

Monitoring Based Low Energy Adaptive Clustering Hierarchy

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Abstract: In this research work an energy-efficient cluster based routing protocol for Wireless Sensor Networks (WSNs) is proposed in which a monitor node is deployed in the sensing network to improve the overall network performance and enhance energy level. The network divided the deployed sensor nodes into four logical regions on the basis of their locality in the sensing field. The nodes of region in which base station is deployed will directly communicate with the base station. The nodes in the region in which monitor node is deployed will directly communicate with monitor node. In remaining two regions cluster hierarchy is used to transmit the data to the nearest destination. The deployed monitor node is rechargeable node in the network. Additionally in proposed work, result of stability period (dead nodes) and residual energy of Leach are compared with the result of proposed algorithm that is proposed energy efficient protocol.

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

1. INTRODUCTION

It has been well known that wireless sensor network [1] is a self-organization network that is constituted by a number of energy-limited micro sensors nodes. Nowadays, wireless sensor network is widely used as a valuable medium to integrate physical world and information world. The main motive of wireless sensor network is identifying, receiving and processing the information within the monitoring area [8]. The wireless sensor network technologies have been widely applied in military, medical monitoring, environmental monitoring, surveillance, industry, etc. In the WSNs, a lot of nodes operate with limited batteries in sensing network which leads to declined of energy level of nodes. Therefore, an economical and frugal management of energy is essential for improving energy efficiency. Because energy dissipation while communication is the major cause of the energy consumption in WSN, so a high-performance routing protocol is often a key requirement in WSNs systems. The design of routing protocols in WSNs is very challenging due to their inherent characteristics of large scale, no global identification, dynamic topology, and very limited power, memory, and computational capacities [2].

Till now, many energy-efficient routing algorithms have been proposed by various researches with the aim of energy saving [3]. The existing routing protocols in WSNs can be categorized into flat routing protocols, hierarchical routing protocols, single-path routing protocols and multipath routing protocols [8]. Recent research on WSNs routing protocols has proven that clustering and multipath are needed to improve energy efficiency and load balancing of network. In these hierarchical schemes the nodes are grouped into squads and perform data aggregation [3]. In this way, the number of transmissions to the base station is reduced due to this the system

scalability and energy efficiency can be improved. In this protocol the probability of collision of data is more, which can effect the performance of network. Further in next sections, the cluster-based protocols are discussed. Also, the results of proposed algorithm have been shown.

II. LITERATURE SURVEY

In wireless sensor networks, [1] number of tiny nodes are deployed for monitoring the environment. But sensor nodes operate on limited batteries this is the main challenging issues in WSN [6] and to overcome the foremost problem of energy consumption, firstly direct transmission approach was proposed by W. Heinzelman et. al.[2]In the direct transmission, a node senses data from its region and transmits it directly to the sink or base station as shown in figure 1.

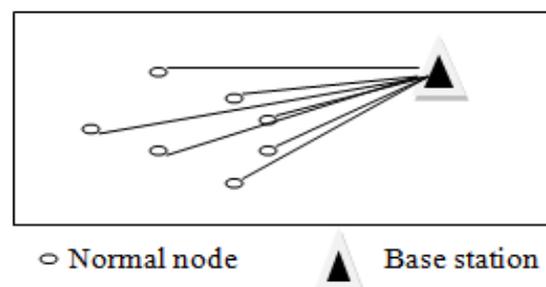


Figure: 1 Direct Transmission

After this a clustering based concept that is Leach was introduced by S. Lindsey et. al.[3]. Leach is one of the prominent proactive sensor network protocol. In leach clusters are formed to fuse data before transmitting to the base station. After this another protocol was proposed by

V. Loscri et. al.[4] that was TL-Leach . In TL-Leach two level hierarchy was done. In this technique the clusters heads were divide in two levels that was primary cluster-heads and secondary cluster-heads. The secondary cluster heads firstly transmit their data to primary cluster heads and then primary cluster heads send data to base station. In this way, it builds a two-level hierarchy. After various modification in routing protocols, D. Mahmood et. al. [7] proposed the most prominent wireless sensor network’s routing protocol that is modified Leach (MODLEACH). In this technique clusters head replacement scheme was introduced to make network energy efficient. Though one thing is common in all protocols that focus on energy conservation and data aggregation. M. Tahir et. al. [13] introduced link quality metric to divide a network into three logical portions resulting in lower routing overhead. The various researchers tried to preserve energy in WSN's by introducing various energy efficient techniques.

