A Research Paper on the Use of Homogeneous Rings for Clustering in Efficient Wireless Sensor Networks

Manvi Chopra[1], Rahul Bhatt[2], Gesu Thakur[3]

[1]Assistant Professor, Electronics and Communication, School of Engineering, DevBhoomiUttarakhand University, Chakrata Road, Manduwala, Naugaon, Uttarakhand 248007

[2]Assistant Professor, Computer Science & Engineering, School of Computer Science & Engineering, DevBhoomiUttarakhand University, Chakrata Road, Manduwala, Naugaon, Uttarakhand 248007

[3]Associate Professor, Computer Science & Engineering, School of Computer Science & Engineering, DevBhoomiUttarakhand University, Chakrata Road, Manduwala, Naugaon, Uttarakhand 248007

[1]ece.manvi@dbuu.ac.in, [2]socse.rahul@dbuu.ac.in, [3]head.ca@dbuu.ac.in

Article Info

Page Number: 1612 - 1624

Publication Issue:

Vol 71 No. 4 (2022)

Abstract

Wireless Sensitive Networks, or WSNs, are self-contained systems that are extensively spread and rely on a small number of low-cost distributed devices. These networks are also known as sensor networks. These devices have significant drawbacks in terms of processing power, memory capacity, communication channels, and the amount of energy they use. Sensory nodes are responsible for collecting interest rates in a certain region and making them accessible to sink nodes, which are located in external systems and networks. Because of ways that save energy, nodes may sleep for extended periods of time. The most important issue is how to successfully construct a network taking into account the limitations of WSN and the needs of the different applications. During the course of my investigation, I discovered that the nodes located in close proximity to the sink would be subject to a much greater level of power consumption than the nodes located farther away owing to the added transmission load. As a consequence of this, the nodes in the area near the sink will lose power extremely rapidly, which will result in the fast death of the network, despite the fact that the nodes farther away from the sink still have a significant amount of idle power. The difficulty for WSNs is the need for a system that lowers the amount of power that is used by the nodes that are

Article History
***Article Received**: 25 March 2022*
***Revised**: 30 April 2022*
***Accepted**: 15 June 2022*
***Publication**: 19 August 2022*

located close to the sink.

Keywords: Consumption, Communication, Nodes, Networks, and Transmission are some of the keywords to look for.

1. The opening statement

In most cases, wireless sensor networks, also known as WSNs, consist of a large number of compressed nerve implants that are surgically inserted in order to gather data from a specific sensory area. For a very long time, WSN has struggled with finding a method that is both cost-effective and efficient for the collecting of data. In recent years, the method of data collecting known as clustering has seen widespread use in the quest to reduce overall power consumption and increase the lifespan of networks. However, the majority of the already suggested power reduction strategies do not take the quality of service (QoS) component into consideration. This is particularly true with regard to the origin of the resource and the possibility of data loss. Because of the power they provide in a variety of operating systems, such as military status, environmental monitoring, and other applications, wireless sensor networks (WSNs) are employed extensively.

A typical WSN will consist of a large number of sensors, each of which will have a restricted radio frequency range and limited battery power. After being deployed, the sensor node examines its immediate environment and sends data about anything of interest to the processor. Among them, the technique of merging the sensors of adjacent buildings to produce clusters is the one that has garnered the most interest. In such WSN-based collections, the (CH), also known as the cluster head, is responsible for controlling the standard sensor nodes (RSNs) that are present in the same group. Sink is used to store the acquired data, either directly or via a succession of CHs in neighboring clusters. Cluster head is used for collecting and compiling all of the data from RSNs, while sink is used to store the obtained data. There have been a lot of research done on WSNs, and a lot of them have concentrated on improving energy efficiency. This is because the sensor node may sometimes become squeezed because of power.

