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PERFORMANCE ENHANCEMENT OF LEACH PROTOCOL IN WIRELESS SENSOR NETWORK IN TERMS OF NETWORK LIFE TIME

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ABSTRACT: Wireless sensor nodes are made up of small electronic device, which can sense, processing, computing and transmitting data from physical environment like surveillance field. These nodes basically depend on batteries for energy, which get reduces at a faster rate because of computation and communication operations which they have to perform. Communication protocols can be designed to make utilization of energy resources of a sensor node and is to be obtaining real time functionality. In this thesis, I proposed a new modified enhanced Leach Algorithm in which threshold value is calculated for next round and consider the total node energy of the network. A comparison between traditional leach and proposed Leach is done on the basis of the network lifetime. The implementation of the protocol is done by using MATLAB.

I. INTRODUCTION

Wireless sensor network is consist of sensor nodes with limited power supply and constrained computational and transmission capability. Because of limited transmission and computational ability, and high density of sensor nodes, transfer of data packets takes place in multi-hop data transmission. The sensor nodes work on non-rechargeable batteries, so with the efficient routing the network should be energy efficient with efficient utilization of the resources and then it is an important research concern. Wireless sensor network are not centralized .There is no fixed static infrastructure and peer to peer communication is between the nodes. Due to multiple functions sensor nodes can be used in various applications such as forest fire detection, health care, environment monitoring, target tracking, inventory control, surveillance, energy management and reconnaissance, and so on. The main responsibility of the sensor nodes in a network is to forward the collected information from the source to the sink for further operations, but the resource limitation. For different application suitable routing algorithms are designing. The important issue in wireless sensor network is to fulfill the different performance demand. In wireless sensor networks, the most fundamental component is the sensor nodes, and these sensor nodes have low cost, low power consumption, small size, and short-distance wireless communication characteristics. Nodes in WSN in three roles: data acquisition, data transfer station and cluster head nodes. The role of data acquisition is to collect the data from surrounding environment, directly or indirectly through communication routing protocol for transfer the data to the remote base station. The data transfer station, after the completion of the data acquisition task, receives the data from the neighbors will be forwarded to the distance of the base station. Cluster-head node, this node is responsible for collecting the data from the entire node within the cluster and by fusion of the data sent to the base station. Advances in wireless evolution of low cost sensor nodes have led to introduction of low power wireless sensor networks. Due to multiple functions and ease of deployment of the sensor nodes it can be used in various applications such as target tracking, Environment monitoring , health care, forest fire detection, inventory control, surveillance, energy management, and reconnaissance, and so on [27]. The main responsibility of the sensor nodes in a network is to forward the collected information from the source to the sink for further operations, but the resource limitations [28], unreliable links between the sensor nodes in combination with the various application demands of different applications make it a difficult task to design an efficient routing algorithm in wireless sensor networks.

II. CHARACTERISTICS OF WSN

WSN is currently used for real-world unattended physical environment to measure numerous parameters. So, the characteristics of WSN must be considered for efficient deployment of the network. The significant characteristics of WSN are described as follows:

2.1 Energy efficient: Nodes in wireless sensor network are portable and energy used in different purpose such as communication, computation and storage. The computation capacity is low and storage capacities are less most consideration of WSN.

2.2 Low cost: Number of sensor nodes are used in the network to measures any physical environment so it is important to reduce the cost of whole network so the sensor node kept as low as possible.

2.3 Network topology: There are possibilities that nodes can be added and removed from the topology and failure of node occur, there can be energy depletion in the node can take place.

III. ROUTING IN WSN

The main responsibility of the routing protocol is to find path from data sources to sink devices. In the single-hop routing, all the sensor nodes communicate directly with the sink device. In the direct communication the simplest approach is that all data travels a single hop to reach the destination. Where as in multi-hop network the source node does not directly communicate to the sink, relaying of packets is done

by the sensor nodes, routing table assist in the creation and maintenance of packet source and destination. Considering the unique features of low power wireless sensor networks, routing in WSN is much more challenging compared to traditional wireless networks such as ad-hoc networks [25, 26]. First, considering the high density of nodes, the routing protocols should route data over long distances, regardless of the network structure and size, in addition to the above requirement some of the active nodes may fail during the operations due to the environmental factors or energy depletion of sensor nodes or hardware faults, but that issues shall not interrupt the normal operations of the network. Moreover, as mentioned earlier the wireless sensor nodes are restricted in terms of power supply, processing capability and available bandwidth,routing and data forwarding should be performed with effective network resource utilization. Further, considering the performance demands of the wireless sensor networks are totally application dependent, routing algorithms should satisfy the QoS demands of the application for which the network is being deployed. For example, challenges in designing the routing algorithms for environment monitoring will be different from issues that should be considered for health care monitoring or target tracking.

IV. CHALLENGES IN ROUTING PROTOCOLS

The following challenges described the most important design constraints of a WSN.

4.1 Energy: Sensor network design in such a manner that the sensor nodes operate with limited energy budget. Nodes are powered through batteries which either replace or rechargeable when depleted.

4.2 Self Management: Many sensor network applications operate in remote areas and harsh environments. Sensor nodes must be self-managing because it configure themselves, collaborate with the nodes, operate adapt to failure.

4.3 Decentralized Management: Decentralized approach allows every node to make routing decisions based on limited local information. Decentralized approach is more energy – efficient than the centralized solution.

