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Enhancement of Leach Protocol in Wireless Sensor Network

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Abstract- ***Wireless Sensors Networks (WSNs) have a big application in heterogeneous networks. LEACH (Low-Energy Adaptive Clustering Hierarchy) is one of the most interested techniques that offer an efficient way to minimize the power consumption in sensor networks. In LEACH most nodes transmits the data to cluster heads, and the cluster heads aggregate and compress the data and forward it to the base station. The proposed protocol is simulated and the results show a significant reduction in network energy consumption compared to LEACH. LEACH can improve system lifetime by an order of magnitude compared with general-purpose multi-hop approaches.***

Keywords: wireless sensor networks, LEACH, hierarchical routing protocol, routing protocol, alive node.

1. Introduction

Energy efficient is of great importance in WSN. LEACH stands for **Low-Energy Adaptive Clustering Hierarchy** and is one of the first hierarchical protocols. LEACH (Low-Energy Adaptive Clustering Hierarchy) is one of the most interested techniques that offer an efficient way to minimize the power consumption in sensor networks. When the node in the network fails or its battery stops working then LEACH protocol is used in the network. Leach is self-organizing, adaptive clustering protocol in which sensor nodes will organize themselves into local clusters and cluster members elect cluster head (CH) to avoid excessive energy consumption and incorporate data aggregation which reduces the amount of messages sent to the base station, to increase the lifetime of the network. Therefore this algorithm has an effect on energy saving.

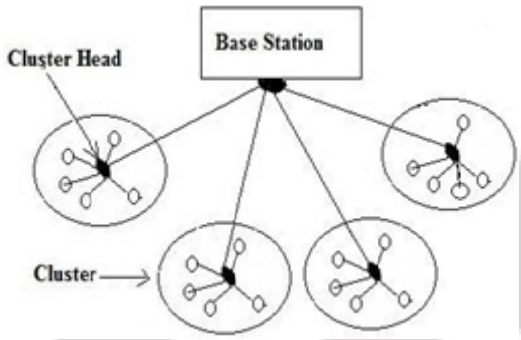

Figure1: Leach Protocol

LEACH organizes nodes into clusters with one node from each cluster serving as a cluster-head (CH) shown in figure 1. It randomly selects some predetermined number of nodes as cluster heads. Cluster heads then advertise themselves and other nodes join one of those cluster heads whose signal they found strongest.

There are different types of communication protocol is used like that PEGASIS, GROUP, LEACH-PO, EECS algorithms is useful. LEACH routing protocol operations based on rounds, where each round normally consists of two phases. First is setup phase and second is steady state phase.

1. Setup phase: In setup phase cluster-head and cluster are created. Whole network nodes are divided into multiple clusters. Some nodes elect themselves as a cluster-head independently from other nodes. These nodes elect themselves on behalf Suggested percentage P and its previous record as cluster-head. Nodes which were not cluster-head in previous 1/p rounds generate a number between 0 to 1 and if it is less then threshold T(n) then nodes become cluster-head. Threshold value is set through this formula.

$$T(n) = \frac{p}{1 - p(r \bmod (1/p))} \quad if\ n \in G$$

P: the percentage of nodes which are cluster-heads
r: the current round
G: the set of nodes that has not been cluster-heads in the past 1/P rounds.

2. Steady State Phase: each cluster-head waits to receive data from all nodes in its cluster and then sends the aggregated or compressed result back to a BS.

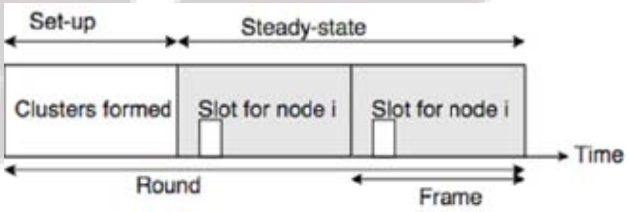

Figure 2: Steady State Phase

In Steady State phase, the operation is divided into frames, in each frame; cluster member nodes send their data to the aggregation node according to their time slots. The duration of the steady state phase is longer than the duration of the set-up phase in order to minimize overhead.

