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Research Paper

# ENHANCEMENT OF SENSOR NODE EFFICIENCY IN HETEROGENEOUS NETWORK USING DISTANCE (SEP) IN WSN

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In this research we reflect the Wireless Sensor Networks (WSNs) have seen an increased interest in various applications like border field security, disaster management and medical applications. So, large number of sensor nodes are deployed for such applications, which can work autonomously. Due to small power batteries in WSNs, efficient utilization of battery power is an important factor. Clustering is an efficient technique to extend life time of sensor networks by reducing the energy consumption. In this paper, we propose a protocol; Distance based Stable Election Protocol (D-SEP). Our CH selection scheme is based on the weighted election probabilities of each node according to the Energy Consumption (EC) of each node. Our simulation results show that our proposed protocol, ECRSEP outperforms all these protocols in terms of network stability and network lifetime.

**Keywords:** WSN, SEP protocol, CH, etc.

## INTRODUCTION

While Wireless Sensor Networks (WSNs) are increasingly equipped to handle more complex functions, in-network processing may require these battery powered sensors to judiciously use their constrained energy to prolong the effective network life time especially in a heterogeneous settings. Clustered techniques have since been employed to optimize energy consumption in this energy constrained WSN.

We propose clustering algorithm in a three-tier node scenario to prolong the effective network life-time. Simulation results shows that the D-SEP

protocol achieves better performance in this respect, compared to other existing clustering algorithm such as LEACH and SEP in both heterogeneous and homogenous environments.

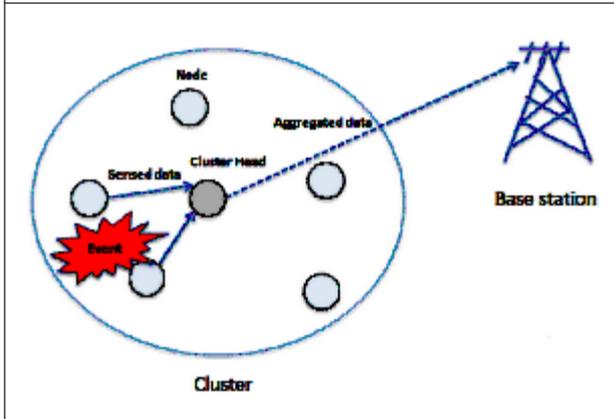
WSN technologies have been employed in recent years for monitoring purposes in various domains from engineering industry to our home environment due to their ability to intelligently monitor remote locations.

Sensor nodes are organized in the sensing zone to display exact boards and assemble data.

Before, the sensor nodes send the data to sink or Base Station (BS) though the wireless

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**Figure 1: Event Detection at the Cluster Head Heterogeneous with WSN**

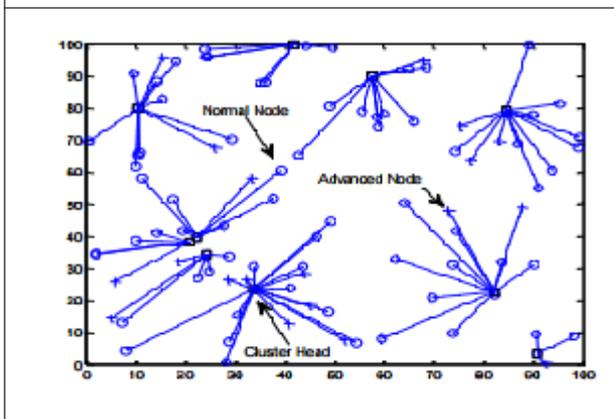


transmission system. WSN have been universal in numerous submissions counting healthcare system, battlefield surveillance system, environment monitoring system, and so on. Power or energy saving is most of the significant structures for the sensor nodes to range their lifetime in wireless sensor networks. A sensor node consumes typically its energy in conveying and receiving packets. In wireless sensor networks, the chief power source of the sensor node is battery.

### SEP WITH HETEROGENEITY

SEP (Stable election protocol (Smaragdakis, 2004) is a projected system for heterogeneous

**Figure 2: Snapshot of Cluster Foundation in SEP for 100 Nodes**



wireless sensor networks. Now two kinds of nodes (Advanced and normal nodes) are measured with dissimilar initial energy.

