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# Modified Stable Election Protocol(M-SEP) for Wireless Sensor Network

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**Abstract- Wireless sensor network have various applications such as automation, agriculture, security and environmental monitoring. Since thousands of sensors are usually deployed in the monitoring area with restricted energy. So the routing protocol must be designed. The main objective of routing protocol design is to minimize the energy consumption with increasing the network lifetime. In this paper we analyses the LEACH protocol cluster head selection and proposed a new way of cluster head selection based on the residual of energy considering the heterogeneity of sensor nodes. We divide the network into three regions based on energy of nodes and y coordinates of sensor nodes. Simulation result shows that proposed protocol performed well in comparison of LEACH, SEP, M-SEP.**

***Index Term*- WSN, Residual energy, Cluster, Routing**

## I. INTRODUCTION

With rapid advancement in electronics industry, small inexpensive battery-powered wireless sensors have already started to make an impact on the communication with the physical world. The wireless sensor networks (WSNs) can be deployed in a wide geographical space to monitor physical phenomenon with acceptable accuracy and reliability. The sensors can monitor various entities such as: temperature, pressure, humidity, salinity, metallic objects, and mobility; this monitoring capability can be effectively used in commercial, military, and environmental applications. Since WSNs consist of numerous battery-powered devices, the energy efficient network protocols must be designed [2]. Due to escalating in Micro-Electro-Mechanical System technology, now it is possible to set up thousands or millions of sensor nodes.

The intense deployment of WSN makes it quite difficult to recharge node batteries. Therefore, a key subject for WSNs is to curtail power expenditure of sensor nodes to prolong network lifetime. Many clustering based algorithms [3] [4] are proposed Clustering is a technique which well managed the energy consumption of network by minimizing the transmission range of sensor nodes. In this modus operandi node no longer transmits data directly to base station instead cluster head receives the complete message from all group nodes, aggregates and forward towards the base station.

The reason behind dividing the sensing field into the various regions is to trim down the network energy consumption; these different regions use different communication hierarchy for communication with the base station.

Sensor nodes in region zero use direct communication hierarchy whereas the sensor nodes in rest two regions use clustering hierarchy to transmit the data to base station.

The structure of the remaining paper is as follows: In Section 2, Motivation toward this work is described. In Section 3, Network model for quantitative analysis of our protocol. Section 4 evaluates the performance of the proposed protocol. Finally, Section 5 concludes the paper and provides directions for some future work.

## II. MOTIVATION

Due to the fact that clustering protocols consume less energy, these protocols for WSNs have gained extensive acceptance in many applications. Many state of the art WSN protocols exploit cluster based scheme at manifold levels to minimize energy expenditures. CH in most cluster based protocols is selected on the base of probability. It is not obvious that CHs are distributed uniformly throughout the sensor field. Therefore, it is quite possible that the selected CHs concentrate in one region of the network. Hence, a number of nodes will not get any CHs in their environs [6]. Similarly some protocols used unequal clustering and try to use recourses proficiently.

Multiple levels clustering hierarchy has following major drawbacks.

- In multiple level schemes, one CH forward data to otherCH which relays data to BS. If relay CH is faraway,than it is necessary for forwarder CH to transmit datawith high power.
- In clustering protocols, a member node decides itselfwhether to become CH or not. It is possible that somedistant nodes are selected as CHs. Therefore, these nodesconsume lot of energy to forward data to BS. Hence,these nodes will die early.

## III. NETWORK MODEL

Sensor nodes are randomly deployed in sensing area in most of the routing protocol and so the energy of the nodeis not efficiently utilized.That's why a modification has been taken by dividing the network into the three regions based on the energy of nodes and y coordinate of sensor nodes. Here the fractions of total nodes are equipped with more energy. Let b be fraction of total node n, which are equipped with q time more energy than other nodes and called as advanced nodes, so the normal nodes are (1-b)*n.We divide the regions such as:



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**Region 0**-Random deployment of normal nodes lying on 20<Y≤80.
**Region 1**-Random deployment of 50% of advanced nodes lying on 0<Y≤20.
**Region 2**-Random deployment of rest 50% of advanced nodes lying on 80<Y≤100.
The idea behind this type of deployment is that advance nodes have extra energy than normal nodes. The corners are more distant from base station than other so they require more energy for data transmission. That's why we deployed advanced nodes in the region 1, 2. As shown in fig 1.