2. Algorithm

1. PEGASIS: Power-Efficient Gathering in Sensor Information: PEGASIS (Power-Efficient Gathering in Sensor Information Systems), a near optimal chain-based protocol that is an improvement over LEACH. In PEGASIS, each node communicates only with a close neighbor and takes turns transmitting to the base station, thus reducing the amount of energy spent per round. We could have constructed a loop, however, to ensure that all nodes have close neighbors is difficult as this problem is similar to the traveling salesman problem in this Algorithm PEGASIS is Chain construction using the greedy algorithm.

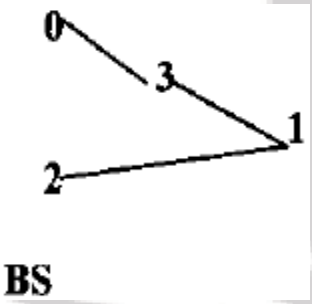

Figure 3: Chain construction using the greedy algorithm. [2]

2. GROUP: a Grid-clustering Routing Protocol for Wireless Sensor Networks: GROUP, grid-clustering routing protocol that provides scalable and efficient packet routing for large-scale wireless sensor networks. GROUP can distribute the energy load among the sensors in the network, and provide in-network processing support to reduce the amount of information that must be transmitted to the sink.

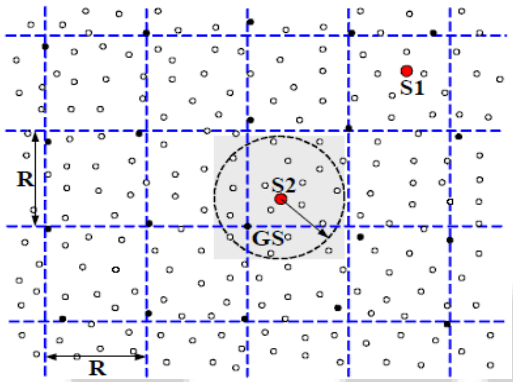

Figure 4: Example cluster grid [3]

Every T seconds, PS initiates the cluster grid construction process by broadcasting a GS-election command within its radio coverage range. The aim of GS-election command is to elect one sensor node as the Grid Seed (GS) from PS's neighbors.

3. Problem Statement

LEACH protocol will consume lot of its energy if the distance is so far. The LEACH protocol is also to single hop network.

The CH uses most of its energy for transmitting and collecting data, because it will die faster than other Protocol. LEACH protocol must not be used to greedy approach to select the nearest of the node.

3.1 Proposed Methodology

In proposed methodology is there delay the distance between two cluster heads, because it is single hop network. We take one cluster head and define its nearest of the cluster heads and last cluster head send information to base station. Calculate its Threshold value to define its distance between two cluster heads.

- Proposed work introduces modified Leach to find out which sensor nodes are able to become cluster head and how long they retains as cluster head on the basis of their energy level to prolong the network lifetime.
- In LEACH Protocol the CH uses most of its energy for transmitting and collecting data, because, it will die faster than other Protocol. So our goal is to increase the network lifetime.

