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Augmenting the Network Lifetime through Enhanced LEACH

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Abstract: ***The wireless sensor network (WSN) is a type of wireless ad hoc network that consists of large number of sensors that are effective for gathering data in a variety of environments. Since the sensors operate on a battery of limited power, it is very important to have the maximum lifetime of the network. Therefore, to continue maximum lifetime between sensor nodes, it is necessary to utilize efficient clustering algorithm. For better lifetime of the network, energy saving protocol Low Energy Adaptive Clustering Hierarchy (LEACH) is in trend. In this research both of these aspects have been considered. This research presents an improved version of LEACH protocol which aims to reduce energy consumption within the WSN and prolong the lifetime of the network. The research work studies the clustering protocol energy-efficient LEACH and cooperative multi input and multi output (EE-LEACH-MIMO). The network lifetime is considered during the study. The LEACH protocol has been augmented adding the parameter of angle. During the research work the augmented protocol is analyzed and compared with the existing EE-LEACH-MIMO protocol.***

Keywords: WSN, LEACH, cluster head, network lifetime

1. Introduction

Wireless communication is where there is no physical connection between the sender and the receiver but instead radio, electromagnetic or acoustic waves are used in place of wires, cables or fiber optics. WSN is a collection of wireless mobile nodes which dynamically forms a network with the use of any existing network infrastructure or centralizes administration. Sensor node is a tiny autonomous device which is used for the monitoring, tracking and surveillance. Before this, work has been done by researchers on increasing lifetime and to provide maximum coverage. These all problems are related to the base of WSN i.e. Sensor Deployment. By placing the nodes at a pre-determined optimized location, sensing range can be minimized. Sensing range minimization will lead to increased lifetime as less energy will be consumed during monitoring of targets.

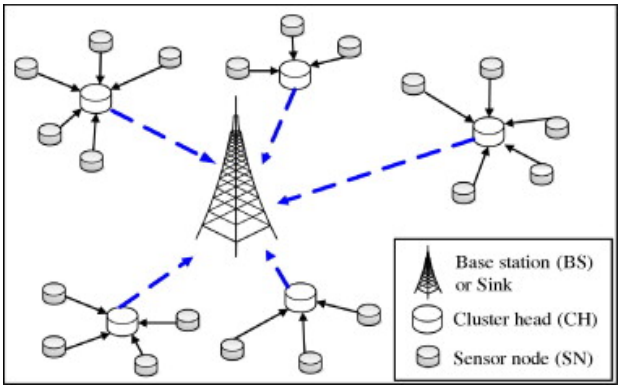

Figure1: Wireless Sensor Nodes

This research work studies the clustering protocol EE-LEACH-MIMO. LEACH (Low Energy Adaptive Clustering Hierarchy) protocol is the basic and the most important protocol in wireless sensor network which uses cluster based broadcasting technique. LEACH protocol requires improvement as it does not make use of residual energy of the nodes, provide sufficient consideration to their location and check the non-uniformity in their distribution for the selection of the cluster head.

Extending the lifetime for energy-constrained wireless sensor networks, energy LEACH protocol is used which improves the cluster head selection procedure. It checks the residual energy of each node and decides whether it becomes the cluster head or not. In EE-LEACH-MIMO, both the residual energy and the location are used as criteria for choosing the cluster head and the cooperative nodes of the MIMO system. The LEACH protocol can be enhanced by adding the parameter of angle for partitioning the network. The rectangular network is plotted and the location and residual energy of the nodes are considered for choosing the cluster head effectively. During the research work, the enhanced LEACH protocol will be analyzed and compared with the EE-LEACH-MIMO protocol. In this process network is divided into clusters that vary according to different angles.

The process of basic LEACH is divided into various rounds where each round consists of two phases: cluster setup and data transmission. In the cluster setup phase, clusters are formed and the cluster head is generated randomly. In data transmission phase, the member node sends data to the cluster head; cluster head then sends it to the sink. To overcome the ineffectiveness of the basic LEACH in the neglect of the residual energy, enhanced LEACH is used.

Augmented or enhanced LEACH protocol increases the lifetime of the network. Network lifetime is defined as the time interval from the start of an operation until the last live node in the network. EE-LEACH-MIMO and enhanced LEACH protocol is implemented in Network Simulator-2.

2. LEACH Protocol

The LEACH protocol was first proposed by Wendi B. Heinzelman. It is one of the clustering protocols. In clustering, the network is divided into many clusters; each cluster consists of a cluster head and many other member nodes. To overcome the ineffectiveness of the LEACH in making the use of residual energy, the enhanced LEACH protocol is used.

3. Enhanced LEACH

In this research, enhanced LEACH protocol has been proposed in which the angle is optimized for partitioning the network. The cluster head is chosen by using the residual energy and the location of the nodes in the rectangular network. Scheme takes into account the selection of cluster head for extending the life time of network. The limitation that was found in LEACH was its neglect of the residual energy. To overcome this ineffectiveness enhanced LEACH protocol uses both the residual energy and the location for choosing the cluster head. In the enhanced LEACH protocol the network is uniformly divided into clusters. Each cluster consists of cluster head and many member nodes. N nodes are randomly distributed in S*S region space. By using multi-hop routing the cluster head is chosen effectively. We will now describe this methodology in detail.

4. Methodology

The procedure will be focused on the finding better solution for lifetime of the wireless sensor networks by choosing the cluster head effectively. In this scheme, operations are performed in three different stages: area portioning, cluster head generation and data transmission.

Stage 1: Area Partition
Firstly the network is partitioned by the sink by applying the optimum angle: k_{angle} that forms different clusters. Then, the k_{angle} is further split into h_{opt} by the following strategy:

$0 \leq h_{opt} \leq k_{angle}$ -1

here h_{opt} varies from

0: .1: k_{angle}-1

Stage 2: Cluster Head Generation
The second stage is the cluster head generation. In the network based on clustering, cluster head is responsible for coordinating the operations among other sensor nodes in the cluster, collecting, fusing the data and then sending it to the sink. Thus, the load on the cluster head is more and consumes more energy. So during the generation of the cluster head, both the position and the residual energy of the node are considered. In the first round, node whose position is close to the sink is chosen as the cluster head. In the following rounds the member nodes can be the cluster heads if it satisfies both of these conditions:

1) Its location becomes closer to the sink.
2) The residual energy of the nodes must be greater than the threshold.

$E_{res}(j) > E_{th\_d}$

where $E_{res}(j)$ is its residual energy and E_{th_d} is the threshold energy. The threshold energy is set to be the average residual energy of all the alive nodes in the cluster.

Stage 3: Data Transmission
After the above stages, data transmission takes place i.e. nodes send their data during their allocated TDMA (time division multiple access) slot, to the cluster head. Thereafter the cluster head creates and broadcasts its own TDMA schedule which includes time slots for data transmission from member nodes to the cluster head and then from the cluster head to the sink. The cluster head then fuses the data packet received from member nodes and transfers it to the sink.

5. Conclusion

In the proposed method, we implemented Enhanced LEACH that uses both the location and the residual energy of the node. Network is partitioned by the sink by applying the optimum angle to have uniform cluster head distribution. The network constitutes rectangular grids in order to centrally place all the nodes. For the future work, the simulation area can be varied and different angles can be applied.

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