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A Comparative Analysis of Optimizing Leach Clustering Algorithm with Mobile Sink in WSN

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Abstract: - Wireless sensor networks are consisting of several sensor nodes that collect information from their surroundings and then transmit to the end user. In wireless sensor networks, the battery is the main issue. Network lifetime of network depend upon the sensor's communication. Various methods and techniques are used to enhance the network lifetime. Some authors' focuses on the mobile sink which is used to reduce the energy consumption. The low energy adaptive clustering hierarchy (LEACH) is an effective algorithm where all the nodes within the cluster send their respective data to the local cluster head.[1] Here, the cluster head selection is done by the technique neural network (NN) in the area of 150*150, 200*200 and 250*250, 350*350, 450*450 which provides greater functionality in the homogeneous WSNs.

Keywords: Wireless sensor network, battery, Network lifetime, clustering, LEACH, mobile sink ,neural network.

I. INTRODUCTION

Wireless device networks (WSN) consisting of tiny devices, that gather information by cooperating with one another.[2] These tiny sensing devices area unit referred to as nodes and carries with it electronic equipment (for information giving out), memory (for information storage), battery (for energy) and Transceiver. The dimensions of every device node vary with application. On behalf of instance, in military or police work applications it would be microscopically tiny. Its price depends on parameters similar to memory size, process rate and battery. Today, wireless device networks area unit wide employed in the business and industrial areas like for instance, environmental observation, surroundings observation, method observation and police work. for instance just in case of military space, we will use wireless device networks to watch any movement. If a happening be trigger, these machine nodes sense it and launch the knowledge to the bottom position (called sink) by communication by alternative nodes. [3] The employment of wireless device networks is raising day by day and next to an equivalent time it face the difficulty of energy constraint in terms of restricted series period. As a result of every node depends on energy for its behavior, this has developed into a serious issue in wireless device networks. The not a success of single node will interrupt the whole system or application. Each sensing node will exist in lively, idle and sleep

modes. In active mode nodes consume energy once receiving or transmittal information. In idle mode, the nodes consume virtually an equivalent quantity of power as in active mode, whereas in snooze mode, the nodes ending the radio to avoid wasting the energy. The subsequent steps will be taken to avoid wasting power cause by announcement in wireless device networks.

- To list the state of the nodes (i.e. transmittal, receiving or sleep).
- Changing the transmission vary among the sensing nodes.
- Using skillful routing and information grouping ways.
- Avoiding the behavior of unwanted information as within the case of overhearing.

In WSNs the sole supply of life for the nodes is that the battery and communication with alternative nodes or sensing activities consumes lots of energy in process the information and transmit the collected data to the sink.[2]

Sensors

Sensors are used by the wireless sensor nodes to capture the data from their surroundings. The analog signal produced by the sensors is digitized by an analog-to- digital converter and sent it to controller for processing. Main elements of a WSN node is

- Controller
- Communication device(s)
- Sensors/actuators
- Memory
- Power offer

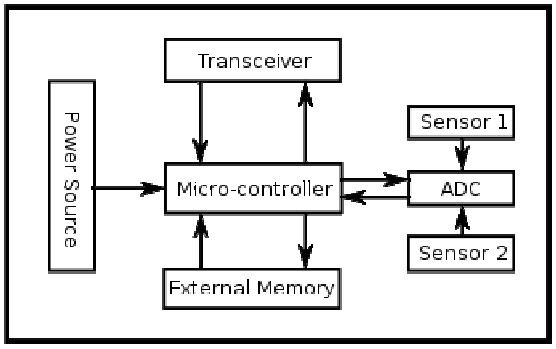

Fig 1. Components of sensor node

The main characteristics of a WSN

- Power consumption constraints for nodes exploitation batteries or energy gathering
- Ability to deal with node failures (resilience)
- Mobility of nodes
- Heterogeneity of nodes
- Scalability to massive scale of readying
- Ability to face up to harsh environmental conditions
- Ease of use

Clustering

The key intention of graded routing or cluster primarily based routing is to aptly maintain the energy usage of device nodes by connecting them in multi-hop communication among a exacting cluster. Cluster construction is often supported the energy reserve of sensors and sensors closeness to the Cluster Head (CHs). Agglomeration plays a key role for power save in WSNs. By clustering, the sensor nodes are divided into groups known as division cluster. Each cluster has a cluster head that aggregates data from the nodes in the cluster and forwards the data to the sink directly or step by step using other clusters' heads (chain communication).[4]