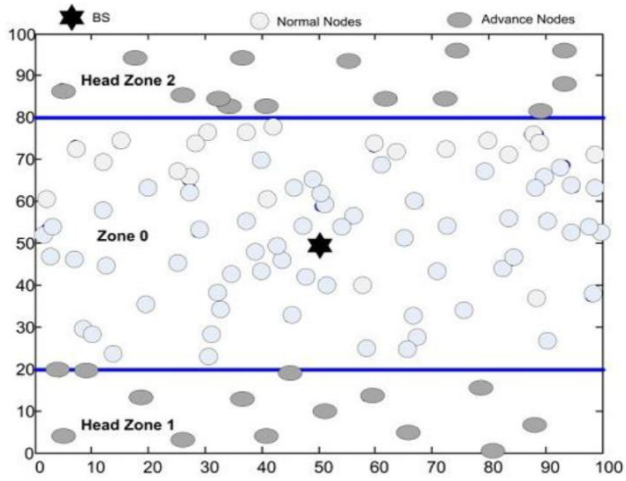


**Fig 1:** Network Model

### *A. Operation*

Proposed routing protocol mainly uses two techniques for data transmission:

1. **Direct Communication**-Sensor nodes in region zero transmit data directly to base station after collecting the data.
2. **Clustering-** the rest two regions sensor nodes used the clustering hierarchy for transmitting the data to the base station. The main work of cluster head is to collect the data from its member nodes, and aggregate it and then transmit to BS.

The most important task is to select the cluster head among the nodes.The cluster head is formed among advance nodes which are randomly deployed in region 1, 2. Every node decides whether to become cluster head in current round or not. A random number is generated between 0 and 1 for each node. If this number is less or equal to the given threshold T(n) then it becomes cluster head. The threshold value is given as:

$$T(n)=\begin{cases}\left[\dfrac{p}{1-p\times \mathrm{mod}(r \bmod (1/p))}\times\dfrac{E_{remain}}{E_0}\right] if\,(n\in G)\\ 0\end{cases} \quad (1)$$

Where p= the desired % of cluster head, r=current round, G= set of node not selected as cluster head in current round, $E_{Remain}$= remaining energy of node in current round, $E_0$= initial energy of node in current round.

Probability of advance node to become cluster head

$$P_{adv}=\frac{p}{1+b\times q}\times(1+q) \quad (2)$$

Then accordingly threshold for advance node

$$T(adv)=\begin{cases}\left[\dfrac{p_{adv}}{1-p_{adv}\times \mathrm{mod}(r \bmod (1/p_{adv}))}\times\dfrac{E_{remain}}{E_0}\right] if\,(n\in G)\\ 0\end{cases} \quad (3)$$

Once cluster head selected, the cluster head broadcast the advertisement message to the nodes, based on the signal strength of the advertisement message received by nodes, they decides to form the cluster and join the cluster head as member node of that cluster. After formation of cluster head nodes send data to respective cluster head and cluster head received the data aggregates it and send to the base station as shown in fig 2:

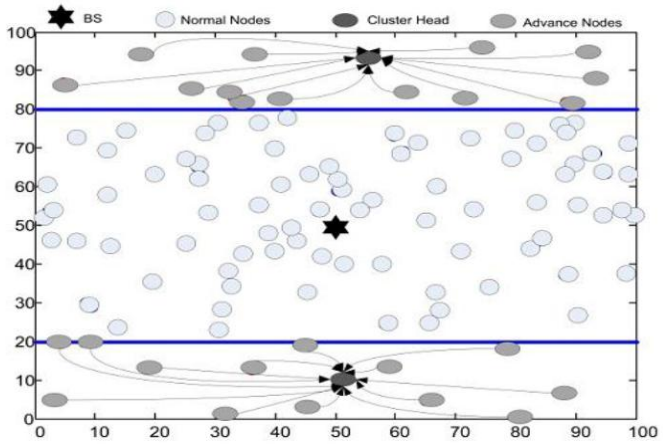


**Fig 2:** Nodes sending data to cluster

When data is received from nodes, then cluster head aggregates data and send it to base station shown by fig 3:

