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Mon-Leach Based Network to Increase Throughput of WSN Network

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Abstract: In this work an energy-efficient cluster based routing protocol for Wireless Sensor Networks (WSNs) is proposed in which a monitor node is deployed in the network to enhance the overall network performance. The network divided the deployed sensor nodes into four logical regions on the basis of their locality in the sensing field. The nodes will directly communicate with Base station and Monitor node in two regions, in which Base station and Monitor node is deployed. Whereas for remaining two regions, cluster hierarchy is used to transmit the data and cluster heads from these regions will further send their data to the nearest destination either Base station or Monitor node. The monitor node is high power node deployed in the network. Further, in proposed work result of throughput and percentage of alive nodes of Leach are compared with the results of proposed algorithm that is Mon-Leach.

Keywords: Leach, WSN's, cluster head, routing protocol, Mon-Leach etc.

I. INTRODUCTION

A sensing network consisting of nodes with limited battery power are deployed to collect useful information from the field. Gathering sensed information in an energy efficient manner is critical to operate the sensor network for a long period of time [2]. It has been well known that wireless sensor network is a self-organization wireless network system constituted by a number of energy-limited micro sensors under the various industrial applications. Nowadays, wireless sensor network is widely used as an effective medium to integrate physical world and information world. The main motive of wireless sensor network is identifying, receiving and processing the information within monitoring area [8]. For this several algorithm has been developed and also the researchers are focusing on additional enhancement The popularity of Wireless Sensor Networks has increased tremendously due to the vast potential of the sensor networks to connect the physical world with the virtual world. The routing protocol research is one of the hot spots in the wireless sensor network. In the wireless sensor network, the energy of the sensor node is finite and these nodes cannot be recharged. So the efficient use of node energy becomes the first factor to be considered for designing routing protocol. To improve this factor the various protocols was launched like Leach, Leach-C (where the central base station performs the clustering), Pegasis(chain based protocol), TL-Leach, and I-Leach (improved Leach) [1,2,3,8]. As the Leach protocol is a typical layering routing protocol for wireless sensor network, which uses self-organizing and dynamic cluster formation. As compared with the traditional routing protocol, it have advantages of low energy consumption and long survival time, but there is still a problem that more or fewer cluster head may have bad effect on the network, so, for the better network performance it is important to select the optimal number of cluster head [6]. Further in next sections, the cluster-based protocols are discussed. Also, the results of proposed algorithm have been shown.

II. LITERATURE SURVEY

Due to cheap manufacturing of wireless sensor network the network with sufficient computation and require less transmitting or receiving powers are available now. Therefore, hundreds of nodes are deployed in a network for any desired application. These sensor nodes have a limited power and energy which must be used in a correct manner to increase node's lifespan. No doubt powerful circuit is needed for adequate use of energy. However, a routing protocol running on the network plays an important role in bandwidth consumption, security and energy conservations. To overcome this pressure, firstly direct transmission approach was discussed by W. Heinzelman et. al. [1]. In the direct transmission, a node sense data from its region and transmits it direct to the sink or base station. After this another research was introduced that was Leach (clustering based concept). Leach is one of the prominent proactive sensor network protocol [2].

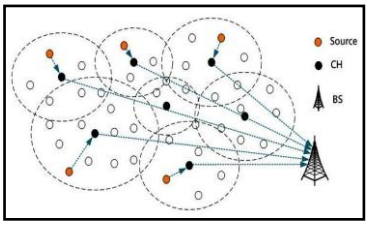

Figure: 1 Low Energy Adaptive Clustering Hierarchy

Figure 1 shows the clustering based Leach protocol. On the basis of cluster-head selection algorithms, today numerous protocols have been developed. Every protocol have different attributes and enhancements, mainly in cluster- head based algorithms. After Leach an improved version that is Leach-C (Leach-Centralized) was introduced by W. Heinzelman. In this the central base station performs the clustering to improve the energy efficiency. Another improved scheme of Leach is Pegasis (Power-Efficient Gathering in Sensor Information on System) as this approach was given by S. Lindsey et. al.