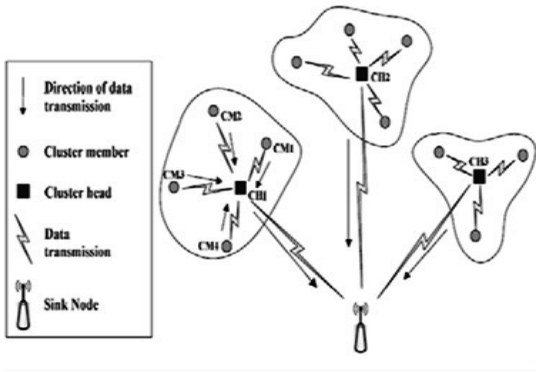

Fig 2. Clustering

There are two types of communication which is used in wireless sensor network.

Inter cluster communication-communication with other cluster heads.

Intra cluster communication- communication of regular nodes with cluster head.

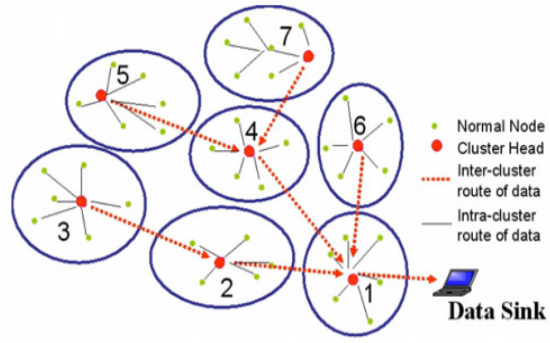

Fig 3. Cluster Communication

II. CLUSTERING TECHNIQUES

Low Energy Adaptive Clustering Hierarchy (Leach)

WSNs are micro indicator systems that are spatially distributed. WSN is a energy restricted process since the indicator nodes have confined battery living that shortens the network lifetime. Maximizing the network lifetime is dependent upon an successful conversation protocol. Energy consumption is, thus, a vital style problem in WSN. A cluster-based strategy is the fundamental method to increase the scalability, efficiency, efficiency and time of the network.[5]

LEACH, a hierarchical clustering redirecting project, was planned by Chandrakasan, Heinzelman and Balakrishnan, in MIT. Leach is a project that is useful in homogenous networks. In a homogenous network, all nodes have similar level of initial energy. Fundamentally there are two kinds of

redirecting methods in WSNs: Flat redirecting methods are these in that the redirecting condition of each node in the network could be the same. You can find number particular nodes in network and each node has similar status. Therefore, the network traffic is spread similarly among all nodes. Comparatively, hierarchical redirecting methods utilize the idea of clusters that splits all nodes in to communities or clusters.[6] Nodes in this kind of network have different levels. A CH is picked among all of the nodes and different hierarchical redirecting methods might use various ways of choosing CHs.

LEACH is a reduced energy project that'll adjust clustering. It is a cluster-based project that utilizes the idea of randomized turning of regional cluster-heads and blows the vitality load consistently among all of the indicator nodes in the feeling field of the network.

Characteristics of LEACH:

- Create of clusters through regional collaboration and control.
- To lessen the Information aggregation in network traffic.
- Regional pressure to degree straight back earth communication.
- Randomized turning of the chaos heads and also the equivalent clusters.
- Random Death of nodes.

Assumptions of LEACH:

- All nodes are related in context of initial energy.
- All nodes utilize Omni-directional antenna.
- BS is repaired and is remote from WSN
- Energy consumption of each node to deliver knowledge to different is equal.[7]

LEACH employs the idea of rounds. The task time id referred as a round. Each round constitutes 2 periods:
(a) Setup phase,
(b) Continuous phase

Setup Phase:
In the foundation or startup phase, each node decides whether to become a cluster-head (CH) in the current round. To be picked a CH; each node yields a random number between 0 and 1. The limit is established for the present round and the generated random number is set alongside the limit of the provided round. If the quantity is less than limit T(n), that particular node is likely to be picked the CH for that round.[8]
The threshold is set up as:

$$T(n) = \begin{cases} \frac{p}{1-p*(r \bmod \frac{1}{p})} & ,n \in G \\ 0, & otherwise \end{cases} \quad (1)$$