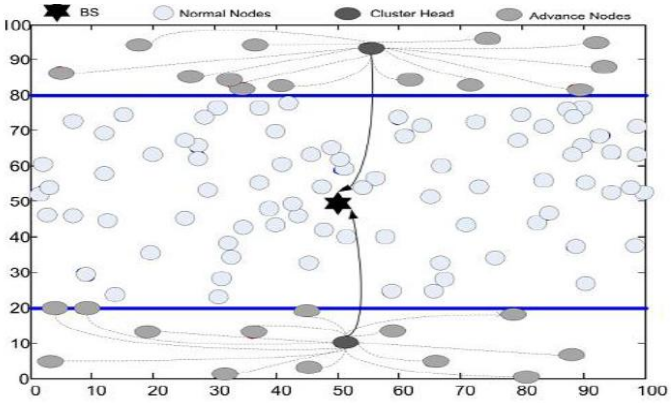


**Fig 3:** cluster head sending data to BS



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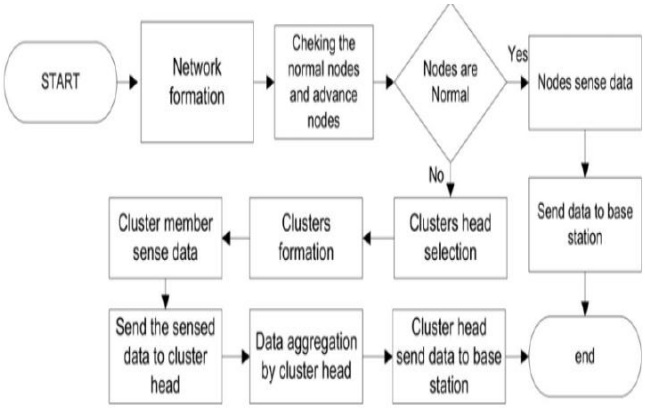


**Fig 4:**flow chart of proposed algorithm

## IV. PERFORMANCE EVALUVATION

Here we take the network field of 100m×100m with total of 100 nodes deployed in the sensing area and BS is deployed in the center of network. We also take some of the assumptions: Let 20% of nodes are advanced node and probability is 0.1, and other parameter are given by the following table 1:

| **Parameter** | **Value** |
|---|---|
| Initial energy $E_0$ | 0.5j |
| $E_{elec}$ | 5nj/bit |
| $E_{fs}$ | 10pj/bit/$m^2$ |
| $E_{mp}$ | 0.0013pj/bit/$m^4$ |
| message size | 4000 bits |
| Initial energy of advanced nodes | Eo(1+q) |

**Table1:** Radio parameter

1. ***Network Lifetime***-Fig 5: and Fig 6: shows the result while considering b= 0.2 and q=1, means 20 nodes are advance node out of 100 nodes. As Fig 5 shows that the network lifetime is also increased due to the advanced nodes and cluster head selection technique because here we also use the residual energy of nodes for cluster head selection.

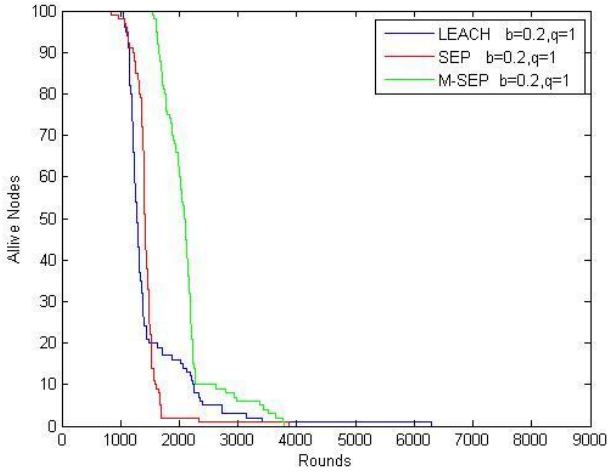


**Fig 5:** Network lifetime for M-SEP, SEP, LEACH

2. ***Throughput***- Fig 6: depicts the performance of our proposed protocol M-SEP with LEACH, SEP. It shows the number of packet transmitted to the base station for the LEACH, SEP, M-SEP.