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[2]. It is a chain based protocol to minimize the number of dead nodes. In this each node communicates with its close neighbor node and take its own turn to transmit data to the base station. After this, the next proposed algorithm was Two-Levels Hierarchy for Low-Energy Adaptive Clustering Hierarchy (TL-Leach). The TL-Leach uses random rotation of local cluster base station [3]. Though one thing is common in all protocols that focus on energy conservation and data aggregation. M. Tahir et. al. introduces link quality metric to divide a network into three logical portions resulting in lower routing overhead[13]. The various research try to preserve energy in WSN's by differentiating idle and operational mode of a sensor node.

III. NETWORK ARCHITECTURE

In this section, the network is based on existing routing protocol (Mon-Leach); a Monitoring Leach is proposed and conferred with the motive to enhance the network throughput and percentage of alive nodes by reducing the energy utilization of Wireless Sensor Network. During setup section, preliminary activities to data communication like regions formations, cluster formation, cluster head formation and determination of equal regions, deployment of monitor node have been done.

A. Network Model

The network area is assumed as 100*100 meter sq. consists of 100 sensor nodes. The network divided the deployed sensor nodes into four logical regions on the basis of their locality in the sensing field .The nodes will directly communicate with Base station and Monitor node in two regions, in which Base station and Monitor node is deployed. Whereas for remaining two regions, cluster hierarchy is used to transmit the data and cluster heads from these regions will further send their data to the nearest destination either Base station or Monitor node. The monitor node is high power node deployed in the network. Figure 2 shows the deployment of nodes in four regions.

B. Monitoring Leach

In Monitoring Leach, the cluster heads are selected on the basis of probability, which is user defined and high impact on the network. The clustering is used to save network energy by minimizing the transmission distance of the nodes. The nodes will directly communicate with Base station and Monitor node in two regions, in which Base station and Monitor node is deployed. Whereas for remaining two regions, cluster hierarchy is used to transmit the data and cluster heads of these regions will further send their data to the nearest destination either Base station or Monitor node. Thus every node forward data to its concerned Cluster Head, but there is an issue of collision if two nodes send data at same time to same cluster head. To avoid this monitor node assist CH to issue TDMA to all nodes.

C. Network Division and Monitoring Node Role

In this sensing network, the nodes are divided into four regions. In region 1, Base Stations is deployed and in region 4 monitor node is deployed.

- Nodes of region-1 communicate directly with the base station.
- Nodes of region-4 communicate directly to monitor node.
- Nodes of region 2 and 3 use clustering hierarchy to transmit their data to nearest destination either monitoring node or base station. Monitoring node helps CHs in issuing TDMA for member nodes.

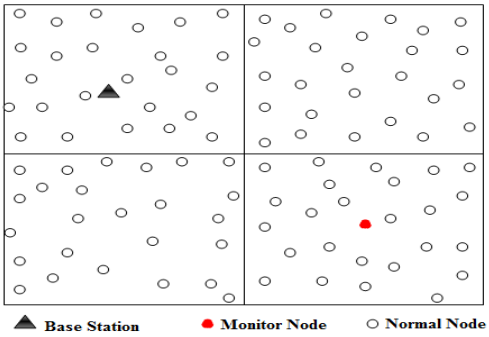

Figure: 2 Deployment of nodes in four regions.

