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Energy Efficient PEGASIS Routing Protocol in Wireless Sensor Network

Sujata[1], Brijbhushan[2]

[1]M.Tech, Electronics and Communication, Shoolini University, Solan, H.P, India
[2]Technical Instructor, Electronics and Communication, Shoolini University, H.P, India

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Abstract - *At present, Wireless Sensor Network is most standard services occupied in commercial and industrial applications as a result of its technical development in a processor, communication and low-power usage of embedded devices. WSN is basically formed by a huge number of wireless sensors. These sensor nodes are able to do some kind of processes, gathering sensed information and as well as communicating with other connected nodes in the network. One of the major points at issue for Wireless Sensor Networks (WSNs) is the design of energy-efficient Routing. The efficiency of wireless sensor network abundantly depends on the routing protocol used. The protocol is an important aspect, which can reduce the delay while offering high energy efficiency and long span of network lifetime. One of that protocol is PEGASIS, it is rest on the chain structure and every chain have only one cluster head, it take the profit of sending data to its closet neighbor. In this paper, main objective is to achieve energy efficiency using PEGASIS Routing Protocol for WSN.*

Key Words: *Wireless sensor networks, routing protocol, PEGASIS protocol, energy efficiency.*

1. INTRODUCTION

Recent technological advances in the area of wireless communications and micro-electro-mechanical systems have made it suitable to develop small sized and low cost sensors. A sensor network is the group of sensors connect to transducers be determined to monitor the conditions at diverse locations. The Sensors are meant to evaluate the physical or environmental changes. A sensor network has a huge number of nodes, which are arrange in open environment randomly [1]. The consideration of WSNs was originally motivated by military applications, but nowadays it is being carry out in various civilian applications like intrusion detection, security, weather monitoring, inventory control, disaster management, etc. Sensor node is also known as mote which is small, lightweight and portable devices equipped with a microcomputer, transducer, power source, and transceiver. Electrical signals are produced by the transducer which is based on the sensed physical phenomena. The information is processed and sensed by microcomputer. The transceiver receives instructions from the base station/central computing system and sends data to it [2].

1.1 Routing in WSN

Routing is conventionally defined as the technique of determining a path between the source and the destination node upon request of message transmission from a given node.

In WSNs, the network layer is mostly acclimated to perform the routing of data messages. In case of large multi-hop networks, the source node cannot get as far as the destination directly, and therefore, intermediate nodes have to pass on their messages. An intermediate node has to settle an issue to which neighbor an incoming message should be forwarded if the message is not to come to itself. As a matter of course, routing tables that list the most appropriate neighbor for any given message destination are used. The implementation of routing tables in the matter of a particular routing algorithm specifies the paths for each destination. The construction and maintenance of these routing tables is the desperate job of both a centralized and a distributed routing protocol in WSNs. The construction of these tables basically reduced to stabilizing what is the path from a given node to reach a given destination [15].

1.2 Routing Protocols in WSN

Routing protocols are essentially classified into following categories, which are:-

Location-based Protocols

In location-based protocols, sensor nodes are label by means of their locations. Location information sensor networks distance between two particular nodes energy consumption can be calculated.

Hierarchical Protocols

In the hierarchical Clustering protocol, clustering is an energy-efficient communication protocol that can be used by the sensors to circulate their sensed data to the sink.

Data Centric Protocols

In Data-centric protocols, data is delivered from source sensors to the sink, when the source sensors circulate

their data to the sink; intermediate sensors can do some form of aggregation on the data originating from several source sensors and send the aggregated data into the sink. This process can result in energy savings because of lesser transmission required to transmit the data from the sources to the sink.

Mobility-based Protocols

Mobility leads new challenges to routing protocols in WSNs. Sink mobility need energy efficient protocols to insure data delivery originated from source sensors toward mobile sinks.

Multipath-based Protocols

In view of data transmission between source sensors and the sink, there are two routing specimen: single-path routing, multipath routing. In single-path routing, each source sensor deliver its data to the sink by the shortest path. In multipath routing, each source sensor finding the first 'k' shortest paths to the sink and divides its load uniformly among these paths.

Heterogeneity-based Protocols

In this type of sensor network architecture, there are two kind of sensors: line-powered sensors, they have no energy constraint, the battery-powered sensors having insufficient lifetime, and hence should utilize their available energy efficiently by reducing their potential of data communication and computation.

QOS-based Protocols

To reduce energy consumption, important point to examine is quality of service requirements i.e. interruption, reliability, and fault tolerance.

2. CURRENT SITUATION IN WSN

For the adaptive use of power, many superlative routing algorithms were proposed. One of them is just based upon cluster-type system, that protocol is LEACH algorithm and several others are rest on the chain-structure, that protocol is PEGASIS algorithm.

2.1. LEACH (Low-Energy Adaptive Clustering Hierarchy)

LEACH is a routing protocol in which the data is forwarded to the BS (base station) in a cluster-based manner. There are few factors which should be noticed such as maximizing network lifetime, minimizing energy consumption and performing data processing at intermediate nodes to lower the number of transmissions. Being a cluster-based hierarchy, the complete network is just divided into clusters and every cluster has a cluster-head assigned to it. Cluster design is dynamic in each and every round and the cluster head is making decision for the data collection from all the nodes of that cluster, it proceeding data and transfer the collected data to the BS. In LEACH protocol, cluster-heads are elected randomly but the energy used up for each round is balanced as all sensor nodes have a possibility to be selected as a cluster-head. As long as each round, 5% of the all sensor nodes are the cluster-heads.