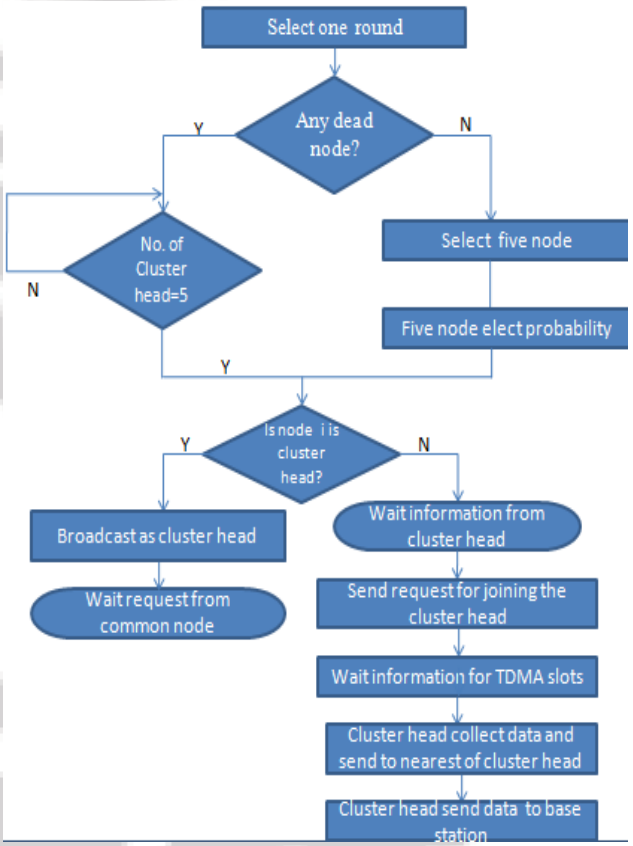

Figure 5: Flowchart of Leach protocol

We select any one round and take 100 numbers of nodes and calculate its election probability and each node elects its nearest of the node. If node i is not cluster head than Wait information from cluster head and send join request for joining the cluster head. Cluster head collects the data and gives to nearest of the cluster head. After it collect the data is send to the base station and then we going on steady state phase each node are divide into time slots.

4. Results and Analysis

Implementing LEACH in MATLAB

In this work, the following assumptions were made.

Steps for implementation are as following:

- Initializing the random sensor network and declaring the parameters used in the field.
- Declaring the initial energy level of nodes and advanced nodes have higher energy than that of normal node.
- After starting the round, we declare the election probability for advanced nodes on which selection criteria of cluster head depends.
- Firstly we check if there is a dead node in the sensor field, and checking these criteria after every round.
- Election of cluster heads for normal nodes and advanced node are done in different loops which depends on the election probability used.
- After a cluster head sent its data to sink, calculation of energy dissipated is done, through energy models considered in the project, in order to calculate how much energy dissipated after a steady state and whether a cluster head is eligible to transmit data in the next round too. This energy thoroughly depends upon the distance between base station and cluster head.

Simulation Parameter

Sr. No.	*Parameter*	*Value*
1	Simulation area	100m x 100m
2	Number of nodes	100
3	Initial Energy	0.5J/node
4	Maximum round	1000
5	Election probability	0.1

When we gives initial energy 0.5 j/node than LEACH protocol is calculates that number of round to be dead and maximum round is wetake1000 than simulation parameter one node is dead. When we take0.25j/node then 93 node will be dead in our simulation.

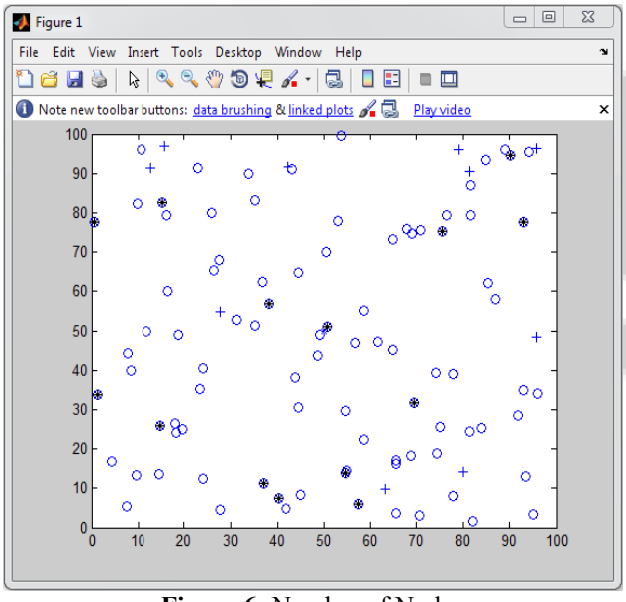

Figure 6: Number of Nodes

In this figure the energy to be increased so the energy to be more savings and life time of the node.