III. PROTOCOLS IN WSN

In WSN, number of tiny nodes with limited battery life are deployed for various applications. During transmission of data to base station, energy consumption becomes the major challenge. For this purpose various energy efficient routing protocols have been introduced.

This paper also focus on the energy efficiency of WSN, so a new energy efficient protocol is introduced. The motive of this proposed energy efficient protocol is to enhance the network lifetime and minimize the consumption of residual energy in Wireless Sensor Network. During the setup of sensor network, groundwork activities to data communication like regions formations, cluster formation, cluster head formation and distribution of equal regions, deployment of monitor node have been done.

A. Proposed Energy Efficient protocol

In proposed energy efficient protocol, the deployed sensor nodes are divided into four logical regions on the basis of their locality in the sensing field. The nodes of region in which base station is deployed will directly communicate with the base station. The nodes in the region in which monitor node is deployed will directly communicate with monitor node. The deployed monitor node is rechargeable node in the network. In remaining two regions cluster hierarchy is used to transmit the data to the nearest destination. Thus every node forwards 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 assists cluster head to issue TDMA to all nodes.

IV. SIMULATION PARAMETERS

In this paper, an energy efficient protocol is proposed to make the WSN more reliable and energy efficient. For this 100 sensor nodes are deployed in the sensing field having dimension of 100*100m. Also each node carries its individual initial energy. The detail of other simulation parameters for proposed energy efficient protocol is listed in table 1.

Table: 1 System parameters

Sr. No.	Parameters	Standards taken
1	Base station	1
2	Proposed monitor node	1
3	Simulation Round	5000
4	Referred protocol	Leach
5	CHs	Probability based
6	Initial energy	0.5 Joules

The above simulation parameters are used to implement proposed energy efficient protocol in WSN. The simulation results of proposed energy efficient protocol are compared in terms of dead nodes and residual energy and further the result are compared with the results of basic Leach.

V. SIMULATION STEPS

In this section various simulation steps are discussed to make Wireless sensor network more reliable and energy efficient by introducing proposed energy efficient protocol. The Figure: 2 show the mechanism of proposed energy efficient protocol.

➤ STEP 1

Setup phase-In the sensing network, the nodes are divided into four regions. In region1, Base Stations is deployed and in region 4 monitor node is deployed.

- Nodes of region-1communicate directly with thebase 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 clusters heads in issuing TDMA for member nodes.

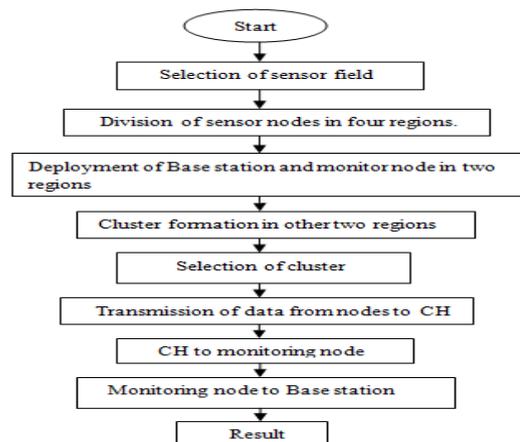


Figure: 2 routing mechanism of Monitoring Leach

➤ STEP 2

Initial Phase- In this phase, base station broadcasts a HELLO packet to sensing nodes in the network. Hello packets, basically check all link status and gets

information about nodes. Base station stores all information of nodes in node table which includes identification, residual energy, and distance of the node from the base station, cluster head and monitor node.

➤ STEP 3

Cluster Head Selection- Cluster head is elected on the basis of residual energy of node. 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.

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

where p = probability of the CHs, r = random number from 0 to 1, C = Set of nodes not elected as CH before current round.