The advanced or progressive nodes are prepared with extra energy than the normal nodes at the opening. Additional, in literature it has been experimental that the SEP produces longer stability area for higher standards of extra energy transported by more controlling nodes, but it cannot be useful to multi-level. We propose a deterministic energy-efficient clustering protocol that is dynamic, distributive, self-organizing and more energy efficient than the existing protocols. It utilizes a simplified approach which minimizes computational overhead-cost to self-organize the sensor network. Our simulation result shows a better performance with respect to energy consumption, which is reflected in the network lifetime in both homogeneous and heterogeneous settings when compared with the existing protocols. It is worthy of note that our approach approximates an ideal solution for balanced energy consumption in hierarchical wireless sensor networks.

### LITERATURE REVIEW

Development in the network life has been found since of the cluster head has not dead ever. As a cluster head has been died it has been substituted by its vice Cluster head.

Babaie *et al.* (2010) have proposed a original technique to choice a cluster Head. LEACH protocol has set threshold value to 0 for next  $1/p$  circles when a node has been designated as a cluster head. This method enhanced LEACH method, by regulating threshold seeing some factors.

Ahlawat *et al.* (2013) has proposed a new method in which idea of Vice Cluster head has

been taken out to recover the network lifetime. Vice Cluster head has been designated as alternative head that has functioned when the cluster head has dropped down. Standards for the selection of vice cluster head have set up on the base of three factors, i.e., Minimum distance, maximum residual energy, and minimum energy.

Bakr *et al.* (2011) have complete attention mostly on covering the WSN lifetime. Lifetime has been protracted by making WSNs dismissed by adding spare nodes. The passive (switched off) spares has been made available to develop active (be switched on) when some active WSN node energy tired.

Beiranavand *et al.* (2013) have proposed a development in LEACH blessed I-LEACH, An Development has been done by as essentially three factors; Residual Energy in nodes, Distance from base station and number of adjacent nodes. Reduction in energy consumption and continuation in network life time has been experiential.

## PROBLEM STATEMENT

One of the problems in the SEP protocol is that the cluster head which are far away to the base station will consume more energy and are dying very frequently. Whereas cluster-heads which are near to the base station takes operation until end, that will cause network instability and the network lifetime is greatly affected.

We will try to enhance the lifetime of the network by avoiding direct transmission method; instead we have used the multi-hop transmission method. By this method we can enhance the lifetime of sensor network. The parameters for the evolutions of results for simulation are described below:

- **Stability period:** It is defined as the time interval between starting of the operation of the network and to the death of the first node. It is also called "stable region."
- **Instability period:** It is defined as the time interval between the deaths of first sensor node to the death of last node.
- **Cluster head per round:** It is the number of nodes that sends data to the sink directly after aggregating the data.
- **Network lifetime:** It is defined as the starting of the network operation to the death of the last node.
- **Throughput:** It is defined as the rate of data sent over network, it includes both the data transfer, i.e., from node to cluster head and cluster head to sink.

## SYSTEM MODEL

### Energy Model

A sensor usage its energy in instruction to transmit out three main purposes: acquisition, communication and data processing.

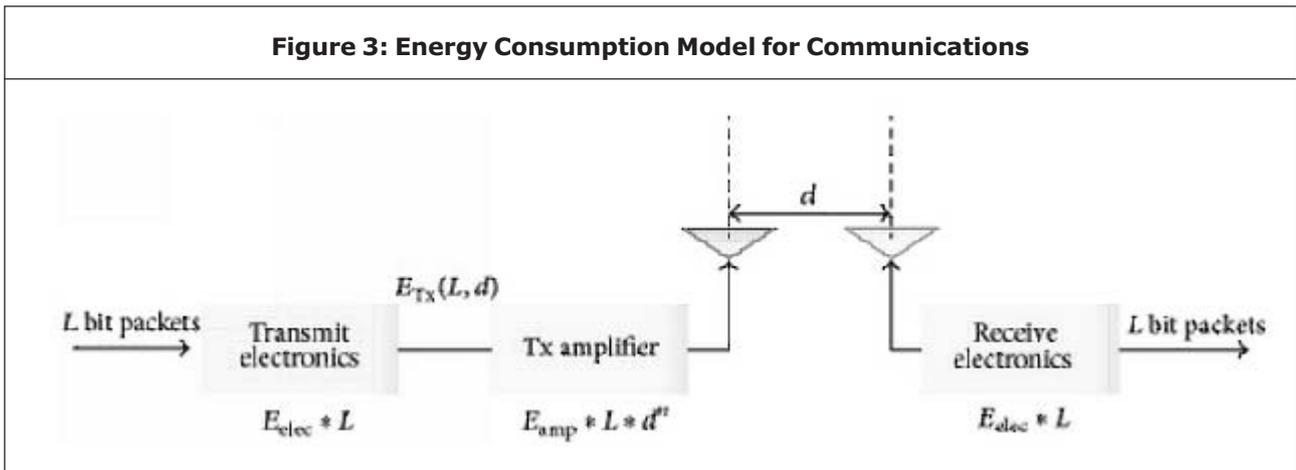
**Acquisition:** the energy expended to convey out the acquisition is usually insignificant. Nevertheless, it differs in substantial proportions dependent on the type of checking being approved out.