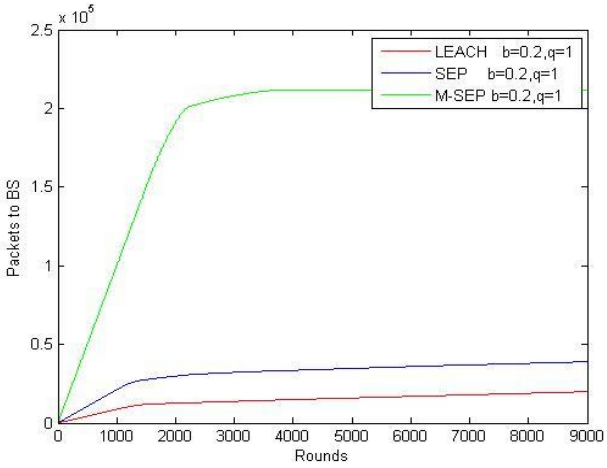


**Fig 6:** Throughput for LEACH, SEP, M-SEP

Again Fig 7: and Fig 8: shows the similar result but here we consider the values of b= 0.1 and q=2.

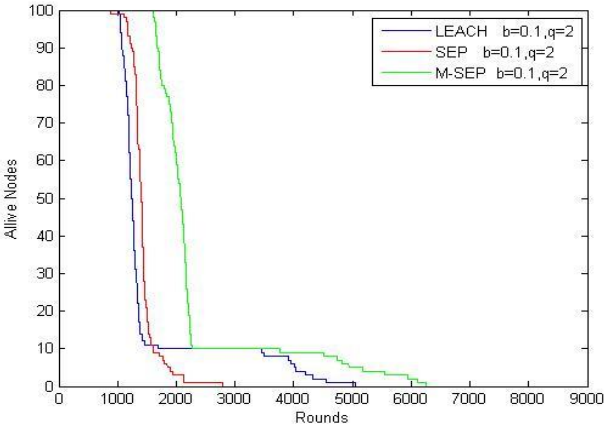


**Fig 7:** Network lifetime for b= 0.1, q=2

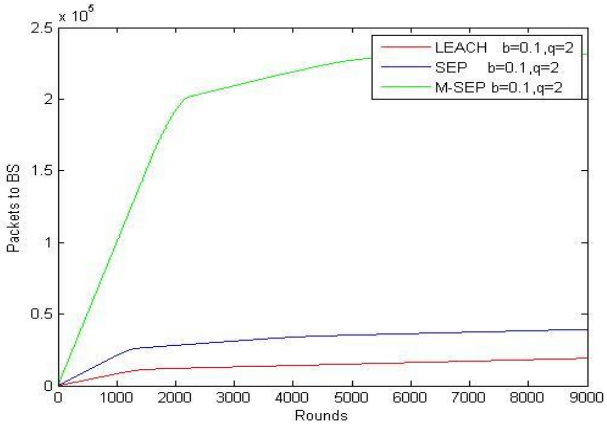


**Fig 8:** Throughput for b=0.1 , q=2



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## V. CONCLUSION AND FUTURE WORK

In this paper we implemented M-SEP for heterogeneous network. In this work we divide the whole network into separate three regions which uses different communication hierarchy for data transmission to the BS. One region use direct communication and rest two use clustering hierarchy. The selection of cluster head is also modified in term of residual energy of nodes. That's why our proposed protocol shows the better performance than LEACH and SEP. In future work we are going to do for various type of network model.

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