4.4 Design Constraints: The main goal of designing the wireless sensor network is to create smaller, cheaper and more efficient device.

4.5 Security: Wireless sensor network have sensitive information. There are numerous techniques and solutions that prevents from various attack.

V. LEACH

The Low-Energy Adaptive Clustering Hierarchy (LEACH) protocol based on "round" concept. In LEACH protocol, each round is consisting of two parts. The first part shows the building the cluster and second part is to stable session. LEACH is clustering based routing algorithm was proposed for lower power consumption. LEACH arranges the nodes into the cluster and chooses one of them as a cluster head. Then the cluster head aggregate the data and compress the information received from all the nodes and send it to the base station. In order to increase the lifetime of the network LEACH, the hierarchical routing protocol was introduced. The routing protocol re-clusters and automatically organizes the nodes for every round [21]. In Leach, nodes organize themselves into clusters. Each cluster then consists of a node that becomes cluster head and rest of nodes forwards their data to cluster head. It is the responsibility of the cluster head to send the data to the sink. All the raw data is collected by the cluster head and only sends the data which is useful to the sink. Since the role of cluster head is vast, so the energy loss is more, if the node acts as cluster head permanently it will lose its power quickly. This problem is overcome by the Leach by rotating the role of cluster head in each round to save the battery of node [21], [23]. In leach it is not necessary to know the whole network, as it is a distributed protocol. Energy can be saved by (a) decreasing the data transfer cost between sensors and cluster heads and (b) keeping the nodes in sleep mode which are not cluster head [24]. It is not good for big regions as it is a single-hop routing protocol in which node can directly send the data to the CH and the sink.

Leach operated in rounds consisting of two phase:

1. Set-up Phase: In the setup phase, cluster heads are find and communication schedules are establish between the clusters. Number (n) is selected the cluster head for that round in between zero and one random number. Then calculating T(n) threshold value .Node act as cluster head if random number which is generated is less than threshold value.

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

p is the probability for cluster head

r is the current round of process

G is the set of nodes that are not previous in round

2. Steady State

All the sensor node directly communicates with the cluster head and it allow only during its allocated slots indicated by schedule received from cluster head. Communication between the cluster head the base station is based on fixed spreading code. Cluster head transmit data when it first sense the channel then check ongoing transmission using the same spreading code.

VI. IMPROVED LEACH ALGORITHMS

As we know that LEACH protocol consist of two phase the first one is set-up phase and second one is steady state and the threshold equation is used for calculating the cluster head for around because of rotating the cluster head responsibility between the sensor nodes is to evenly distributed the energy load.

For increasing the life time of the sensor network using the total energy concept

$$T(n) = \left\{ \frac{p}{1-p\left(r \bmod 1/p\right)} * \frac{Eo}{Etotal} \right\} \text{ if n} \in G$$

Eo is the initial energy of node

Etotal is the sum of energy level of all nodes

VII. SIMULATION RESULT

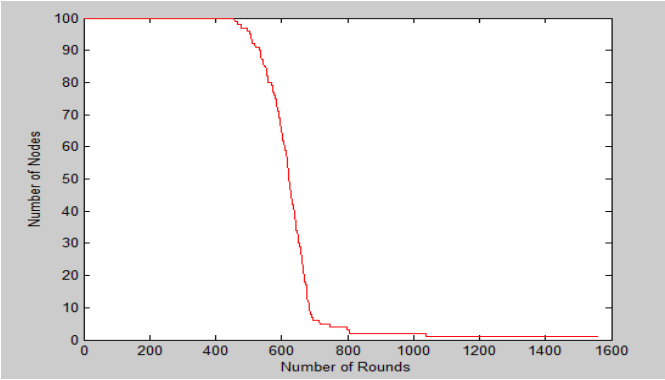
The program uses the MATLAB simulations the sensor node are randomly distributed in the plane region of 100×100.100 sensor node each node initial energy 0.5J.

Table 1. Simulation data

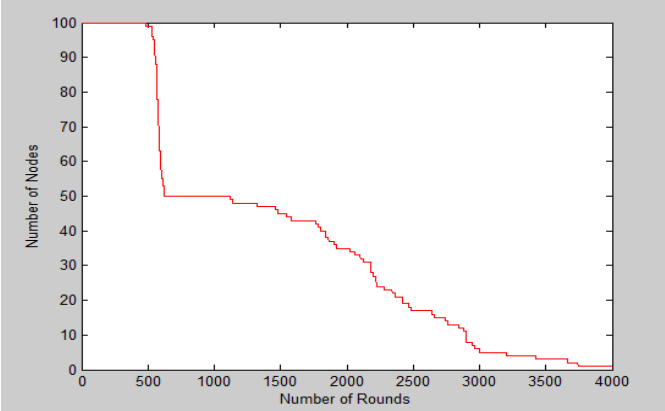
	FIRST NODE DEAD (ROUNDS)	LAST NODE DEAD (ROUNDS)
TRADITIONAL LEACH	500	1000
ENHANCED LEACH	600	3800

7.1 LIFE TIME COMPARISON

Traditional Leach



Enhanced Leach



VIII. CONCLUSION

This paper has better approach to increase the life times of the wireless sensor network as compared to the existing traditional leach. Proposed techniques can show the enhancement of life of network . Hence, the proposed approach is the successful approach to alter the threshold for determining the issues of network power utilization.

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