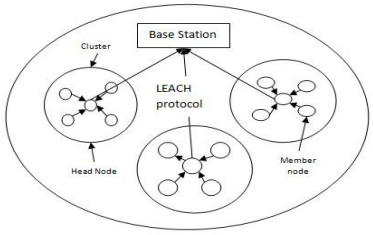

Figure 2.1 : LEACH protocol

Here p is the ratio of cluster-head nodes in the total number of nodes.
r is the current round number. G is the set of nodes that have not been selected as CH nodes in the former $\frac{1}{p}$ rounds. The high energy cluster head position moves among the various detectors in order to to not strain the battery of a single sensor. Receptors decide themselves to be the neighborhood cluster heads at any provided time with a specific likelihood, and broadcast their status to other detectors each alarm node selecting the cluster-head with strongest signal. Each node takes your decision separate of another nodes to become cluster head. Then cluster head creates a TDMA schedule for several nodes within its cluster telling each node when it can transmit.[9] It allows radio element of each low cluster head to be switched off constantly except all through its transitions time, therefore minimizing the power dissipation in the patient.

Steady phase
This operation is split into frames where in fact the nodes deliver their information to CH for the most part one frame in their sign time slot. The CH transfers the aggregated information to the Base place (BS). This project selects the CH arbitrarily and the total energy load of the system is similarly spread to each alarm node by which it can digest less energy and thereby increasing the system lifetime. LEACH outperforms conventional routing practices like strong sign, minimum-transmission-energy, in the static clustering algorithms. LEACH is spread and nodes do not involve get a handle on information from the base place nor familiarity with the worldwide network.[10] The LEACH project provides out energy optimization and also reduces the total amount of information given to prolong the system lifetime. But, it has some disadvantages:

1. It may occur that the same CH node is selected CH again in some other round because it has more energy.
2. It features a hotspot problem, i.e. the CH employs more energy than usual alarm nodes
3. The conventional alarm nodes that overlap their feeling areas generate replicate information that create pointless load on other CHs
4. The CHs are selected arbitrarily, therefore if the node with reduced energy is selected CH, then that

node might be greatly loaded and more energy will undoubtedly be consumed that results in early death of these nodes and eventually decrease the network lifetime.

III. MOBILE SINK (MS)

To improve energy efficiency or decrease to decrease energy consumption a new concept called Mobile Sink has been introduced. In LEACH, BS is fixed. But by adding the concept of moving sink to LEACH, decreases the transmission distance thus increases the lifetime of network. Sink movement may be controlled or un-controlled. In controlled MS, the MS trajectory is predefined while in uncontrolled MS, the sink moves randomly in a pre-determined environment.[11]

IV. NEURAL NETWORK

Neural network consist of parallel or distributed processing components called neurons which are connected in the form of graph topology. All these neurons are connected via weighted connections which are called synapses. These weighted vectors called synapses connect the network input layer to the output layer. The knowledge of neural network is stored on the weights of its connections so that's why the neural network does not need any data storage.[12]

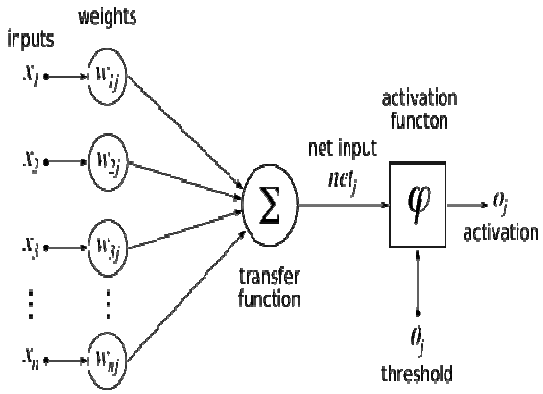

Fig 4.1. Structure of Neural network

Neural network are the arithmetic algorithms which learns the complicated mapping between the input and the output according to supervised training and also classify the input data in a unsupervised manner. One of the problems occurring while using NN is topology. The different type of training rules especially inspired from biology science determines the way of NN to learn. In NN, the training is totally based on learning by example.[13] A set of correct data of input and output is given to the network, and the network change the weights values and produce the new correct output, we called it as learning. One of the major properties of NN is to find the affected data by noise and remove variations after learning. The capability of neural network is depend upon its structure, dynamics and training rules. The main application of neural network is prediction, classification and identification.[14]

Advantages of the Algorithm

- Used to perform nonlinear statistical modeling.
- Requiring less formal statistical training.
- Ability to implicitly detect complex nonlinear relationships between dependent and independent variables.
- Ability to detect all possible interactions between predictor variables, and the availability of multiple training algorithms.