The term "wireless nerve networks" (WSN) refers to a collection of dispersed sensors that are used to monitor local environmental or physical conditions such as temperature, pressure, noise, and so on. These sensors all work together to send their data to a base station that is connected to the network. The WSN is composed of a large number of nodes, all of which are linked to the sensors of the other nodes. Clustering is the most effective strategy for extending the life of a network. With the help of this notion, sensor nodes can be grouped into groups and cluster heads (CHs) may be chosen for each group. The consolidation of energy is a well-known and widely developed development problem that is necessary to extend the life of wireless nerve networks. The collection of data from the specific clusters nodes and the transfer of the integrated data to the base station are necessary steps in this process.

2. The components and procedures

2.1 Sensor Node

A sensor is a very small electronic device that, rather than sending the information it gathers to a base station, it just processes the data it receives and then displays it. It is used in a wide variety of assessments of thinking, including changes in ambient factors like temperature, pressure, humidity, and noise, as well as shifts in a person's health metrics like blood pressure and heart rate. The sensor node should be extremely small in size, have a very low power consumption, be able to function autonomously, have a very high volume, and be able to adapt to the environment in which it is positioned while also functioning without being monitored by another device.

2.2 Station Principal

The base station already has the low-power network software installed when it is purchased. Since the sensor nodes are responsible for transmitting all of the data to the base station, it is very vital for the wireless sensor network to have access to the base channel. Additionally, this data is processed in the basic channel so that analysis and decisions may be made based on it. During the process of putting in place the principal channel in the sensor network, concerns about energy efficiency and dependability are addressed and addressed accordingly.

2.3 Safety Measures for Sensor Networks

In a WSN system, it is essential that all sensor nodes be trusted. However, sensor nodes are often utilized in situations that cannot be regulated and are thus unsuitable. Several distinct kinds of assaults have the potential to utterly cripple the network. In point of fact, the primary weakness that this assault exploit is the unpredictability of the communication route. Nodes in the network that have inadequate hardware capabilities cause the network to have poor security.

Quality of service (QoS) and network security are two major WSN categories. The primary objective of this phase is to verify that the network will continue to function normally despite the presence of an erroneous node or an assault on the node. Second, the goal of this endeavor is to protect the confidentiality of the data while also ensuring its integrity, availability, and youth. In point of fact, the attacker is able to compromise the sensor node in order to change the data's integrity, introduce bogus data into the network, or listen in on the conversation.

2.4 Clustering

Clustering is an extremely important component of the Wireless Network Network, as it helps to ensure that the network is both powerful and reliable. Integration in wireless neural networks has been common practice for a significant amount of time. Integration across dispersed routes is currently being worked on in order to handle challenges like network life and power consumption. Integration into sensor nodes is essential for solving several problems associated with sensory networks, including balance, power, and difficulties that persist over time. Through the network's forwarding nodes, just the information that is absolutely essential is passed around. See Figure 1 for an explanation of what a cluster is and how it works. A cluster is a set of nodes that manages communication between cluster members. Cluster nodes will often communicate with the cluster head, and the data that is gathered will typically be consolidated by the cluster head in order to save power.

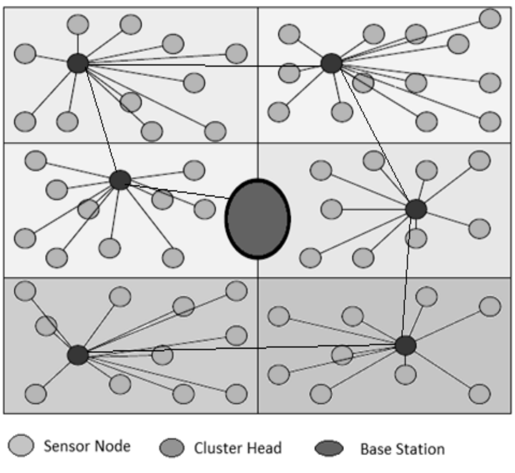

Figure1 Cluster Based data forwarding in Network

2.4 Research Gaps

The most important issue is how to build a network effect taking into account the restrictions of WSN and the diverse needs of applications. During the course of my investigation, I discovered that the nodes located in close proximity to the sink would be subject to a much greater level of power consumption than the nodes located farther away owing to the added transmission load. As a consequence of this, the nodes in the area near the sink will lose power extremely rapidly, which will result in the fast death of the network, despite the fact that the nodes farther away from the sink still have a significant amount of idle power. The difficulty for WSNs is the need for a system that lowers the amount of power that is used by the nodes that are located close to the sink.