**Communication:** It consumes more energy than any other task. It concealments the communications in standings of release and reception.

Figure 1 shows the transmission system model and the instructions useful to measured energy consumption (Li, 2005).

**Data processing:** The energy consumed for the

**Figure 3: Energy Consumption Model for Communications**



control operation is very low as compared with the communication energy. The energy wanted to convey 1 KB over a 100 m distance is around equivalent to the energy essential to transmit out 3 million instructions at a speed of 100 million instructions per second (MIPS). This level strength be much reliant on on the circuitry installed in the nodes and the features requested.

$$E_{linear}(i) = [(2 * i - 1)(e_{elec} + i e_{amp} d_i^\alpha)] \quad \dots(1)$$

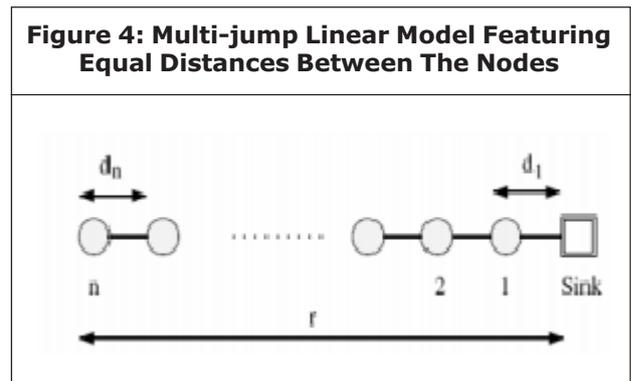
where  $E_{elec}$  signifies energy consumed in transmission,  $e_{amp}$  amplification,  $k$  the message length,  $d$  the transmitter/receiver distance and  $\alpha$  a factor telling attenuation. To obtain a message of  $k$  bits, the receiver then consumes:

$$E_{linear}(i) = [(2 * i - 1)(e_{elec} + i e_{amp} d_i^\alpha)] \quad \dots(2)$$

Communication topology we accept a simple linear topology to deliberate communication mode, as shown in Figure 2 in order to shorten the analysis. At the left of the Figure 2, there are  $n$  sensor nodes decided at intermissions of  $r$ . The base station is on the right end. By single hop mode, each node straight communicates with the base station; by contrast, each node

communicates with the adjacent neighbor in multi-hop mode, nodes route data intended eventually to the base station through middle nodes.

**Figure 4: Multi-jump Linear Model Featuring Equal Distances Between The Nodes**



## PROPOSED IMPLEMENTATION

**Step1:** First of all for network setup all the constants and variable are initialized. Like number of nodes, diameters of sensor network, probability of node to become cluster head, distance of base station from the network, distance between the cluster head and base station, energy supplied to each node, transmitter and receiver energy per node, amplification energy, etc. In this we describe five different types of nodes like normal nodes, intermediate nodes, advance nodes, super nodes and ultra-nodes.