2.2. PEGASIS (Power-Efficient Gathering In Sensor Information System)

Power-Efficient Gathering in Sensor Information Systems (PEGASIS) is the utmost favored chain based hierarchical protocol. The nodes are arranged in the form of a chain for the transportation and aggregation of the data. The creation of chain can be centralized based on the application. PEGASIS is based on the presumption that global knowledge of network is provided to all the nodes. The creation of chain starts from the lattermost node from sink and its nearest neighbor are selected as next node in the chain and so on. The last node must be the sink and the node before sink acts as a leader of the node. Processes like data- processing and aggregation are accomplished by leader node. PEGASIS is not so relevant for the networks with dynamic or time varying topology. As the size of network will be larger, the delay in transmission will be as long, because of that PEGASIS undergoes with scalability issue.

3. COMPARISON IN LEACH AND PEGASIS PROTOCOLS

This section just explains a theoretical based comparison of the leach and pegasis. Both protocols come under hierarchical class, it means that very few nodes are given priority over the others nodes. in leach protocol, local data processing obtain at specific nodes, which are called cluster-heads and at last the aggregated data is send to the sink node. on the other part in pegasis protocol, no aggregation of data occurs. leach is cluster-based hierarchy, at the same time pegasis is a chain-based hierarchy. on the other side, about network lifetime, pegasis provides extended lifetime of the network because there is a balance in energy distribution. the no. of deaths of nodes in pegasis is less as compare to leach.

4. ALGORITHM OF PEGASIS PROTOCOL

The algorithm of PEGASIS is just based on the LEACH protocol. The main idea in PEGASIS is to construct a chain between all the sensor nodes so that every node can collect from and transfer to the closest neighbor. The

Collected data moves from node to node, it get merged, and hereafter a designated node (i.e. cluster head) transmits it to the BS (base station). Nodes take turns send out to the BS so that the average energy consumed by every node per round is just reduced. The technique of building a chain to just reduce the total length is matching to the traveling salesman trouble, which is so difficult. Despite of that, with the radio-communication energy specification, simple chains created with a greedy approach do the job totally well.

Thus, PEGASIS algorithm is having some advantages as:-

- Normal nodes only reach to their neighbour and every nodes will take data fusion in regulation.
- The distance of the connected nodes to each other have been minimized especially
- Nodes take turns to become the cluster head, so it takes no energy.
- Some of disadvantages of PEGASIS algorithm as:-
- Transmission of data results in time-delay.
- Since the limitation of greedy approach, the probability of long chain is max.
- The method of cluster head is not at all suitable for load balance.

5. PROPOSED METHOD

As we knew that there are several issues in the PEGASIS protocol. The main idea in PEGASIS is for each node to receive from and transmit to close neighbors and take turns being the leader for transmission to the BS. This approach will distribute the energy load evenly among the sensor nodes in the network. We initially place the nodes randomly in the play field, and therefore, the i –th node is at a random location. The nodes will be organized to form a chain, which can either be accomplished by the sensor nodes themselves using a greedy algorithm starting from some node. Alternatively, the BS can compute this chain and broadcast it to all the sensor nodes. We used random 100-node networks for our simulations. We placed the BS at a far distance from all other nodes. For constructing the chain, we assume that all nodes have global knowledge of the network and employ the greedy algorithm. 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. The greedy approach to constructing the chain works well and this is done before the first round of communication. To construct the chain, we start with the furthest node from the BS. We begin with this node in order to make sure that nodes farther from the BS have close neighbors, as in the greedy algorithm the neighbor distances will increase gradually since nodes already on the chain cannot be revisited. By implementing this routing protocol at the end we were able to create an energy efficient routing protocol for wireless sensor network.

6. SIMULATION RESULTS

Our simulation results showed that if we introduce more number of sensor in network then we can increase the network efficiency by using pegasis routing protocol in a network the all sensor do not have to waste their valuable time and energy for electing the cluster head for each and every round of its working as like in LEACH routing protocol in our network we have introduced the sensor node and analyzed them to a certain period of rounds or cycles this increased the lifespan but there is a disadvantage also in this that when the sensor node dies all the data which is present at that time on sensor nodes memory also dies so there may be a chance of data loss when we simulated the network. And the cluster-heads which are in sleep state may also get affected due to environmental conditions.

7. CONCLUSIONS

During this work we have observed the working of PEGASIS Routing protocol for wireless sensor networks from theory to our simulation. And we concluded that we can implement the algorithm in the network and our simulation had a good result we have introduced a 1000 sensor nodes and then created a chain using a greedy algorithm in network and had seen that network consumes less energy as they have only one specific task to perform in the network only sensing and transmitting the data.

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BIOGRAPHY

Sujata, M.Tech, Electronics And Communication, Shoolini University, Solan, H.P, India