WSNs also face a significant obstacle in the form of delays while trying to enhance the quality of their services. The avoidance of delay while maximizing energy efficiency are two competing priorities. It is frequently necessary to give up one of them in order to make progress on the other. There is a need for adaptable plans in order to equalize power and cut down on delays.

The pace at which packets are sent is another highly significant characteristic for enhancing quality of service. If smaller nodes are engaged in the packet transmission, then less power is consumed; nevertheless, longer waiting periods at the node may result in the loss of packets, and as a consequence, the packet delivery rate will be decreased. On the other hand, if more nodes engage in the delivery of packets, then a greater rate of packet delivery may be reached; nevertheless, this will result in an increase in the amount of power that is used. Therefore, it is necessary to increase the amount of power used, the delays, and the pace at which packets are sent.

3. The Results and Our Concluding Thoughts

3.1 Proposed protocol

In this model, the uneven clustering is presented, and as shown at Figure 2, we have taken into consideration the possibility that a BS will be placed in a remote location for the region that is being observed. In this particular protocol, the network is partitioned into a number of rings of varying sizes; the sizes of the rings become smaller as they go closer to the BS. In addition, the network's first two rings each include heterogeneous nodes. Within each cluster of rings one and two, there is one CH, which is a super node that has a high starting energy. The rest of the network's nodes are RSNs. After deployment, all of the nodes were given their positions, since their coordinates had been predetermined before deployment. All of the nodes are aware of their location. Super nodes are used to reduce the amount of energy that is consumed by the nodes that are geographically close to BS. In the event of a homogeneous network, nodes that are closer to the BS pass away much more quickly than nodes that are farther away. When the nodes that were closer to the sink were eliminated due to the additional Burdon required to transport traffic from nodes farther away, over 93% of the nodes remained alive. The use of super nodes will be beneficial in resolving the issue. The remaining territory will all have a network that is consistent throughout. Within the confines of this protocol, all of the sensor nodes will be placed in rings at random, with the exception of rings 0 and 1. They will make their decision on the cluster head based on the amount of remaining energy. This protocol is essentially a hybrid model that maintains a consistent level of energy usage across all of the nodes. This is a more expensive option than the homogeneous model, but it is less expensive than the network in which all of the cluster heads are super nodes.

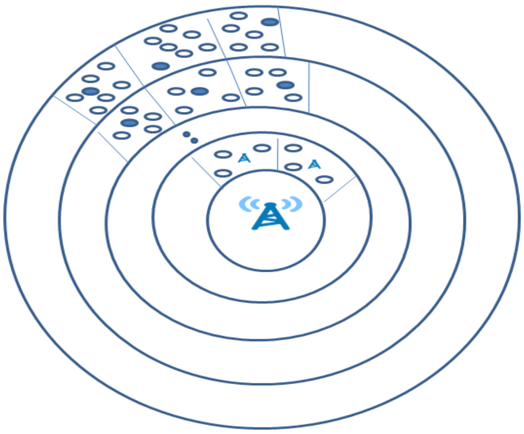

Figure2 Cluster Based Wireless sensor network model

3.1 Algorithm

Step 1: Start

The second step is to create rings RI1 and RI2 that have the same radius and the same ratio.

Create Rings RI3-RIn with Random Radii Greater Than Ri-1 as the Third Step

The fourth step is to generate nodes and then insert equivalent nodes in rings 1 and 2.

Step 5: Assign Random Nodes, with Rings 1 and 2 being excluded from this step.

Step 6: Assign Additional Energy to Cluster Heads in the First Two Rings, RI1 and RI2, and Form Cluster Heads Within Rings RI1-RIn Using LEACH.

Step 7: Continue to do the simulation until the energy in all of the nodes has been used up.

The eighth step is to count the number of rounds and determine how much energy is left in the network.

