui Zhang, Hang Zhao, and Miguel A. Labrador. The anchor location service (als) protocol for large-scale wireless sensor networks. In Proceedings of the First International Conference on Integrated Internet Ad Hoc and Sensor Networks, InterSense '06, New York, NY, USA, 2006. ACM.

[9] Xiaojiang Du and Fengjing Lin. Secure cell relay routing protocol for sensor networks. In Performance, Computing, and Communications Conference, 2005.IPCCC 2005. 24th IEEE International, pages 477-482, April 2005.

[10] Injong Rhee, A. Warrier, M. Aia, Jeongki Min, and M.L. Sichitiu. Z-mac: A hybrid mac for wireless sensor networks. Networking, IEEE/ACM Transactions on, 16(3):511-524, June 2008.

[11] Mehmet C. Vuran and I.F. Akyildiz. Spatial correlation-based collaborative medium access control in wireless sensor networks. Networking, IEEE/ACM Transactions on, 14(2):316-329, April 2006.

[12] ChunlongGuo, Lizhi Charlie Zhong, and J.M. Rabaey. Low power distributed mac for ad hoc sensor radio networks. In Global Telecommunications Conference, 2001. GLOBECOM '01. IEEE, volume 5, pages 2944-2948 vol.5, 2001.

[13] V. Geetha, P.V. Kallapur, and SushmaTellajeera. Clustering in wireless sensor networks:

Performance comparison of fLEACHg and; leach-c protocols using fNS2g.Procedia Technology, 4(0):163 {170, 2012. 2nd International Conference on Computer, Communication, Control and Information Technology (C3IT-2012) on February 25 - 26, 2012.

[14] W.B. Heinemann, A.P. Chandrakasan, and H. Balakrishnan. Application-specific protocol architecture for wireless microsensor networks. Wireless Communications, IEEE Transactions on, 1(4):660-670, Oct 2002.

[15] Wu Xinhua and Wang Sheng. Performance comparison of leach and leach-c protocols by ns2. In Distributed Computing and Applications to Business Engineering and Science (DCABES), 2010 Ninth International Symposium on, pages 254-258, Aug 2010.

[16] ShangweiDuan and Xiaobu Yuan. Exploring hierarchy architecture for wireless sensor networks management. In Wireless and Optical Communications Networks, 2006 IFIP International Conference on, pages 6 pp.-6, 2006.

[17] I.F. Akyildiz, Weilian Su, Y. Sankarasubramaniam, and E. Cayirci. A survey on sensor networks.
Communications Magazine, IEEE, 40(8):102-114, Aug 2002.

[18] Di Tian and Nicolas D. Georganas. A coverage-preserving node scheduling scheme for large wireless sensor networks. In Proceedings of the 1st ACM International Workshop on Wireless Sensor Networks and Applications, WSNA '02, pages 32-41, New York, NY, USA, 2002. ACM.

[19] Chee-Yee Chong and S.P. Kumar. Sensor networks: evolution, opportunities, and challenges. Proceedings of the IEEE, 91(8):1247-1256, Aug 2003.

[20] Wenli Chen, N. Jain, and S. Singh. Anmp: ad hoc network management protocol. Selected Areas in Communications, IEEE Journal on, 17(8):1506-1531, Aug 1999.

[21] W.B. Heinzelman, A.P. Chandrakasan, and H. Balakrishnan. Application-specific protocol architecture for wireless microsensor networks. Wireless Communications, IEEE Transactions on, 1(4):660-670, Oct 2002.

[22] W.R. Heinzelman, A. Chandrakasan, and H. Balakrishnan. Energy-efficient communication protocol for wireless microsensor networks. In System Sciences, 2000. Proceedings of the 33rd Annual Hawaii International Conference on, pages 10 pp. vol.2 -, Jan 2000.

[23] David L. Hall. Mathematical Techniques in Multisensor Data Fusion. London: Artech House Publishers, Boston, 1992.