Disadvantages of the algorithm

- Its "black box" nature.
- Greater computational burden.
- Proneness to over fitting.
- Empirical nature of model development.

V. EXPERIMENTAL SETUP

The paragraph discusses the simulations results and comparative study of the performance. So as to implement the planned style and implementation has been done. Table 1 has shown a spread of constants and variables needed to simulate this work. These parameters square measure customary values used as benchmark for WSNs. In this simulation environment, the 100 sensor nodes are deployed in the area of (150,150),(200,200),(250,250),(350,350),(450,450) The MATLAB simulator is used for the given experiment.[15] The parameters are listed below in the given table. The metrics used for the simulation are:-

- Remaining Energy
- Dead nodes

Table1:- Simulation Parameters

Parameters	Value
Area(x,y)	(150,150),(200,200),(250,250)(350,350),(450,450)
Base Station(x,y)	X(sink)=0,Y(sink)=y_m/2.
Number of nodes	100
Probability	0.1
Initial Energy	0.3J
Transmitter Energy	50 nJ/bit
Receiver Energy	50nJ/bit

Free space Energy(amplifier)	1.0nJ/bit/m^2
Multipath Energy	0.0013nJ/bit/m^2

VI. Simulation Scenario and Results

This is the environment where area is 150*150 meter. Here, the environment of simulation is at the mid, where all the green circles are nodes and Red circle nodes are dead and diamond shaped is the base station which is moving on y axis because the x axis of sink is zero.[14]

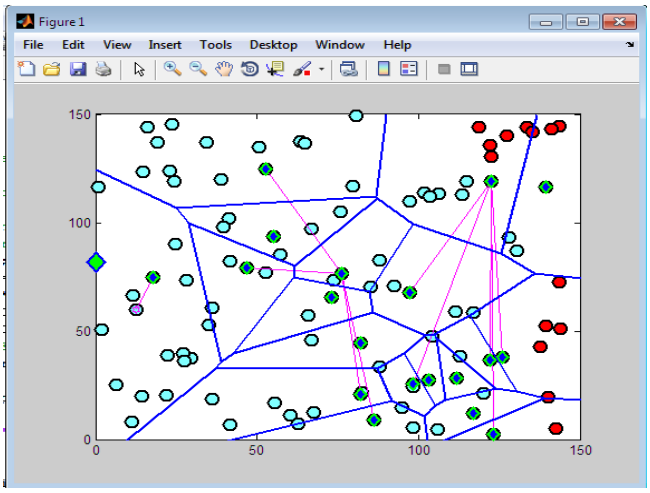

Fig 5.1.1 Simulation Enviornment

Here, the graph shows the simulation when all the nodes are dead. So all the nodes are in the red circle shape and again diamond shaped is the base station which is moving. From the above graph, we can see that the position of base station is moving along y axis.

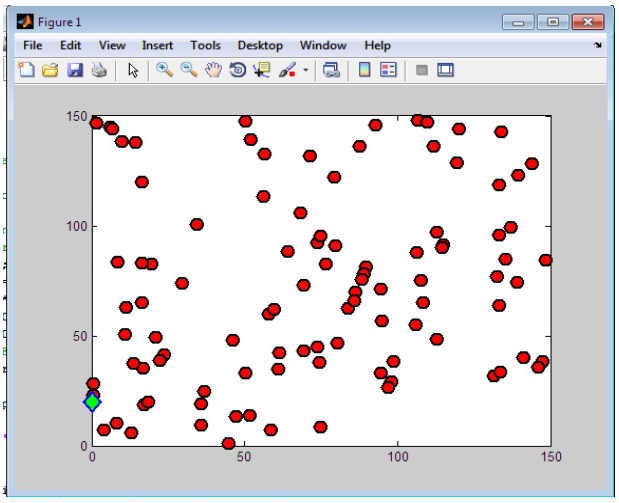

Fig 5.1.2. Simulation Enviornment at the end

Remaining Energy:-

This is the graph of remaining energy, which shows how much energy is left after the simulation. X axis shows the number of rounds .Here we have implemented the RZLEACH and NN RZ LEACH. In the case of RZLEACH the energy ends at the 1100 rounds and on the other hand, in NNRZ LEACH the energy dies at 1600 rounds. So NN RZ LEACH is more effective than the RZLEACH.