3.2 The Results of the Simulation with 400 Nodes

We are now doing Simulation on 400 Nodes as part of our effort. In the first step, shown in Figure 3 (A), 400 nodes will be dispersed over space in an unpredictable manner and given an initial amount of energy. Please take note that the area in the middle of this plot that is colored green will be considered for Base Station. Altering the distance between each ring and the one before it produces several rings with unequal spacing. The next step Cluster Head selection is shown in Figure 3 (B), and it will be constructed according to the positions of the nodes; however, the number of clusters in each ring will not be the same.

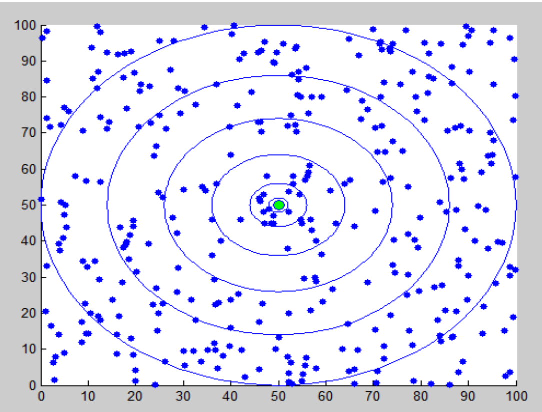

Figure 3 (A) 400 Nodes Network

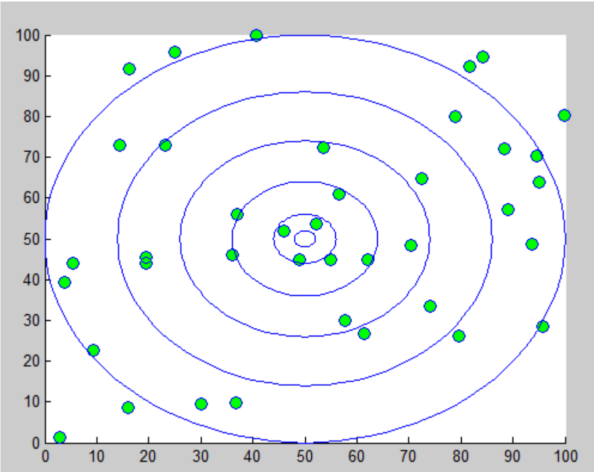

Figure 3(B) Clusters Head

3.1 Results: Existing Work vs Proposed Work

In Figures 4 and 5, we can observe a comparison of Dead nodes to Rounds for two pieces of previously published research. Paper titled "EECS: An Energy Efficient Clustering Scheme in Wireless Sensor Networks" is referenced in work that has already been done. As can be seen in figure 4, all 400 nodes were eliminated before 1200 rounds. As can be seen in Figure 5 from the paper "An uneven cluster-based routing strategy in wireless sensor networks," all of the nodes are eliminated before the round count of 2000.

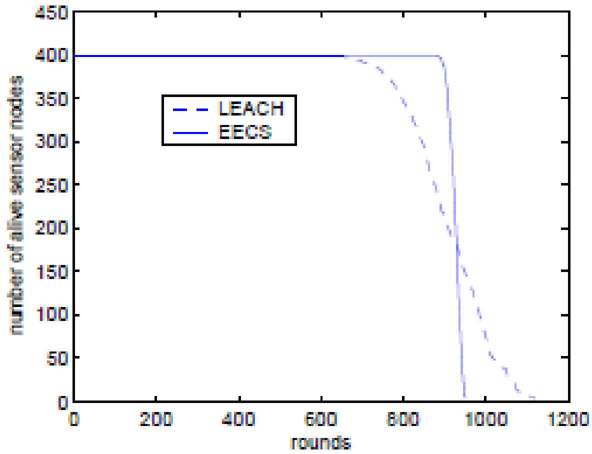

Figure 4 Existing work - LEACH

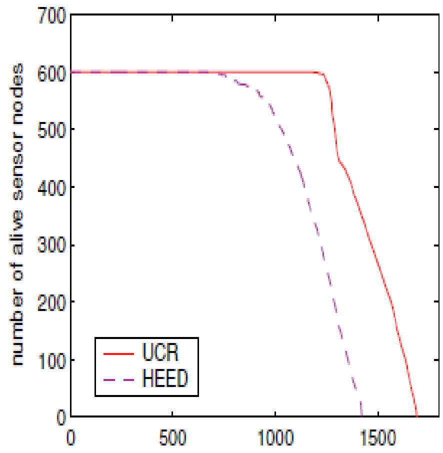

Figure 5 Existing work – UCR

In Figure 6, we are able to observe that The fact that there are about 350 dead nodes after 2000 rounds demonstrates that the performance of the proposed method is superior to that of the other two.