[24] T. Murata and H. Ishibuchi. Performance evaluation of genetic algorithms for owshopschedul-ing problems. In Evolutionary Computation, 1994. IEEE World Congress on Computational Intelligence., Proceedings of the First IEEE Conference on, pages 812-817 vol.2, Jun 1994.

[25] I. Gupta, D. Riordan, and S. Sampalli. Cluster-head election using fuzzy logic for wireless sensor networks. In Communication Networks and Services Research Conference, 2005. Proceedings of the 3rd Annual, pages 255-260, May 2005.

[26] Jong-Myoung Kim, Seon-Ho Park, Young-Ju Han, and Tai-Myoung Chung. Chef: Cluster head election mechanism using fuzzy logic in wireless sensor networks. In Advanced Communication Technology, 2008. ICACT 2008. 10th International Conference on, volume 1, pages 654-659, Feb 2008.

[27] ArjanDurresiFatosXhafa Akio Koyama Junpei Anno, Leonard Barolli. Performance evaluation of two fuzzy-based cluster head selection systems for wireless sensor networks. Mobile Information Systems, 4:297-312, Jan 2008.

[28] H. Bagci and A. Yazici. An energy aware fuzzy unequal clustering algorithm for wireless sensor networks. In Fuzzy Systems (FUZZ), 2010 IEEE International Conference on, pages 1-8, July 2010.

[29] Jin-Shyan Lee and Wei-Liang Cheng. Fuzzy-logic-based clustering approach for wireless sensor networks using energy predication. Sensors Journal, IEEE, 12(9):2891-2897, Sept 2012.

[30] R. R. Mudholkar V. C. PatilRajashree V. Biradar, S. R. Sawant. Multihop routing in self-organizing wireless sensor networks. International Journal of Computer Science Issues, 8(1):155 -164, 2011.

[31] Sanjeev Jain VinayKumar and SudharshanTiwari. Energy efficient clustering algorithms in wireless sensor networks: survey. IJCSI International Journal of Computer Science Issues, 8, Sept 2011.

[32] Abderrahim BENI HSSANE MoulayLahcen HASNAOUI EZZATIABDELLAH, SAIDBE-NALLA. Advanced low energy adaptive clustering hierarchy. (IJCSE)International Journal on Computer Science and Engineering, 2, 2010.

[33] Giuseppe Anastasi, Marco Conti, Mario Di Francesco, and Andrea Passarella. Energy conservation in wireless sensor networks: A survey. Ad Hoc Networks, 7(3):537-568, 2009.

[34] KhaledMatrouk and Bjorn Landfeldt. Rettgen: A globally efficient routing protocol for wireless sensor networks by equalising sensor energy and avoiding energy holes. Ad Hoc Netw., 7(3):514- 536, May 2009.

[35] Anfeng Liu, JuRen, Xu Li, Zhigang Chen, and Xuemin (Sherman) Shen. Design principles and improvement of cost function based energy aware routing algorithms for wireless sensor networks. Comput. Netw., 56(7):1951-1967, May 2012.

[36] Theodore Rappaport. Wireless Communications: Principles and Practice. Prentice Hall PTR, Upper Saddle River, NJ, USA, 2nd edition, 2001.

[37] M.J. Handy, M. Haase, and D. Timmermann. Low energy adaptive clustering hierarchy with deterministic cluster-head selection. In Mobile and Wireless Communications Network, 2002. 4th International Workshop on, pages 368-372, 2002.

[38] Dr.N.RengarajanJ.Gnanambigai and K.Anbukkarasi . Leach and its descendant protocols: A survey. In Proceedings of the 2007 International Conference on Compilers, Architecture, and Synthesis for Embedded Systems, volume 01, 2012.

Jyoti Devi pursuing **MTECH** from Rohtak Institute of Engg. Management, Rohtak (2013-2015) and obtained **B.Tech in Electronics and Communication Engineering from** Co affiliated to Maharshi Dayanand University in 2012. His main research interests includes: Wireless Sensor Networks, Wireless Body Area Networks, MAC Protocols, Next generation Wireless Networks and Image Processing.

.