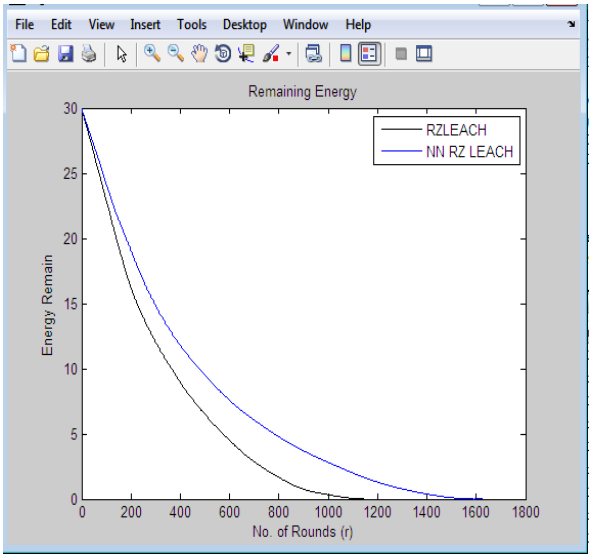

Fig 5.1.3. Remaining energy Vs Rounds

Dead Nodes:- This is the graph of dead nodes in RZLEACH and NNRZLEACH protocol.The network lifetime can be evaluated by using the number of dead nodes. It has been found that the number of nodes die earlier in RZLEACH protocol. Here, we can see from the graph that the nodes are die at the round of 1050 in case of RZLEACH and 1650 in case of NNRZLEACH.

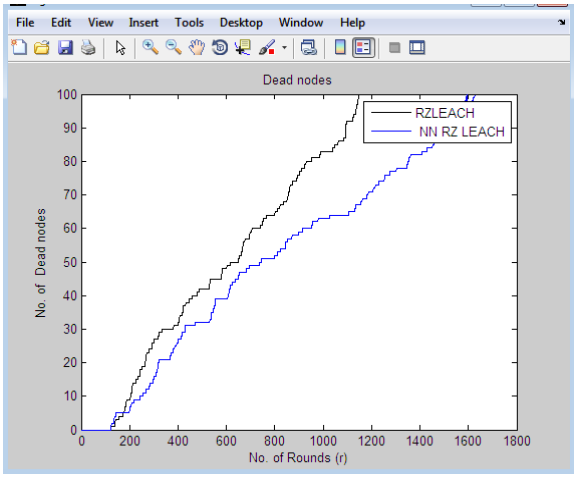

Fig 5.1.4. Dead nodes Vs Rounds

This is the results of area 150*150 meter of remaining Energy which shows how much energy is left after the simulation. X axis shows the number of rounds . In the case of RZLEACH the energy ends at the 1190 rounds and on the other hand, in NNRZ LEACH the energy dies at 1600 rounds. So NN RZ LEACH is more effective than the RZLEACH.

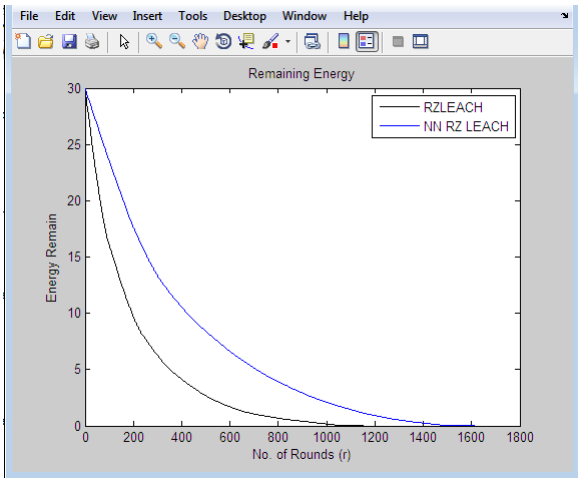

Fig 5.1.5. Remaining energy Vs Rounds

Dead Nodes:- This is the graph of dead nodes in RZLEACH and NNRZLEACH protocol.The network lifetime can be evaluated by using the number of dead nodes. It has been found that the number of nodes die earlier in RZLEACH protocol. Here, we can see from the graph that the nodes are die at the round of 1050 in case of RZLEACH and 1620 in case of NNRZLEACH. .