- Ultra Nodes: Ultra nodes having energy greater than all the other nodes. In RFLSEP, 0.2% of total no. of nodes with additional energy level 4.
- Super Nodes: Super nodes having energy less than ultra-nodes but greater than all the other nodes. In RFLSEP, 0.2% of total no. of nodes with additional energy level 3.
- Advance Nodes: Advance nodes having energy less than ultra-nodes and super nodes but greater than rest of the other nodes. In RFLSEP, 0.2% of total no. of nodes with additional energy level 2.
- Intermediate Nodes: Nodes having energy greater than normal nodes but less than rest of the nodes. In RFLSEP, 0.2% of total nodes with additional energy level 1.
- Normal Nodes: Nodes having energy less than all other nodes are considered as normal nodes. Rest of nodes are normal nodes with energy level 0.5.

Variable a, b, c, d represents the energy level and m, x, y, z represents the fraction with respect to total number of nodes for ultra, super, advance, intermediate respectively. On the basis of energy level probability of nodes to become cluster head is calculated by using following formulas:

$$P_{nm} = p / (1 + a * m + b * x + c * y + d * z) \quad \dots(1)$$

$$P_{int} = p * (1 + b) / (1 + a * m + b * x + c * y + d * z) \quad \dots(2)$$

$$P_{adv} = p * (1 + a) / (1 + a * m + b * x + c * y + d * z) \quad \dots(3)$$

$$P_{sup} = p * (1 + c) / (1 + a * m + b * x + c * y + d * z) \quad \dots(4)$$

$$P_{ult} = p * (1 + d) / (1 + a * m + b * x + c * y + d * z) \quad \dots(5)$$

**Step 2:** For each and every node following steps are repeated until all the nodes become dead.

**Step 3:** For cluster head selection each node

generate random number between 0 and 1. The generated random number is compared with calculated threshold. If the generated random number is less than the calculated threshold then the node will become cluster head for that particular round.

**Step 4:** Confidence Value (56 V) on that first broadcasting happens, is stored in an interior variable in the sensor node called Sensed Value (5F5I). It decreases the amount of broadcasts. Now the sensor nodes will again communicate the packets in identical cluster time when the difference of the 565I and 5F5I is more than the 5F5G, i.e., if the 565I varies from 5F5I by a quantity equivalent to or more than 5F5G, then it supplementary decrease the number of communications. Evaluate energy dissipated using following predefined equations.

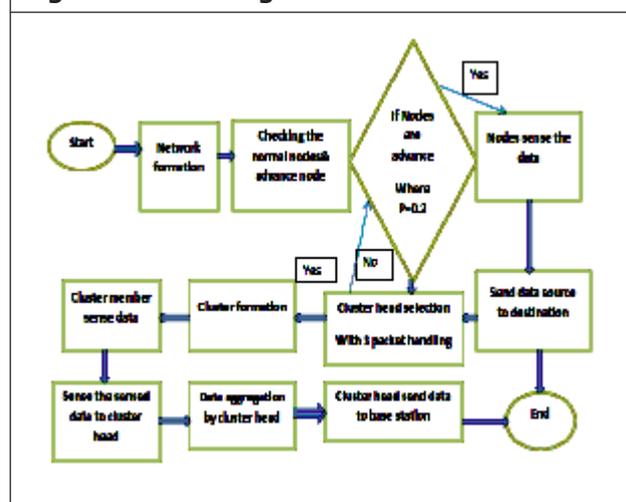
$$d_{to\ CH} = M \sqrt{2\pi k}, \quad d_{to\ BS} = 0.765M^2 \quad \dots(6)$$

$$E_{Tx} 1, d = 1E_{elec} + l \epsilon fs^{d^2}, \quad d < d_0 \quad \dots(7)$$

$$E_{Tx} 1, d = 1E_{elec} + l \epsilon mp^{d^4}, \quad d \geq d_0 \quad \dots(8)$$

**Step 5:** Update remaining energy of each node (i) and move to step 2 again.

**Figure 5: Flow Diagram of Simulation Process**



## RESULTS

The simulation is done in MATLAB. Let us undertake the heterogeneous sensor network with 100 sensor nodes are randomly distributed in the 100 m \* 100 m zone. The base station is situated at the center (50, 50). We have set the minimum probability for becoming a cluster head (pmin) to 0.0005 and primarily the cluster head probability for all the nodes is 0.05. The parameters used in our simulation are listed in the Table 1.

