Clustering In Wireless Sensor Networks Using Modified LEACH (M-LEACH)

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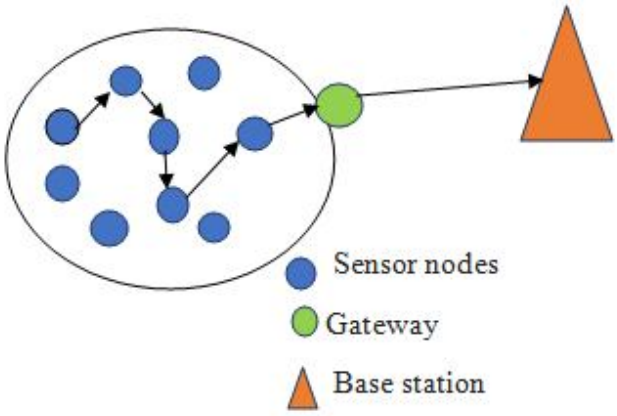
Abstract- *The most common issue wireless sensor networks face is life span of the network. We can increase the life of the network by having maximum number of alive nodes in the network so that data can be easily transmitted to the base station without any energy loss thus making the sensor network more energy efficient. This paper uses M-LEACH approach for making energy efficient networks so that larger amount of data can be transmitted to the base station. Comparison between different protocols is shown to prove that M-LEACH is a better energy conservation protocol.*

Keywords- Clustering, LEACH, M-LEACH, cluster-head, base station.

I. INTRODUCTION

Wireless Sensor Network or WSN is a group of sensor nodes that are scattered about over a range, area or volume. The networks are used for various purposes like detecting and recording the physical conditions of the environment and then to organize the collected data. Wireless ad hoc networks are same as wireless sensor networks because they also depend on wireless connectivity and also on spontaneous formation of networks so that sensor data can be transported wirelessly. The WSN[1] is a collection of nodes and all the nodes are connected to each other. The individual sensor nodes generate data from surrounding nodes by sensing and then sends these data or information to the base station(BS). Every node in the network has a battery connected to it. The major issue that is faced in wireless sensor network is that the efficiency of the nodes sending the data degrades and thus making the node a dead node.



All the sensor nodes are responsible for directly transmitting their data or information to the base station (BS). This situation leads to more energy consumption and decreases networks lifetime This major problem that occurs in WSN is called energy loss. To overcome this problem of energy loss and to reduce energy consumption, all the nodes that have same characteristics are grouped together to form clusters. A head from all the clusters is chosen to be the cluster head (CS). The CS work is to collect data from all its cluster members and then it has to transmit the aggregated data to the BS [1]. Cluster heads spends more energy because they are involved in various activities like data collection, aggregation and transmission.

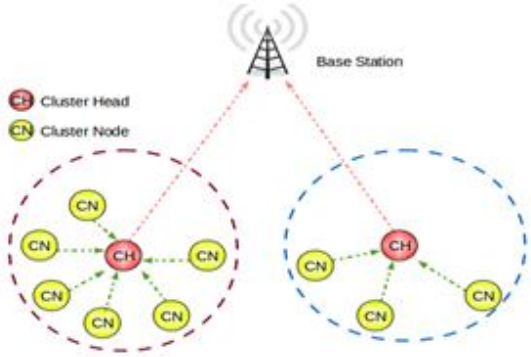


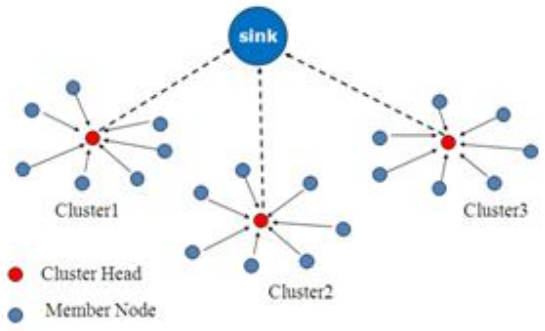
Fig. clustering in WSN

Earlier the work done focused on the data collection method and not on the clustering process. This paper will focus on clustering of nodes so that network can become more efficient by using M-LEACH technique and comparison with LEACH [3][4] protocol. M-LEACH technique means modified low energy adaptive clustering hierarchy technique is used for making clusters in order to make the network more energy efficient and to decrease the number of dead nodes and increase the number of alive nodes.

The paper is organized as follows. Section 2 focuses on the LEACH protocol with its advantages and disadvantages. Section 3 discusses about the proposed M-LEACH technique along with all the computations. Section 4 shows M-LEACH algorithm and Section 5 shows simulations and results.

II. RELATED WORK(LEACH)

LEACH [3] stands for Low Energy Adaptive Clustering Hierarchy is a technique that is used for energy conservation in WSN. The major problem that occurs in WSN is of energy that is dissipated when nodes transfer data to the base station. This problem of energy loss is reduced by using LEACH technique. In LEACH, all the sensor nodes that are available in the network are grouped together to from clusters and one node is chosen to be the cluster-head and the responsibility of the cluster-heads is to transfer the data to the base station. All the members in the clusters must be given a chance to become the cluster-head so that energy of particular node should not be completed destroyed and the node should not become a dead node.



