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Implementation of Enhanced MODLEACH using EHROM for Wireless Sensor Network

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***Abstract*— Energy efficiency is a recent issue in the wireless sensor network (WSN). Hierarchical routing or clustering is the better solution for reducing energy consumption in WSN. LEACH (Low energy adaptive clustering hierarchy) is a convenient hierarchical protocol. There are numerous protocols introduced based on LEACH but still have issues of energy efficiency. Lots of researches are going on CH (cluster head) election algorithm, data aggregation, reducing the amount of transmissions and different power levels. Existing MODLEACH (Modified LEACH) uses three transmission power levels, which reduce energy consumption in the network, also it uses different cluster head election algorithm in which a node is remaining energy greater than the threshold it remains as a cluster head for the next round. The equation used in MODLEACH for electing a cluster head is same as used in LEACH. In the proposed approach i.e. in Enhanced MODLEACH by using the differential equation for the cluster head election as used in HEED (Hybrid Energy-Efficient Distributed Clustering) such that it selects a node as cluster head based on the remaining energy of a node. Also in enhanced MODLEACH by putting an energy hole removing mechanism such that if a node has energy less than the threshold, it puts a node into sleep node. If number of sleep nodes greater than 10 then putting sleep nodes one by one into an active mode. So this approach increased lifetime in terms of the first dead node. Stable period and packets to a base station (BS) or sink. Due to the proposed Enhance MODLEACH the number of dead nodes will be reduced and the efficiency of the nodes will be high, and the cluster head is rotation is done based on the energy of the cluster head this reduces in the network breakdown and the packets delivered to the cluster head is high, and the number of packets delivered to the base station is high.**

***Keywords*— Clustering, energy efficiency, LEACH, lifetime, stability period, WSN**

I. INTRODUCTION

Wireless sensor networks (WSN) consist of several nodes. Each node has computation capability like sensing, control function and transmission/receiving. Every node sends their sensed data to Base Station (BS) using wireless communication. Base station receives sensed data,aggregate that data and takes decision about action for particular application. So there are various application based on WSN like disaster management, animal tracking and monitoring, volcano monitoring etc. In these kind of application, sensor has require energy for various operation; but at such place battery cannot be recharged or replace; so taking care of energy consumption is issue now a days. Every node transmits same kind of data directly to sink (Single hop) it is not efficient way because it consumes more energy; nodes far away from sink dry earlier because they have required more energy to transmit their data directly to sink; so lifetime decreases. Later they introduce multi hop communication between nodes; in this approach most of data transmit through nodes nearer to sink; so nodes were nearer to sink die earlier and network fails. In an efficient wireless sensor network, we need efficient routing protocol that has low routing overhead and well organized data aggregation mechanisms to increase good put of network and to save limited power of sensor node. To solve above problems of energy consumption hierarchical routing (clustering) is best approach. In this approach cluster has been formed; each cluster has several nodes and one cluster head. Every node sends their sensed data to CH; CH aggregates that data and sends data to sink. This paper introduces various clustering protocols. Progressive work on Wireless sensor Networks (WSNs) has enabled the designers to create autonomous sensors, which can be deployed randomly, without human supervision, for the purpose of sensing and communicating valuable data. Various energy-efficient routing protocols are developed for WSNs based on clustering structure. Sensor nodes in WSNs are usually battery operated sensing devices with limited energy resources. So energy efficiency is one of the most important issues and designing power efficient protocols is vital for prolonging the lifetime and performances of the system. WSNs have been considered for certain applications with limited power, reliable data transfer, short range communication, and reasonably low cost such sensing applications. For energy efficiency, extensibility of lifetime, scalability and performance, cluster based routing protocol enforces a structure out of different routing protocols. This technique can also used to perform data fusion, which combines data from source nodes and transmit to destination node with set of meaningful information. Many routing protocols have originated since the development of this field in which LEACH.

II. RELATED WORK

In the past year, many protocols developed for clustering some of importance are as follows: Low Energy Adaptive Clustering Hierarchy (LEACH) was proposed by [1] W. Heinzelman. It was first clustering approach introduces for WSN. It is for homogeneous and dense sensor network. It is TDMA based MAC protocol integrated with clustering and uses simple routing. It is working in 2 phases. 1) Set up phase: Each node generates a random number between 0 and 1. Node be elected as CH by calculating threshold using as in (1),

$$T(n) = p/(1- p(r \% (1/p))) \quad \text{if } n \text{ belongs to } G \qquad (1)$$

If (random number < T (n))
Current node becomes Cluster Head
Else
Current node becomes Cluster Member (normal node).
P = probability to become CH, r = round number,
N = number of nodes
G= set of nodes which not become CH for last 1/p round.