| Table 1: Simulation Parameters Description  |                 |
|---|-----------------|
| Parameter                                   | Values          |
| Simulation Round                            | 100             |
| Sink Location                               | 0.000005        |
| Network Size                                | 100*100         |
| Initial Energy                              | Eo (0.5)        |
| Initial energy of advance nodes             | 3 j             |
| Distance threshold                          | 2 mm            |
| Multi root dist from higher e.ad            | 10 mm           |
| Energy for data aggregation EDA             | 5 nJ/bit/signal |
| Transmitting and receiving energy Eelec     | 5 nJ/bit        |
| Amplification energy for short distance Efs | 111 pJ/bit/m2   |
| Amplification energy for long distance Eamp | 0.014pJ/bit/m4  |
| Probability Popt                            | 0.3             |

Figure 6 shows the whole heterogeneous network in running form of network size 100 and round no. 100.

Figure 7 shows the no. of dead nodes after completion the 100 round heterogeneous network.

Figure 8 shows the results for the cases Average energy of each node with 25 numbers

of rounds. It is obvious that the rounds of the energy decrease 0.6 to 0.567.

Figure 9 shows the results for the cases Average energy of each node with 50 numbers of rounds. It is obvious that the rounds of the energy decrease 0.6 to 0.531.

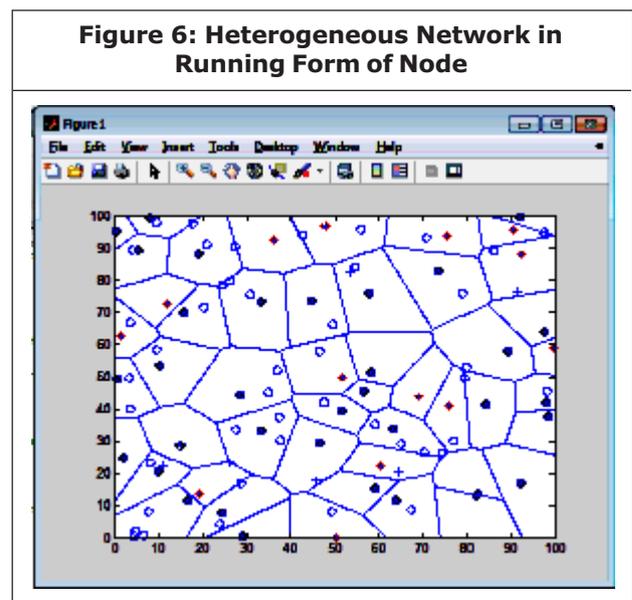
Figure 10 shows the results for the cases Average energy of each node with 80 numbers of rounds. It is obvious that the rounds of the energy decrease 0.6 to 0.52.

Figure 11 shows the results for the cases Average energy of each node with 100 numbers of rounds. It is obvious that the rounds of the energy decrease 0.6 to 0.456.

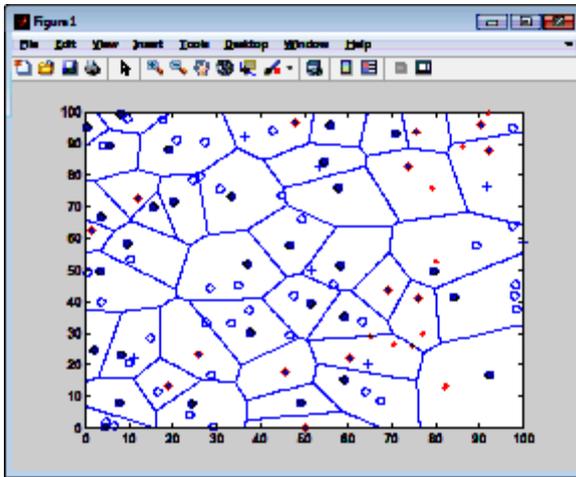
Figure 12 shows the results for the cases dead nodes with 25 numbers of rounds. It is obvious that the rounds of the dead node 0.

Figure 13 shows the results for the cases dead nodes with 50 numbers of rounds. It is obvious that the rounds of the dead node 0.