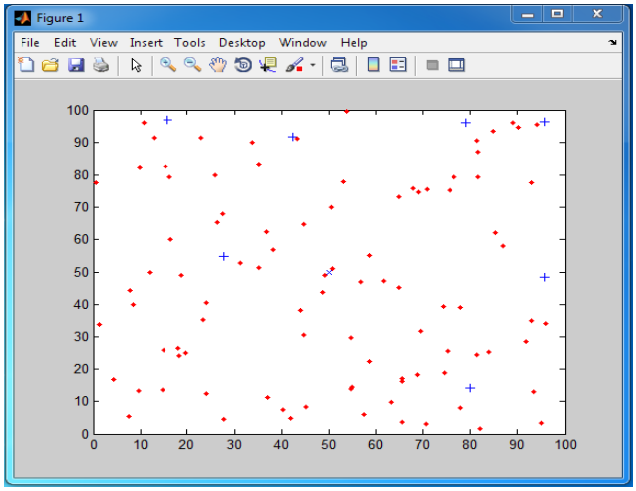

Figure 7: Dead Node

The graph in figure illustrates the number of rounds for which a node is alive at given time intervals for LEACH Protocol.

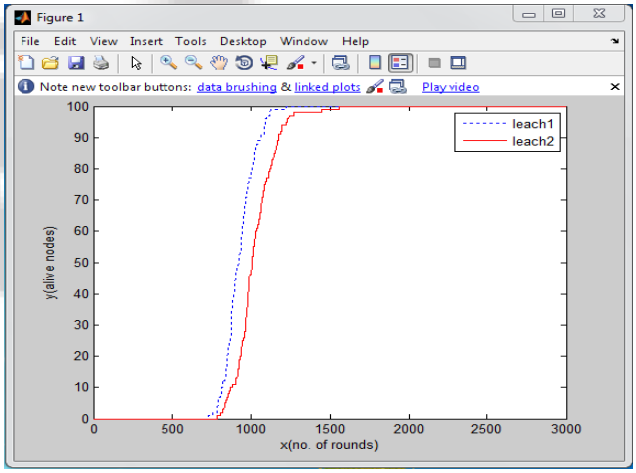

Figure 8: Alive node

Shows how many nodes are still alive with transmission rounds, compared with LEACH after 3000 rounds. The result shows that the network lifetime of our proposed protocol is prolonged compared to that of LEACH1 and how mane energy transmitted.

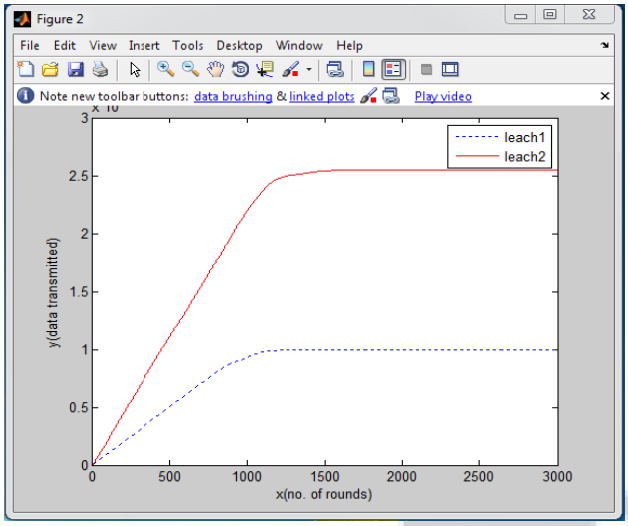

Figure 9: Transmitted node

5. Comparison Table

Energy	*Protocol*	*First Dead Node*	*Last Dead Node*
0.5j/Node	Pegasis	450	890
0.5j/Node	Leach	560	785

6. Conclusion

Data gathering and forwarding is one of the important operations in WSNs and its main cause of energy consumption. Since all nodes send their data to their CHs, hence CH can be the target for which send this node to nearest of the cluster head, and the nodes do not require knowledge of the global network in order for LEACH to operate. The result of simulations conducted indicates that the proposed approach is more energy efficient and hence effective in prolonging the network life time of LEACH. At different times, each node has the burden of acquiring data from the nodes in the cluster, fusing the data to obtain an aggregate signal, and transmitting this aggregate signal to the base station.

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