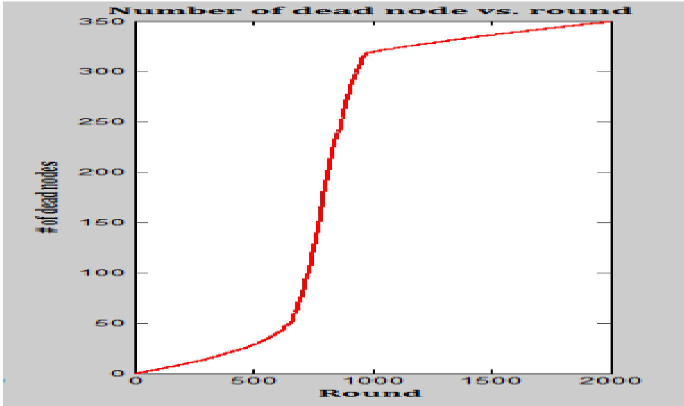

Figure 6 Proposed Method Result

4. Conclusion

In this research, we provide an uneven clustering that is based on a routing protocol that maintains a balance in the energy consumption of all of the nodes. In the event of multihop communication, the problem of hotspots, which ultimately results in the splitting of the network, arises. We have segmented the network into rings of varying diameters such that the nodes that are physically closer to BS would have a smaller diameter and so be able to save more energy. A cluster head is a kind of super node that is in charge of communicating with other cluster heads as well as the nodes that are directly beneath it. This is a hybrid network, and its purpose is to achieve a balance between the consumption of energy and the need to prevent the network's portioning in order to further improve the network's lifetime.

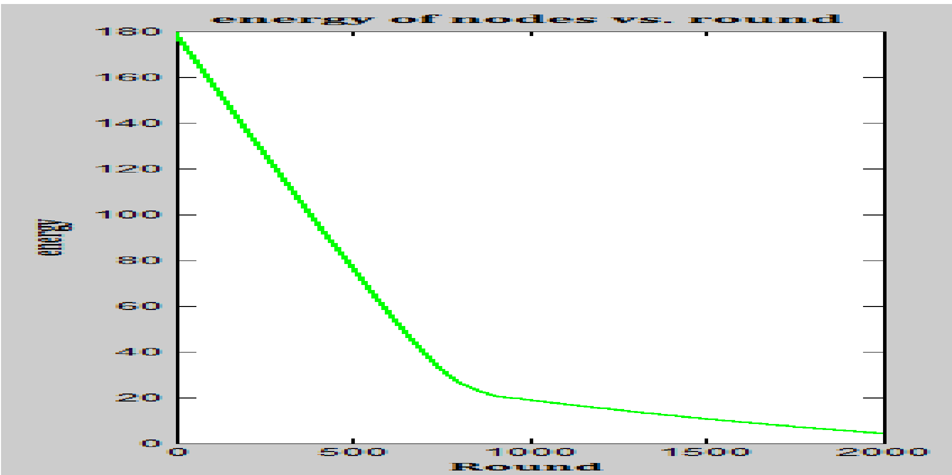

Figure 7 Energy vs Round

The first goal is to develop a design for the WSN that is both energy efficient and uses the ring-based clustering technique.

The performance of our designed network with ring-based clustering was significantly improved since we allocated the identical nodes to the first two nodes. These nodes were located close to the BS and were responsible for communication with any other node and the BS.

Increase the lifetime of the network to get a higher packet delivery ratio, which is the second objective.