Elected CH broadcast advertisement packet nodes to join cluster. According to receive signal strength nodes send joining packet to particular CH. CH send TDMA schedule to nodes which want to join that particular cluster. 2) Steady state phase: nodes transmit sensed data to CH in their time slot according to the TDMA schedule; CH aggregates that data and transmit to sink. In every round, this 2 phase is worked and new CHs were elected. Hybrid Energy- Efficient Distributed (HEED) clustering was introduced by S. Younis and O. Fahmy [5]. The main goal of HEED is to prolong network life. The basic dissimilarity, between HEED and LEACH is a cluster head election process; cluster head election in HEED is not arbitrary. The construction of clusters is based on available remaining energy of the node and intra-cluster communication cost. Cluster heads have higher average remaining energy than the member nodes. The communication method of HEED is the same as LEACH. Multi-hop Clustering for Load Balancing Algorithm (MCLB) was proposed by N. Israr [8]. It is a new cluster based routing algorithm that exploits the redundancy properties of the sensor networks in order to address the traditional problem of load balancing and energy efficiency in the WSNs. The algorithm makes use of the nodes in a sensor network of which area coverage is covered by the neighbors of the nodes and marks them as temporary cluster heads. The algorithm then forms two layers of multi hop communication. The lowest layer which involves intra cluster communication and the highest layer which involves inter cluster communication involving the temporary cluster heads. Performance studies show that the proposed algorithm solves effectively the problem of load balancing and is also more efficient in terms of energy consumption from Leach and the enhanced version of Leach. Energy Efficient Hole Removing Mechanism (E-HORM) was proposed by M. B. Rasheed [9]. In this technique, they use sleep and wake mechanism for sensor nodes to preserve energy. This approach finds the maximum distance node to calculate the maximum energy for data transmission. They considered it as a threshold energy Eth. Every node first checks its power level for data transmission. If the power level is less than Eth, it cannot transmit data. When numbers of sleep nodes are greater than 10 then put sleep node one by one into an active mode

III. MODLEACH PROTOCOL

Modified LEACH (MODLEACH) protocol was introduced by D. Mahmood, and N. Javaid [12], their work is based on LEACH protocol. Basically, they introduce two techniques to robust network life time and throughput. To recognize their proposed algorithm, we need to carefully understand the mechanism used in LEACH protocol [1]. This protocol changes the cluster head at every round and once a cluster head is elected. It will not get another chance for next 1/p rounds. For every round, cluster heads are rotated and clusters will be reformed. The modified LEACH with "efficient cluster head replacement scheme" as showed in Fig.2, has a threshold in cluster head formation at the very next round. If existing cluster head has not consumed much energy during the previous round and has more energy than the required threshold (th = initial energy of node/2), it will persist cluster head for the next round as well. This is how nos. of packets for the clustering process can be minimized and network life time can be increase. If the cluster head has less energy than required threshold then clusters will be reformed using the same phenomenon as LEACH protocol. D. Mahmood and N. Javaid have also introduced two different levels of power to strengthen signals according to the nature of transmission. There can be three types of communication can take place in a cluster based network.

1) Intra Cluster Communication
2) Inter Cluster Communication
3) Cluster Head to Base Station Communication

Intra Cluster Transmission: In which all the communication inside cluster i.e. sensor node sensor information of interest and report sensed information to the cluster head.

Inter Cluster Transmission: In which communication happen between two clusters heads instead of cluster head transmitting its information directly to sink or base station.

Cluster Head to Base Station Transmission: In which cluster head directly communicate with sink or base station Minimum amplification power required to communicate within the Cluster while its required high amplification to transmit the data from the cluster head to BS Communication.