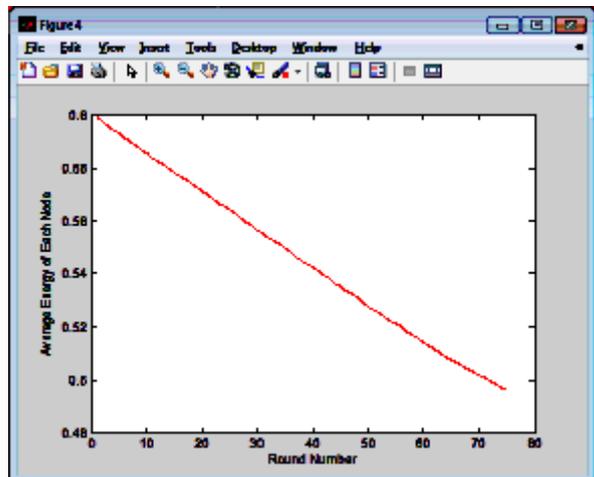
Figure 14 shows the results for the cases dead nodes with 80 numbers of rounds. It is obvious that the rounds of the dead node 4.



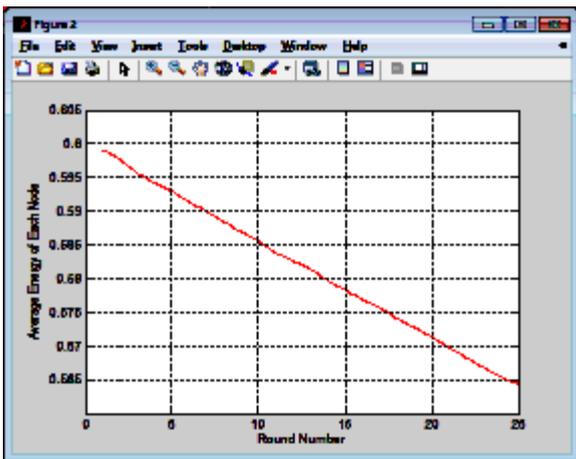
**Figure 7: After Completion the 100 Round Heterogeneous Network**



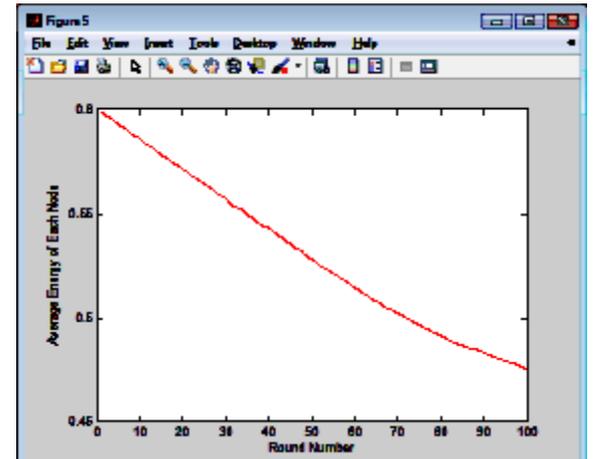
**Figure 10: Average Energy of Each Node with 80 Numbers Of Rounds**



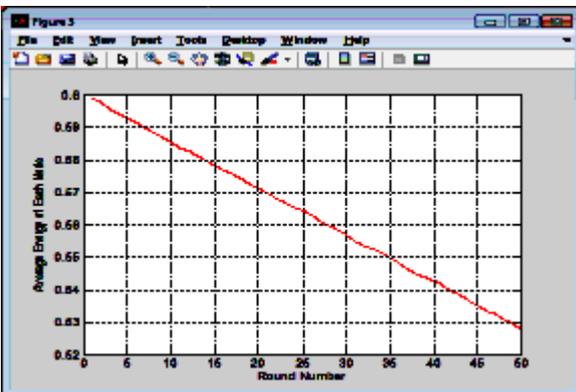
**Figure 8: Average Energy of Each Node with 25 Numbers of Rounds**



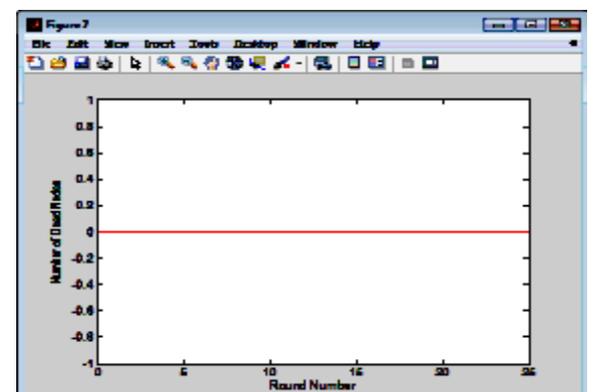
**Figure 11: Average Energy of Each Node with 100 Numbers of Rounds**