Because of the presence of living nodes in the network, the lifetime of the network is enhanced, and the delivery ratio is improved, as illustrated in Figure 7. This occurred as a result of the arrangement of the nodes and the distribution of the energy.

The third goal is to design an effective cluster head selection technique that optimizes the distribution of energy.

The allocation of Cluster Heads had a significant effect on overall performance. Since we gave the cluster head that was closest to the base station a greater share of the available energy, the number of nodes in the first two rings, which are responsible for the delivery of packets, remained unchanged.

Objective 4: Utilizing METLAB to conduct a performance analysis of the suggested method.

The simulation in the study that we have presented demonstrates improved outcomes as the lifespan of the network increases. It is clear that the number of rounds in the proposed work is more than the number of rounds in the current work. Even after 2000 Rounds, Alive Nodes and energy have not been eliminated completely.

6. References

[1] Shantala Devi Patil, Vijayakumar B P," Clustering in Mobile Wireless Sensor Networks", International Journal of Advanced Networking & Applications (IJANA) ISSN: 0975-0282,

[2] Kamal Kumar Sharma, Ram Bahadur Patel," A Reliable and Energy Efficient Transport Protocol for Wireless Sensor Networks’’, International Journal of Computer Networks & Communications (IJCNC) Vol.2, No.5, September 2010.

[3] S. Mehta and K.S. Kwak, "H-MAC: A HYBRID MAC PROTOCOL FOR WIRELESS SENSOR NETWORK" ,International Journal of Computer Networks & Communications (IJCNC) Vol.2, No.2, March 2010.

[4] NassirahLaloo and Mohammad Sameer Sunhaloo," Timeline Improvement of Hierarchical Clustering Algorithms for Wireless Sensor Networks" International Journal of Computer Applications (0975 - 8887), Volume 176 - No.30, June 2020.

[5] Min Yao, Chuang Lin, Yuan Tian, " Energy and Delay Minimization in Cluster-Based Wireless Sensor Networks",IEEE International Conference on Green Computing and Communications, 2012.

[6] AzadehZamanifar, OmidKashefi and Mohsen Sharifi," AOM: AN EFFICIENT APPROACH TO RESTORE ACTOR-ACTOR CONNECTIVITY IN WIRELESS SENSOR AND ACTOR NETWORKS", International Journal of Computer Networks & Communications (IJCNC), Vol.1, No.1, April 2009

[7] Asma Mesmoudi1, Mohammed Feham, Nabila Labraoui," WIRELESS SENSOR NETWORKS LOCALIZATION ALGORITHMS: A COMPREHENSIVE SURVEY", International Journal of Computer Networks & Communications (IJCNC) Vol.5, No.6, November 2013.

[8] Sanat Sarangi1 and Subrat Kar2,"PERFORMANCE ANALYSIS OF AN IMPROVED GRADED PRECISION LOCALIZATION ALGORITHM FOR WIRELESS SENSOR NETWORKS", International Journal of Computer Networks & Communications (IJCNC), Vol.2, No.4, July 2010.

[9] WidedAbidi and TaharEzzedine,"New Approach for Selecting Cluster Head based on LEACH Protocol for Wireless Sensor Networks", ENASE 2017 - 12th International Conference on Evaluation of Novel Approaches to Software Engineering.

[10] Seema Bandyopadhyay and Edward J. Coyle,"An Energy Efficient Hierarchical Clustering Algorithm for Wireless Sensor Networks ", IEEE INFOCOM 2003 .

[11] Zhongwei Zhang and Hong Zhou," EMPIRICAL EXAMINATION OF MOBILE AD HOC ROUTING PROTOCOLS ON WIRELESS SENSOR NETWORKS", International Journal of Computer Networks & Communications (IJCNC), Vol.1, No.1, April 2009.

[12] Hitesh Mohapatra, Sourabh Debnath & Amiya Kumar Rath ,"Energy Management in Wireless Sensor Network Through EB-LEACH", EasyChair Preprint, June 15, 2019.

[13] Priyanshu Gupta a, PallavRaj,"Energy Efficient Diagonal based Clustering protocol in Wireless Sensor Network", Intelligent Communication and Computational Research.