In LEACH, amplification energy is set same for all kinds of communication. By using a low energy level for intra cluster transmissions with respect to the cluster head to BS transmission leads in saving much amount of power. Moreover, multi power levels also reduce the PDR (Packet Dropping Ratio). Here there are chances of occurring collision or interference with other packets. In this circumstance, they assume that a cluster at maximum may cover an area of 10X10m2 in a field of 100X100m2. Energy that is enough to transmit at the far ends of a field of 100X100m2 must be lowered 10 times for intra-cluster communication. When node act as a Cluster Head, routing protocol switches the node to high power amplification and when that node becomes a cluster member, routing protocol switches the node to low level power amplification. Different transmissions power levels decrease the retransmission of a packet, collisions and interference for other signals.

IV. EMODLEACH PROTOCOL

The block diagram consists of the overall mechanism of Emodleach protocol. It consists of methods forming a cluster network and also method for election of cluster head for the specified network. If the node's energy is greater than the threshold it will be selected as cluster head. In other case if cluster head's energy is less than the threshold it acts as a normal node. If the node's energy is less than the threshold it acts as a sleep node. Hence the number of sleep nodes becomes greater than 10 then the process makes the sleep nodes to come to the active state i.e. one by one.

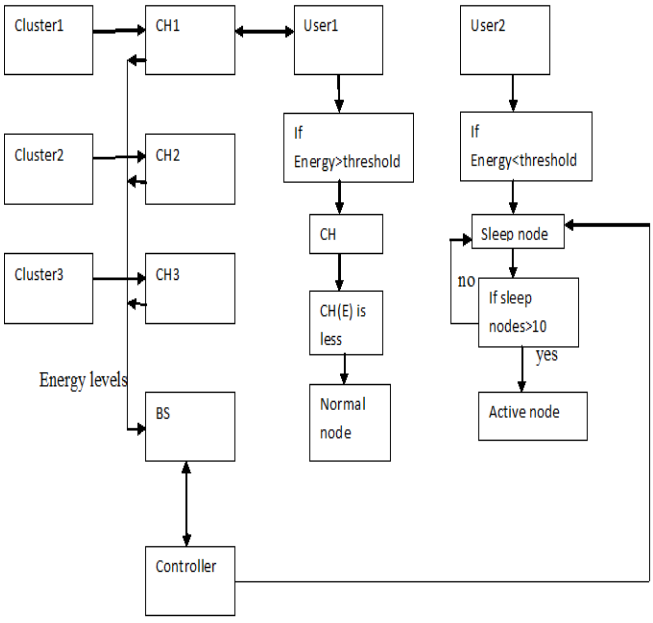

Fig.1 Block Diagram of Emodleach

V. IMPLEMENTATION

We enhance MODLEACH by using better equation for calculating the threshold for electing node as cluster head and energy hole removing mechanism as showed in Figure 3.

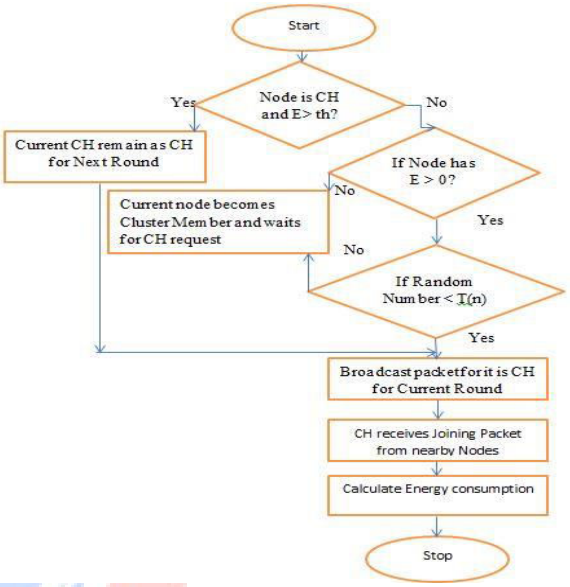

Fig. 2 Cluster Head Election Algorithm

MODLEACH is good protocol but it calculates threshold as in (1) for electing node as the cluster head is same as used by LEACH. Due to this there is no limitation on the number of cluster heads. They use better cluster head election technique but it works for initially some of the round because if cluster head has less energy than the required threshold, it will work same as LEACH algorithm. To avoid this problem we calculate the threshold for electing cluster head as in (2) rather than used by LEACH and MODLEACH as in (1). In HEED they not used randomness but we used randomness to avoid number of iteration like HEED. It calculates a threshold based on the ratio of the remaining energy of node and initial or maximum energy of node and probability of a node to become a cluster head.