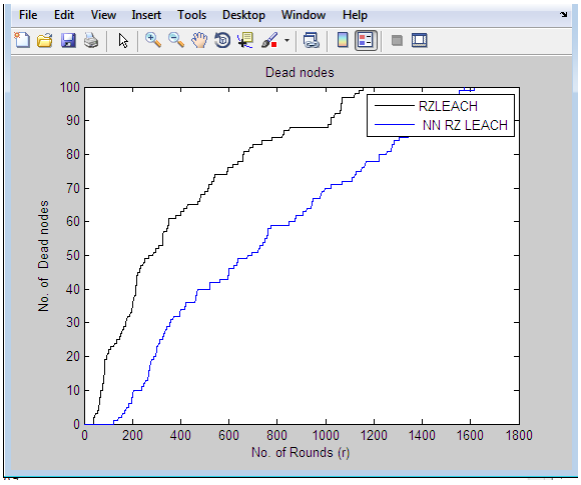

Fig 5.1.6 Dead nodes Vs Rounds

This is the results of area 250*250 meter of remaining Energy which shows how much energy is left after the simulation. X axis shows the number of rounds . In the case of RZLEACH the energy ends at the 950 rounds and on the other hand, in NNRZ LEACH the energy dies at 1450 rounds. So NN RZ LEACH is more effective than the RZLEACH.

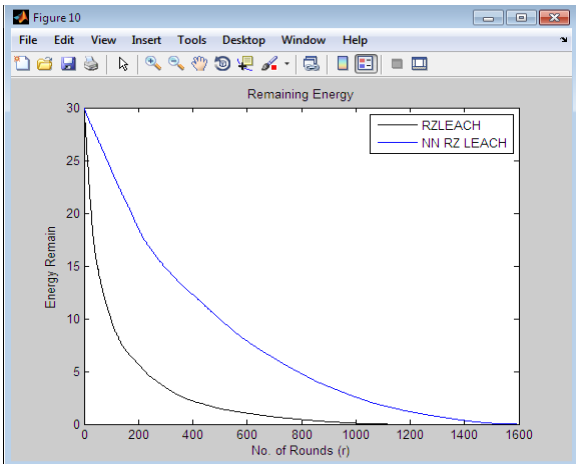

Fig 5.1.7. Remaining energy Vs Rounds

This is the graph of dead nodes in RZLEACH and NNRZLEACH protocol.The network lifetime can be evaluated by using the number of dead nodes. It has been found that the number of nodes die earlier in RZLEACH protocol. Here, we can see from the graph that the nodes are die at the round of 1020 in case of RZLEACH and 1600 in case of NNRZLEACH.

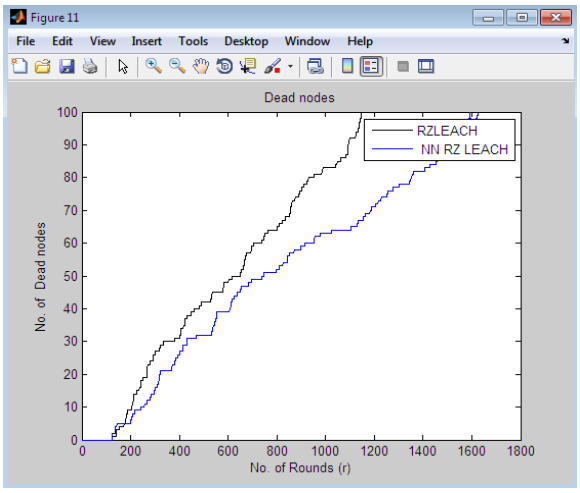

Fig 5.1.8. Dead nodes Vs Rounds

This is the graph of remaining energy, which shows how much energy is left after the simulation. X axis shows the number of rounds .Here we have implemented the RZLEACH and NN RZ LEACH. In the case of RZLEACH the energy ends at the 900 rounds and on the other hand, in NNRZ LEACH the energy dies at 1500 rounds. So NN RZ LEACH is more effective than the RZLEACH.