LEACH protocol uses two phases for data transfer [6][7]: -

1. SETUP PHASE- In Setup Phase the nodes become cluster-head. Each node who wants to become a cluster-head generates a number between 0 and 1. If the value of the number is smaller than the threshold value then node becomes the cluster-head and if the value generated is greater then the threshold value then node becomes the normal node in the cluster. The threshold value is calculated by the formula:

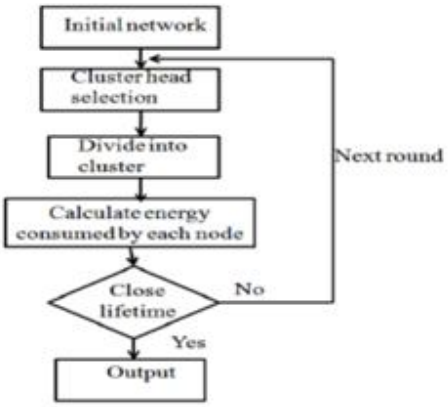
$$T(n)\ Leach=\begin{cases}\dfrac{p}{1-p\left(r \bmod \frac{1}{p}\right)} & \text{if } n \epsilon G\end{cases}$$

Where p= % of cluster-head

r= no. of rounds and

G= nodes that are not selected to become cluster-head in the previous round.

2. STEADY PHASE – In the Steady Phase node send the data to the base station. All the nodes send their data to respective cluster-heads and then these cluster-heads are responsible for transmitting the data to the base station.



Advantages-

- Any node that is a cluster-head can again be selected as cluster-head.
- Cluster-head communicate directly to Base station.
- Less amount of energy is dissipated
- Data aggregation at cluster-head.
- Information about sensor nodes location is not required.
- Provides stability in the network.

Disadvantages-

- Cannot be applied to large regions.
- Dynamic clustering causes increased overheads.
- For communicating data to the base station, LEACH totally depends on cluster-heads and not on cluster members.
- Cluster-heads are non-uniformly distributed in the network.
- Cluster-heads directly communicate data to the base station so there is no inter-cluster communication.

Attacks on LEACH-

Various attacks LEACH protocol undergoes[8] –

- Sybil Attack- There are many networks that face Sybil attack. This attack affects the security of the networks. This is one of the most difficult attacks and cannot be easily detected. In this attack, all the harmful nodes use the identity of other nodes in order to gain the data exchanged between the harmless nodes.
- Selective Forwarding- This attack influences the LEACH protocol. In this attack, the harmful nodes place itself in the path where data is being exchanged.

III. M-LEACH TECHNIQUE

As discussed in section 2, LEACH technique uses two phases. The first phase is called the setup phase in which all the nodes are chosen and the second phase is called the steady phase in which the nodes transmit the data to the BS. The limit condition is utilized to choose the group set out toward a round. This protocol is applied for choosing the cluster-heads from the clusters. When the cluster heads are chosen that non-cluster-head members send the data to the cluster-head and then the cluster-heads are used for transmitted that data to the base station after applying various data aggregation and gathering operations.

Ecurrent is the current energy Rem= Ecurrent/Eo

$$T(n)\ new\_Leach1=\begin{cases} Rem * \frac{p}{1-p\left(r \bmod \frac{1}{p}\right)} & \text{if } n \epsilon G \end{cases}$$

From equation (2), we stall out after a couple rounds of information transmission, yet despite everything we have accessible hubs with vitality enough to exchange the data to sink. The purpose for this issue is the edge of group head choice is less, in light of the fact that the lingering vitality of the accessible hubs is less. To deal with this issue, we use W1 as the weight example of the system to additionally conform the limit

$$T(n)\ new\_Leach2=\begin{cases} Rem * W1 * \frac{p}{1-p\left(r \bmod \frac{1}{p}\right)} & \text{if } n \epsilon G \end{cases}$$

W1-weight exponent of network. Presently, every last hub in the system has the unmistakable leftover vitality. So, the best edge esteem can be proficient by changing W1. Both Equation (2) and Equation (3) speaks to that hubs with more vitality is chosen as group head when contrasted with hubs with lower vitality level.

Among all the strategies of WSN, LEACH is a conventional approach where we elect cluster-heads. The current approaches for providing security are cryptographic and thus non-effective and need high memory to additional check keys. This serves as vital hindrance in the present sorts of leach, which would be dealt with in the M-LEAC.

Advantages of M-LEACH

- Provides high network stability.
- Nodes can run for large number of rounds.
- More energy efficient than LEACH.
- Cluster-heads energy is never completely dissipated.

IV. M-LEACH ALGORITHM

In M-LEACH the main focus is maintaining energy loss in the network. We can achieve this with the following algorithm.