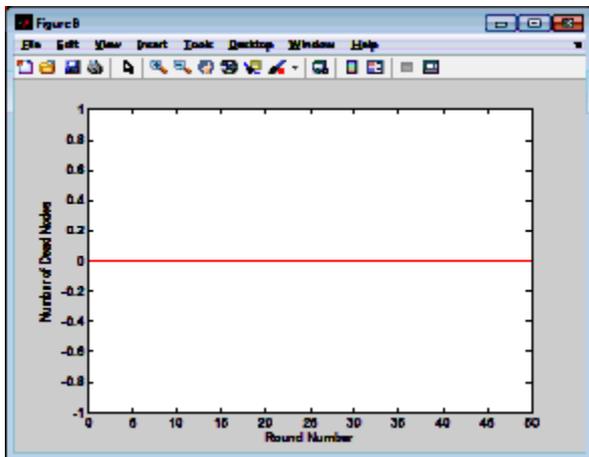
**Figure 9: Average Energy of Each Node with 50 Numbers of Rounds**



**Figure 12: Number of Dead Nodes of Initial 25 Rounds**



**Figure 13: Number of Dead Nodes of Initial 50 Rounds**



**Figure 14: Number of Dead Nodes of Initial 80 Rounds**

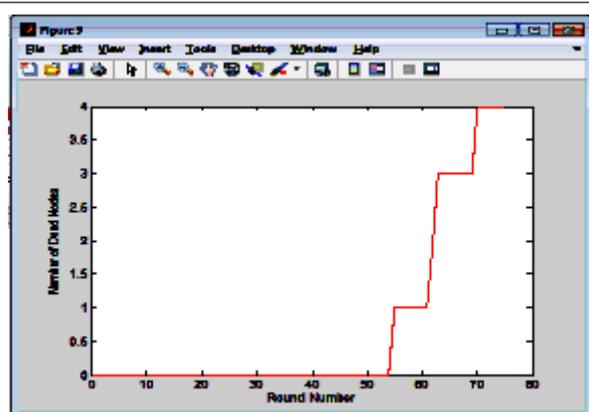
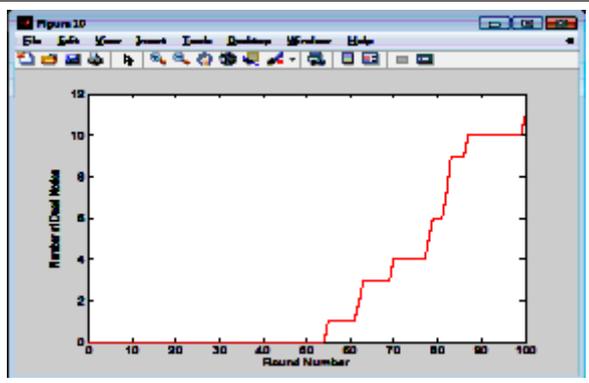


Figure 15 shows the results for the cases dead nodes with 100 numbers of rounds. It is obvious that the rounds of the dead node 10.5.

**Figure 15: Number of Dead Nodes of Initial 100 Rounds**



Finally, we observe that the network lifetime increase with our result analysis.

## CONCLUSION

The SEP protocol for the heterogeneous wireless sensor network, discussed the two types of sensor nodes (normal and advanced) possible for the wireless sensor networks. It evaluates the performance of SEP protocol under these energy models using MATLAB. Due to the concept of energy level based cluster head selection, hard and soft threshold value, three levels of node heterogeneity and being reactive routing network protocol SEP produces increase in energy efficiency, enhanced lifetime of network and maximum throughput as shown in the simulation result. It is observed that there is minimizing level of energy consumption, energy efficient, more stability, and network life time, only required in case of SEP protocol in comparison with other protocol.

In the future, the link heterogeneity of networks will be considered. Also the impact of location and size of the cluster to cluster heads election algorithm will be our further research and also includes introducing some level of mobility in the network.

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