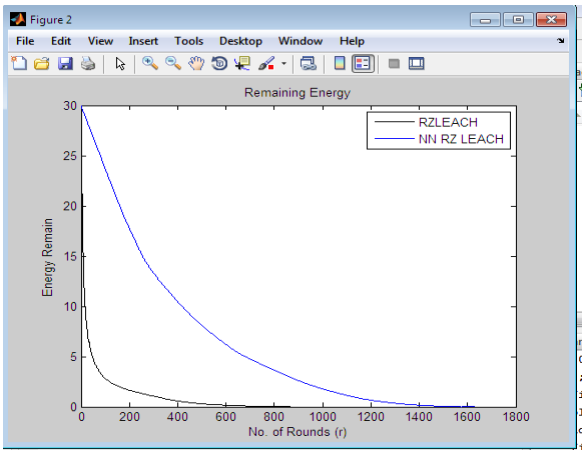

Fig 5.1.9. Remaining energy Vs Rounds

This is the graph of dead nodes in RZLEACH and NNRZLEACH protocol.The network lifetime can be evaluated by using the number of dead nodes. It has been found that the number of nodes die earlier in RZLEACH protocol. Here, we can see from the graph that the nodes are die at the round of 850 in case of RZLEACH and 1630 in case of NNRZLEACH. .

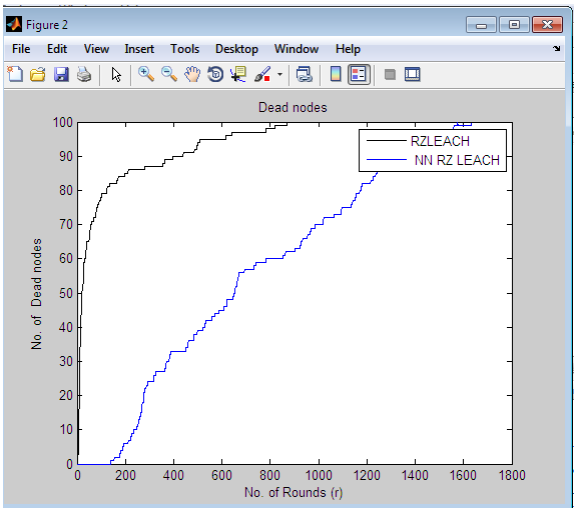

Fig 5.1.10. Dead nodes Vs Rounds

This is the graph of remaining energy, which shows how much energy is left after the simulation. X axis shows the number of rounds .Here we have implemented the RZLEACH and NN RZ LEACH. In the case of RZLEACH the energy ends at the 600 rounds and on the other hand, in NNRZ LEACH the energy dies at 1500 rounds. So NN RZ LEACH is more effective than the RZLEACH.

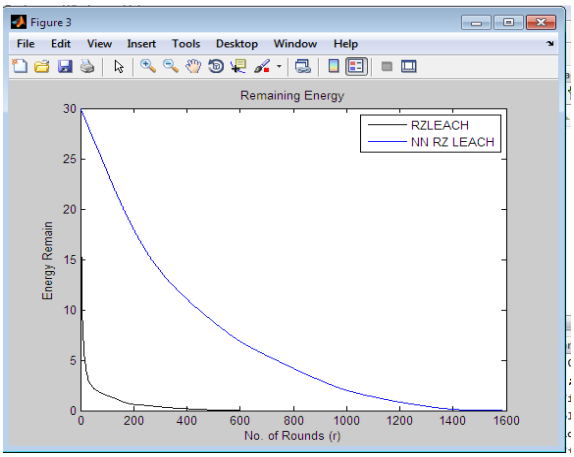

Fig 5.1.11. Remaining energy Vs Rounds

This is the graph of dead nodes in RZLEACH and NNRZLEACH protocol.The network lifetime can be evaluated by using the number of dead nodes. It has been found that the number of nodes die earlier in RZLEACH protocol. Here, we can see from the graph that the nodes are die at the round of 600 in case of RZLEACH and 1600 in case of NNRZLEACH.

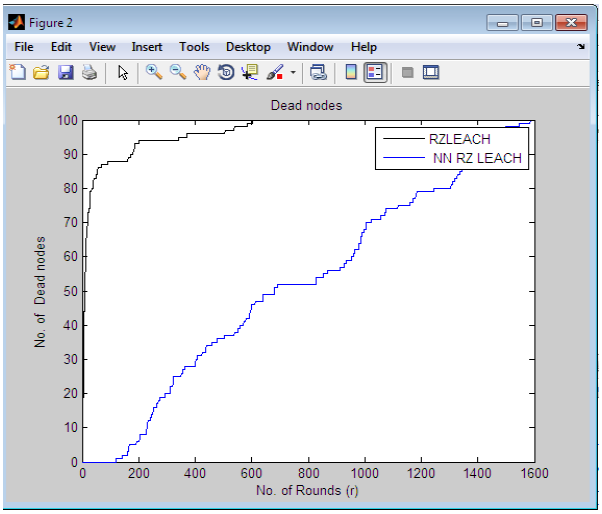

Fig 5.1.12. Dead nodes Vs Rounds

VII. CONCLUSION AND FUTURE SCOPE

In this paper, we have proposed the NN RZ LEACH is an efficient technique. This protocol adopts the selection of cluster head using neural network approach which outperforms RZ LEACH. The proposed protocol shows the better improvement over existing protocol. But this work has not taken into account the utilization of 3D WSNs, which are becoming major area of research in these days. Therefore in near future work we will extend the planned technique for 3D WSNs environment. [9]