T (n) = Cprob*(Er/Ei) (2)
Cprob = probability of a node to become cluster head [0.05, 0.9]
Er = remaining energy of node
Ei = initial energy of node

If (random number < T (n))
Current node becomes Cluster Head
Else

Current node becomes Cluster Member (normal node).

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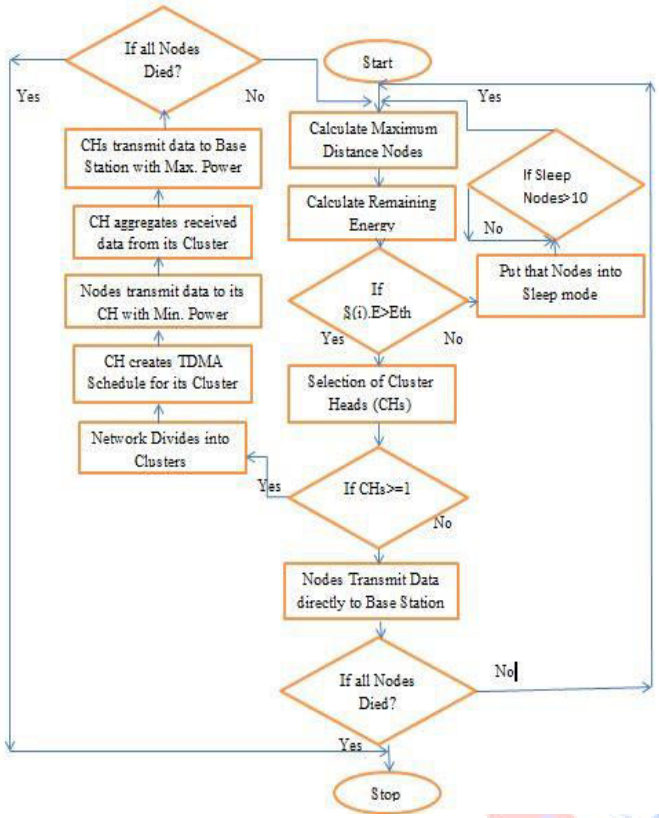

Fig. 3 Enhanced MODLEACH Algorithm

Cluster head election algorithm is same as showed in Figure 2. But we calculate the threshold as in (2). Cluster head remains in active energy; also it requires energy for performing data aggregation as well as for transmitting aggregated data to sink or BS. Equation (2) limits the number of cluster heads in the network. Less number of cluster head less energy consumption in the network. So this approach saves energy in the network.

Energy Hole Removing Mechanism

Our technique outperforms in terms of network lifetime and stable period. Now we explain how the sleep and awake mechanism is carried out in LEACH and TEEN to remove the energy holes. LEACH and TEEN are homogeneous routing protocol and all the nodes have the same probability to become a cluster head. Cluster head consumes more energy during transmission due to data load of member nodes. Nodes forward their own data to cluster heads according to the TDMA schedule. All nodes are in sleep mode and turn on their transmitters during data transmission to save energy. According to our approach, the nodes that have the energy level less than the threshold are in sleep mode to save energy. In this way, we save energy to prolong network lifetime and stable period.

Also there is the problem of energy hole. Nodes which are become dead earlier in the network are known as energy holes. We proposed Energy hole removing mechanism, it put a node into a sleep mode if node have energy less than threshold (th1); if number of sleep nodes greater than 10 then putting sleep nodes one by one into active mode so stable period increases.It uses transmission power level as used in MODLEACH. So energy consumption is reduced ultimately lifetime increases. As well as in our approach if CHs are greater than 1 then nodes transmit data to CH other wise to Base Station, because multiple transmission and reception consumes more energy. So here energy saved and packets to BS increase.