D. Working Phases

In this section, its clears the communication process of the base station, monitor node and deployed sensing nodes. The three working phases are given below. Initial Phase- Base station broadcasts a HELLO packet in the network. Hello, packet basically checks all link status and gets information about nodes. Base station stores all information of nodes in node table which include ID, residual energy, and distance of the node from the base station, cluster head and monitor node. Setup- It includes the deployment of nodes in four region. Cluster Head Selection- Cluster head is elected based on the residual energy of node and probability that is defined by p. Each node selects itself as a Cluster Head according to the probability. Nodes in current round generates a random number between [0-1]. If the generated random number is less than a predefined threshold T(s) value, then the node becomes Cluster Head.

$$T(s) = \begin{cases} \frac{p}{1-p\times(rmod\ (1/p))}, & if\ s \in C \\ 0, & otherwise \end{cases}$$

p = probability of the CHs, r = random number from 0 to 1, C = Set of nodes not elected as CH before current round. Scheduling- Each CH creates a TDMA based schedule for its member nodes CH aggregates data and it forwards it to Monitor node. Monitor node assigns a TDMA schedule to Cluster Head to avoid collision. Monitor node aggregates data and forward to the base station.

IV. SIMULATIONS AND RESULT

In this section, the performance of proposed work has been evaluated by carrying out simulation in term of throughput and alive nodes, further the results have been compared with Mon-Leach to prove the effectiveness of the network. The simulation result shows higher

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performances of throughput and network lifetime of Mon-leach than the Leach. Simulation of the proposed work is done in MATLAB. The simulation parameters are listed in Table 1.

Table 1: System Parameters

Sr. No.	Parameters	Standards taken
1	Environment Size	100*100 m
2	Deployed Sensor nodes	100
3	Base station	1
4	Proposed monitor node	1
5	Simulation Round	5000
6	Referred protocol	Leach
7	CHs	Probability based
8	Initial energy	0.5 Joules

The Figure 3 given below shows the result of throughput. Throughput is defined as the total number of request fulfilled per second. The throughput achieved by proposed Mon-Leach is better than Leach. The proposed protocol gives better throughput due to increased network life time. The given graph rep illustrates the analysis of throughput comparison with Leach and Mon-Leach.

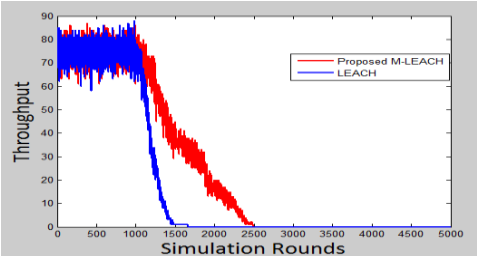

Figure: 3 Graphical Representation of N=100, 100 x 100m of throughput

It is deduce that by introducing monitoring node network life time is improved due to which throughput of network is increased. The Figure 4 shows the graphical representation between total number of alive nodes and the number of rounds. The simulation is carried out up to 5000 rounds. The comparison of Mon-Leach and Leach clearly shows that network lifespan of proposed Mon-Leach is better than that of Leach. In proposed Mon-Leach, nodes die more slowly than Leach. At the round of 1800 almost all nodes die in Leach while proposed Mon-Leach 40% nodes are alive.

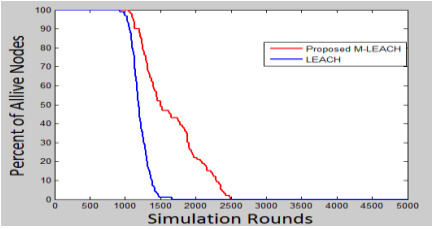

Figure: 4 Graphical Representation of N=100, 100 x 100m of alive nodes

The simulation results that are shown in figure 3 and figure 4 represent network lifetime by showing better performance of throughput and percentage of alive nodes respectively.

V. CONCLUSION

In this paper, an energy-efficient technique that is Mon-Leach described using monitor node to minimize energy consumption and to improve the performance of Clustered-Based wireless sensor network. In this work, the network is divided into four logical sections. The nodes communicate directly with Base station and Monitor node in two regions, where Base station and Monitor node is deployed. Whereas for remaining two regions, cluster hierarchy is used to transmit the data and cluster heads of these regions will further send their data to the nearest destination either Base station or Monitor node. The monitor node is high power node deployed in the network .This method encourages a better distribution of Cluster Head in the system. Simulation results indicate that the proposed Mon-Leach performs well compared to traditional Leach routing protocol in terms of throughput and network life span.

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