➤ STEP 4

Scheduling- Each Cluster head creates a TDMA based schedule for its member nodes. Cluster Head aggregates data and forwards it to Monitor node. Monitor node assigns a TDMA schedule to Cluster Head so as to avoid collision. Monitor node aggregates data and forwards to the base station.

VI. SIMULATIONS RESULT AND DISCUSSION

In this section, the performance of proposed work has been evaluated by carrying out simulation in term of dead nodes and residual energy, further the results have been compared with proposed energy efficient protocol to prove the effectiveness of the network. The simulation results show that the residual energy and network stability in proposed energy efficient protocol is much more as compared to Leach protocol.

The Fig:3 given below shows the result of stability and instability period of nodes. The percentile of dead nodes achieved by proposed energy efficient protocol is better than Leach.

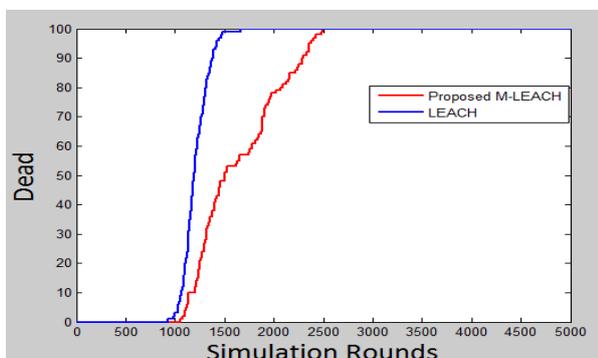


Figure: 3 Graphical Representation of N=100, 100 x 100m of dead nodes

It is deduced that by introducing proposed energy efficient protocol the network life time is improved because after

1350 rounds only 50% nodes are dead in proposed energy efficient protocol while in case of Leach almost all nodes are dead after 1350 rounds.

The Fig: 4 show the graphical representation between residual energy and the number of rounds. The simulation rounds are carried out up to 5000 rounds. The comparison of proposed Mon-Leach and Leach clearly shows that proposed Mon-Leach yields less energy consumption than that of Leach. After 1500 rounds the energy of network becomes zero in Leach but in proposed energy efficient protocol the 10% energy of the network is still remaining after 1500 rounds.

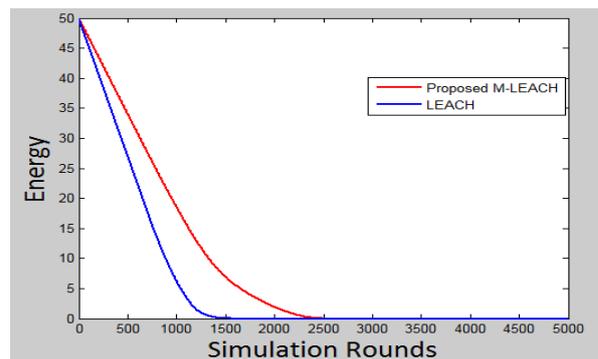


Figure: 4 Graphical Representation of N=100, 100 x 100m of residual energy.

The simulation results depicted in Fig: 3 and Fig: 4 clearly show that the proposed energy efficient protocol is more efficient than the Leach.

VII. CONCLUSION

In this paper, a new energy efficient protocol is described. This new protocol uses to minimize energy consumption and to improve the performance of Clustered-Based wireless sensor network. The network divided the deployed sensor nodes into four logical regions on the basis of their locality in the sensing field. Out of these four regions, in one region, base station is deployed while in other region monitor node is deployed. The nodes of region in which base station is deployed, will directly communicate with base station and the nodes of region in which monitor is deployed, will directly communicate with monitor node. In remaining two regions cluster hierarchy is used to transmit the data to the nearest destination. The deployed monitor node is rechargeable node in the network. This method encourages a better distribution of Cluster Heads in the system.

Simulation results show that the proposed energy efficient protocol performs well as compared to traditional Leach routing protocol in terms of number of dead nodes and residual energy of sensing nodes. In Leach after the 1000 rounds about 10% nodes are dead while in proposed energy efficient protocol all nodes are alive after the 1000 rounds. The remaining residual energy in Leach is only 10% after 1000 rounds but in case of proposed energy efficient protocol, 20 % residual energy is remaining after 1000 rounds.

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