VI. RESULTS AND DISCUSSION

After implementing the proposed system on NS2 platform, the results obtained are as follows:

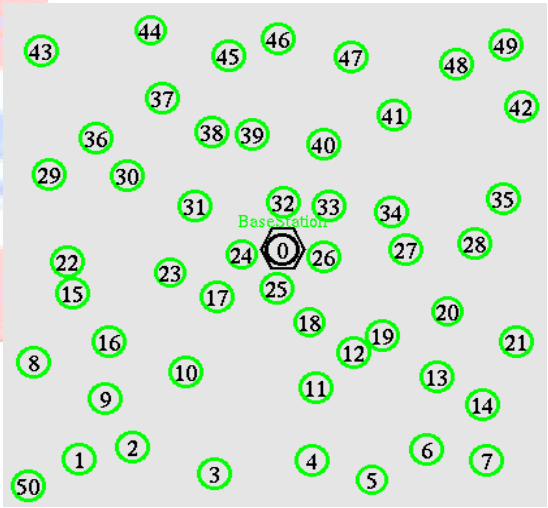

Fig. 4 Network Creation

The above figure shows the topology of network. Here we are wireless sensor nodes and a single base station.

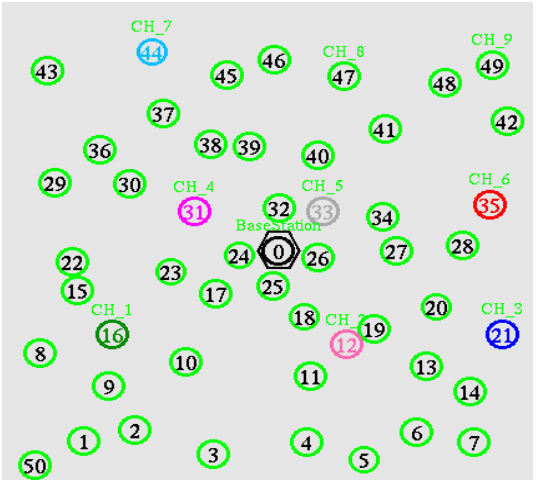

Fig. 5 Network divided into clusters

In figure 5 the network is divided into different clusters, where each cluster is having Cluster Head (CH).

The following graph shows the comparison graph for Packet Delivery Ratio (PDR) drawn using Xgraph, and it is better in case of proposed system as compared to existing system.

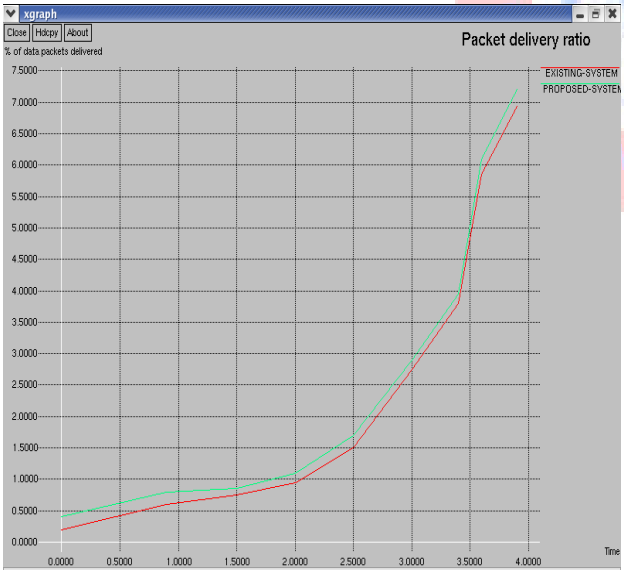

Fig. 6 Xgraph of Packet delivery ratio

The figure 7 shows the comparison graph for Receiving BS, and this parameter is high for proposed system as compared to existing system.

Fig. 7 Xgraph for receiving data rate for BS

The figure 8 shows Xgraph for Receiving CH, and it shows the comparison between proposed system and existing system, it is better for proposed system as compared to existing system.

Fig. 8 Xgraph for receiving data rate for CH

VII. CONCLUSION AND FUTURE WORK

The clustering reduces energy consumption in Wireless Sensor Network. LEACH was first clustering protocol. Here several protocols based on LEACH are introduced with their advantages and disadvantages. Proposed protocol for homogeneous and also for proactive network as well as

reactive are explained. Protocol uses different cluster head election equation and algorithm by using which it is possible to limit number of cluster heads and which is also increases lifetime of network. And the usage of technique like sleep and awake scheduling helpful in removing energy hole and better stability period. Along with these some different power levels introduced in order to reduce energy consumption and decrease the retransmission of packet, packet collision and interference with signals. The proposed approach helped in reducing the energy consumption and also useful in increases the lifetime. According to simulation results and analysis of proposed schemes, proposed protocol performs better than LEACH and MODLEACH. Lifetime of reactive protocol is much higher than proactive protocol.