1. Select field dimension and coordinates of the sink and no. of the nodes.
2. Assign optimal election probability of node to become cluster head.
3. Assign initial energy, election transmission energy, election residual energy and data aggregation energy.
4. No. of round nodes will perform.
5. Create sensor network.
6. Form clusters and decides cluster-heads and normal nodes.
7. Normal nodes will send data to the cluster-head and cluster-head to BS for every node.
8. After completion of round, check for dead nodes and alive nodes.
9. Normal nodes get a chance to become CH.
10. Calculate energy dissipated by associated CH
1. S3(i).E =S3(i).E- ((ETX+EDA) * 4000 + EMP * 4000 (distance * distance *distance))
11. Repeat till all round are completed.

V. SIMULATIONS AND RESULTS

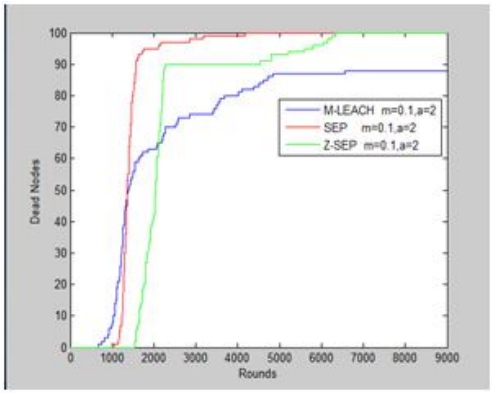
All the algorithms LEACH, SEP and proposed M-LEACH technique are implemented in MATLAB. In various configurations 9,000 nodes are deployed to 100 x 100-meter

field area. To depict the best results no. of dead nodes are compared.

All the three techniques are compared on the basis of dead nodes to show that M-LEACH technique provides best results. Dead nodes are those nodes that have no energy stored after transmitting the packets to the BS and these nodes cannot be used for further data transmissions.

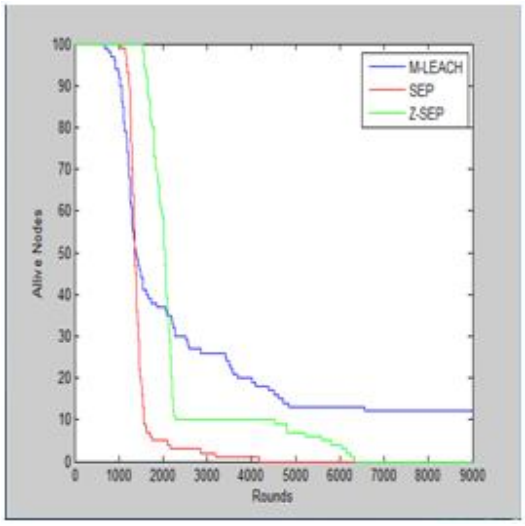
DEAD NODES

No. of rounds	No. of DEAD nodes SEP	Z-SEP	M-LEACH
1000	12	10	7
2000	96	67	60
3000	98	90	74
4000	99	91	81
5000	100	93	87
8000	no nodes left	100	90
9000	no nodes Left	no nodes left	88



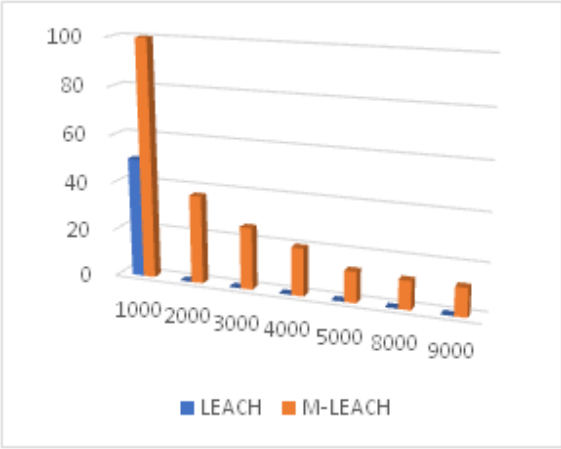
ALIVE NODES

No.of rounds	no. of ALIVE nodes SEP	Z-SEP	M-LEACH
1000	95	90	100
2000	5	30	37
3000	2	10	26
4000	1	10	20
5000	0	7	13
8000	0	0	12
9000	0	0	12



Comparison of LEACH and M-LEACH

No.of rounds	No.of ALIVE nodes LEACH	M-LEACH
1000	50	100
2000	-	37
3000	-	26
4000	-	20
5000	-	12
8000	-	12
9000	-	12



This shows that M-LEACH protocol is more energy-efficient than LEACH [7] protocol because no. of alive nodes depicts that these nodes can be used again for data transmission and at a fixed point no more nodes will die due to energy loss. This also shows one of the drawbacks of LEACH that nodes work for only 1500 rounds and then no alive nodes are present and on the other hand M-LEACH can work for more than 1500 and at one fixed point no nodes will die .

VI. CONCLUSION AND FUTURE WORKS

The Wireless Sensor Network is made Energy efficient by using the M-LEACH technique. The results show that M-LEACH technique performs better than LEACH and other protocols for making clusters of networks more efficient and to increase the lifetime of the nodes. Increasing nodes lifetime shows that node is not dead and can be used for further data transmission to the BS and making the network more efficient.

The future research can be based on the use of Genetic algorithm. Genetic Algorithms uses fitness function that can be used for cluster head selection so that network can become more energy efficient and can provide more accuracy to the nodes.

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