[14] Kirubasri G, Priya V, Sundarakumar M.R,"A Contemporary Survey on Clustering Techniques for Wireless Sensor Networks", Turkish Journal of Computer and Mathematics Education Vol.12 No.11 (2021), 5917-5927.

[15] Rajkumar and H. G. Chandrakanth,"EDCH: A Novel Clustering Algorithm for Wireless Sensor Networks", EJERS, European Journal of Engineering Research and Science, Vol. 4, No. 3, March 2019.

[16] Ravi Tandon,"DETERMINATION OF OPTIMAL NUMBER OF CLUSTERS IN WIRELESS SENSOR NETWORKS", International Journal of Computer Networks & Communications (IJCNC) Vol.4, No.4, July 2012.

[17] Mervat Mustafa Raouf,"Clustering in Wireless Sensor Networks (WSNs)", Journal of Baghdad University College of economic sciences issue-57- April 2019.

[18] Guihai Chen · ChengfaLi,"An unequal cluster-based routing protocol in wireless sensor networks", Wireless Netw (2009) 15:193–207, 3 April 2007.

[19] Preetkamal Singh1, Dr. OP Gupta,"A Brief Research Study of Wireless Sensor Network", Advances in Computational Sciences and Technology ISSN 0973-6107 Volume 10, Number 5 (2017) pp. 733-739.

[20] ParulBakaraniya, SheetalMehta,"FEATURES OF WSN AND VARIOUS ROUTING TECHNIQUES FOR WSN: A SURVEY", International Journal of Research in Engineering and Technology ISSN: 2319-1163,Volume: 01 Issue: 03 | Nov-2012.

[21] Ramegowda.K, Dr.R.Sumathi,"AN INTRODUCTION TO BASIC CONCEPTS OF CLUSTERING METHODS IN WIRELESS SENSOR NETWORKS", INTERNATIONAL JOURNAL OF CURRENT ENGINEERING AND SCIENTIFIC RESEARCH (IJCESR),VOLUME-2, ISSUE-9, 2015.

[22] Manal Abdullah, HendNourEldin,"Density Grid-Based Clustering for Wireless Sensors Networks", International Conference on Communication, Management and Information Technology (ICCMIT 2015)

[23] XuxunLiu,"A Survey on Clustering Routing Protocols in Wireless Sensor Networks", Sensors 2012, 12, 11113-11153.

[24] WooSuk LEE &Kye-Dong ,"JungImprovement of cluster head selection of LEACH Protocol", International Journal of Applied Engineering Research ISSN 0973-4562 Volume 12, Number 20 (2017).

[25] BasmaFathi SOLAIMAN," Energy optimization in wireless sensor networks using a hybrid K-means PSO clustering algorithm", Turkish Journal of Electrical Engineering and Computer Sciences · January 2015.

[26] Aamir Shaikh and Siraj Pathan," Research on Wireless Sensor Network Technology", International Journal of Information and Education Technology · January 2012.

[27] Mahmood Ali and Sai Kumar Ravula," REAL-TIME SUPPORT AND ENERGY EFFICIENCY IN WIRELESS SENSOR NETWORKS", Technical report, IDE0805, January 2008.

[28] Rudranath Mitra1, Diya Nandy2," A SURVEY ON CLUSTERING TECHNIQUES FOR WIRELESS SENSOR NETWORK", International Journal of Research in Computer Science eISSN 2249-8265 Volume 2 Issue 4 (2012).

[29] Rajeev Piyare1 and Seong Ro Lee," TOWARDS INTERNET OF THINGS (IOTS): INTEGRATION OF WIRELESS SENSOR NETWORK TO CLOUD SERVICES FOR DATA COLLECTION AND SHARING", International Journal of Computer Networks & Communications (IJCNC) Vol.5, No.5, September 2013.

[30] Geetha. V.a, Pranesh.V," Clustering in Wireless Sensor Networks: Performance Comparison of LEACH & LEACH-C Protocols Using NS2", Geetha. V. et al. / Procedia Technology 4 (2012) 163 – 170,2011 Published.