Researchers are going to enhance proposed protocol in future by using better cluster head selection method as well as better sleep and awake schedule. Also researchers try to simulate this protocol using open source tool and try to put it in real environment.

REFERENCES

[1] W. Heinzelman, A. Chandrakasan and H. Balakrishnan, "Energy Efficient Communication Protocol for Wireless Microsensor Networks," IEEE Proceedings of the 33rd Hawaii International Conference on System Sciences (HICSS '00) 2000.

[2] H Karl and A Willig, "Protocols and Architectures for Wireless Sensor Networks," John Wiley & Sons, Ltd. ISBN: 0-470-09510-5, 2005.

[3] Md. A Rahman, S Anwar, Md. IleasPramanik, Md. Ferdous Rahman, "A Survey on Energy Efficient Routing Techniques in WSN," IEEE, 2013.

[4] D.P Manjeshwar, E. Agrawal, "TEEN: A Routing Protocol for Enhanced Efficiency in Wireless Sensor Networks," IEEE In Proceedings of the 15th International Parallel and Distributed Processing Symposium (IPDPS), San Francisco,CA, USA, pp. 2009–2015, 23–27 April 2001.

[5] S. Younis, O. Fahmy, "HEED: A hybrid energy-efficient distributed clustering approach for ad-hoc sensor networks," IEEE Trans. Mobile Computer, pp. 366–379, 2004.

[6] L. Qing, Q. Zhu, M. Wang, "Design of a distributed energy-efficient clustering algorithm for heterogeneous wireless sensor networks," In ELSEVIER, Computer Communications, 2006.

[7] R. Chaudhary, Dr. S. Vatta, "Performance Optimization of WSN Using Deterministic Energy Efficient Clustering Protocol: A Review," International organization of Scientific Research Journal of Engineering, 2014.

[8] N Israr, I Awan, "Multihop clustering Algorithm for load balancing in Wireless Sensor Networks," International Journal of Simulation, Systems, Science and Technology, vol. 8, No. 1, pp. 13-25, 2007.

[9] M. B. Rasheed, N. Javaid, Z. A. Khan, U. Qasim and M. Ishfaq, "EHORM: An Energy Efficient Hole Removing Mechanism in Wireless Sensor Networks," 26th IEEE Canadian Conference on Electrical and Computer Engineering (CCECE2013), Regina, Saskatchewan, Canada, 2013.

[10] M. B. Rasheed, N. Javaid, A. Javaid, M. A. Khan, S. H. Bouk, Z. A. Khan, R. D. Khan, "Improving Network Efficiency by Removing Energy Holes in WSNs," Journal of Basic and Applied Scientific Research, ISSN 2090-4304 3(5)253-261, 2013.

[11] V. Sunkara and A. Pal, "Assisted-Leach (A-Leach) Energy Efficient Routing Protocol for WSN," International Journal of Computer and Communication Engineering, Vol. 2, No. 4, July 2013.

[12] D. Mahmood, N. Javaid, S. Mehmood, S. Qureshi, A.M. Memon, T. Zaman, "MODLEACH: a variant of LEACH for WSNs," 26th IEEE Canadian Conference on Electrical and Computer Engineering (CCECE2013), Regina, Saskatchewan, Canada, 2013.

[13] S. El Khediri, N. Nasri, A. Wei, A. Kachourid, "A New Approach for Clustering in Wireless Sensors Networks Based on LEACH," Published by ELSEVIER, Procedia Computer Science 32, 1180 – 1185, 2014.

[14] P. N. Renjith and E. Baburaj,"An Analysis on Data Aggregation in Wireless Sensor Networks," IEEE International Conference on Radar Communication and Computing (ICRCC), SKP Engineering College, Tiruvannamalai, TN., India. 21-22 pp. 62-71, December 2012.

[15] Nikunjkumar K. Pandya, H. J. Kathiriya, N. H. Kathiriya, A. D. Pandya, "A Review: Energy efficient clustering protocols for Wireless Sensor Network," International Journal of Advance Research In Science And Engineering (IJARSE), ISSN-2319-8354(E), pp. 1010-1017, Vol. No.4, Special Issue (01), March 2015.