REFERENCES

[1] S. Mottaghi and M. R. Zahabi, "Optimizing LEACH clustering algorithm with mobile sink and rendezvous nodes," *AEU-International J. Electron. Commun.*, Vol. 69(2), pp. 507–514, 2015.

[2] K. Hussain, A. H. Abdullah, K. M. Awan, F. Ahsan, A. Hussain, and others, "Cluster head election schemes for WSN and MANET: a survey," *World Appl. Sci. J.*, Vol. 23(5), pp. 611–620, 2013.

[3] Y. Gu, Y. Ji, J. Li, and B. Zhao, "ESWC: efficient scheduling for the mobile sink in wireless sensor networks with delay constraint," *IEEE Trans. Parallel Distrib. Syst.*, Vol. 24(7), pp. 1310–1320, 2013.

[4] W. Liang, J. Luo, and X. Xu, "Prolonging network lifetime via a controlled mobile sink in wireless sensor networks," in *Global Telecommunications Conference (GLOBECOM 2010), 2010 IEEE*, pp. 1–6, 2010.

[5] W. Liu, K. Lu, J. Wang, G. Xing, and L. Huang, "Performance analysis of wireless sensor networks with mobile sinks," *IEEE Trans. Veh. Technol.*, Vol. 61(6), pp. 2777–2788, 2012.

[6] M. Sharma and A. K. Shaw, "Transmission time and throughput analysis of EEE LEACH, LEACH and direct transmission protocol: a simulation based approach," *Adv. Comput.*, Vol. 3(6), pp. 75, 2012.

[7] R. Munjal and B. Malik, "Approach for improvement in LEACH protocol for wireless sensor network," *2012 Second International Conference on* in *Advanced Computing & Communication Technologies (ACCT),* , pp. 517–521, 2012.

[8] J. Kaur and V. Sahni, "A New Approach for Energy Efficient Linear Cluster Handling Protocol In WSN," *Int. J. Comput. Sci. Inf. Secur.*, Vol. 14(3), p. 219, 2016.

[9] S. Singhal, A. K. Gankotiya, S. Agarwal, and T. Verma, "An investigation of wireless sensor network: a distributed approach in smart environment," *2012 Second International Conference on* in *Advanced Computing & Communication Technologies (ACCT)*, pp. 522–529, 2012.

[10] S. Shi, X. Liu, and X. Gu, "An energy-efficiency Optimized LEACH-C for wireless sensor networks," *2012 7th International ICST Conference on* in *Communications and Networking in China (CHINACOM),* pp. 487–492, 2012.

[11] G. S. Kumar, P. M. V Vinu, and K. P. Jacob, "Mobility metric based leach-mobile protocol," *6th International Conference on* in *Advanced Computing and Communications (ADCOM 2008). 1*, pp. 248–253, 2008.

[12] C. Konstantopoulos, G. Pantziou, D. Gavalas, A. Mpitziopoulos, and B. Mamalis, "A rendezvous-based approach enabling energy-efficient sensory data collection with mobile sinks," *IEEE Trans. parallel Distrib. Syst.*, Vol. 23(5), pp. 809–817, 2012.

[13] W. R. Heinzelman, A. Chandrakasan, and H. Balakrishnan, "Energy-efficient communication protocol for wireless microsensor networks," *Proceedings of the 33rd annual Hawaii international conference on* in *System sciences*, pp. 10, 2010.

[14] G. Xing, T. Wang, Z. Xie, and W. Jia, "Rendezvous planning in mobility-assisted wireless sensor networks," in *Real-Time Systems Symposium, 2007. RTSS 2007. 28th IEEE International*, pp. 311–320, 2007.

[15] L. Ying, N. T. Ming, and L. B. Keat, "A wavelet based image sharpening algorithm," in *Computer Science and Software Engineering, 2008 International Conference on*, Vol. 1, pp. 1053–1056, 2008.

