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Energy Efficient Data Gathering in Wireless Sensor Network Using Pegasis and Genetic Algorithm

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Abstract: Wireless sensor network is a network consisting of different number of small nodes deployed in the remote areas to execute the task of sensing, computation and data forwarding. These wireless sensor nodes keep on gaining drained in the energy whenever the data transmission phase comes into action. To obtain a longer lifetime these wireless nodes are handle with various routing techniques which makes the communication between nodes and Base Station much more efficient in terms of energy consumption. Many energy-efficient protocols are of huge importance in order to increase the network lifetime during data gathering. The parameter that is important for protocols in a wireless sensor network is its energy awareness. The factors that are introducing unequal energy dissipation among the nodes are the distance of nodes from base station and inter nodal distances in the network. Thus the protocol construct should be energy efficient. PEGASIS Protocol which forms chain using greedy algorithm and gives elegant solutions to the problem. In this research work, first we implement PEGASIS Protocol using greedy chain and then we use Genetic Algorithm to construct data routing chain, which uses its crossover and mutation parameters and find an optimized routing path for data gathering. Genetic Algorithm increases the network lifetime for same number of nodes. Simulations are done and the results of PEGASIS and Genetic Algorithm are compared with each other on the basis of energy consumption and number of rounds.

Keywords: wireless sensor network, Routing Protocol, Pegasis protocol, Energy efficiency, Genetic Algorithm etc.

I. 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 hasa huge number of nodes, which are arrange in open environment randomly. The consideration of WSNswas 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.

II. ROUTING IN WIRELESS SENSOR NETWORK

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.

III. ROUTING PROTOCOLS IN WIRELESS SENSOR NETWORK

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

A. 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.

B. 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.

C. 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.

D. 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.

E. 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.

F. 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.

IV. 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.

V. 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 fromthe 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.

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VI. Comparison In Leach And Pegasis Protocol

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.

VII. Proposed Work

The work done includes the PEGASIS protocol implementation. The protocol is implemented using Greedy Chain which is the conventional method of implementing PEGASIS. It is then implemented using Genetic Algorithm. The greedy chain starts the chain formation from the farthest node from the base station. The next node is selected which is at a smaller distance from the others. So the inter-nodal distances are calculated and the nodes are selected. During this process the distances start increasing towards the end of the chain which leads to more energy dissipation.

VIII. Genetic Algorithm

Genetic Algorithm is a heuristic search algorithm based on the concepts of natural selection and evolution. Genetic algorithms are evolutionary algorithms (EA) which provide solution to optimization problems using genetic operators like mutation, selection and crossover. In a genetic algorithm a population of chromosomes is developed, the candidate solution (fitness value) is generated. The population of chromosomes is generated randomly.

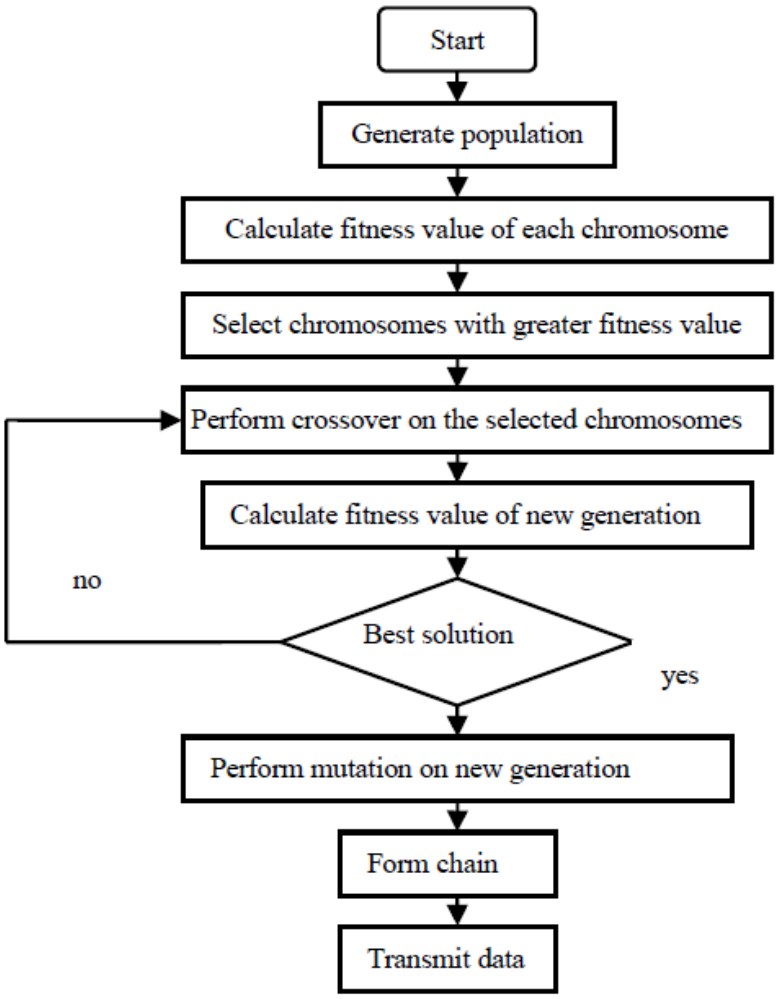

Fig 1. Flow chart of the proposed scheme

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IX. Result And Discussion

All simulations were done on a 100m*100m area and nodes were randomly distributed in this region. The implemented protocol PEGASIS is simulated using 100 nodes. The chain construction is done in PEGASIS using greedy approach and Genetic Algorithm. Each node has same initial energy level.

A. Energy is .25

Protocol	10	20	30	40	50	60	70	80	90
LEACH	650	700	750	800	900	1000	1100	1200	1300
PEGASIS	1150	1170	1180	1190	1200	1220	1250	1300	1500
PEGASIS GA	3000	3100	3300	3400	3500	3600	3800	4300	4490

Table1. Comparison of wireless sensor network protocols when energy .25

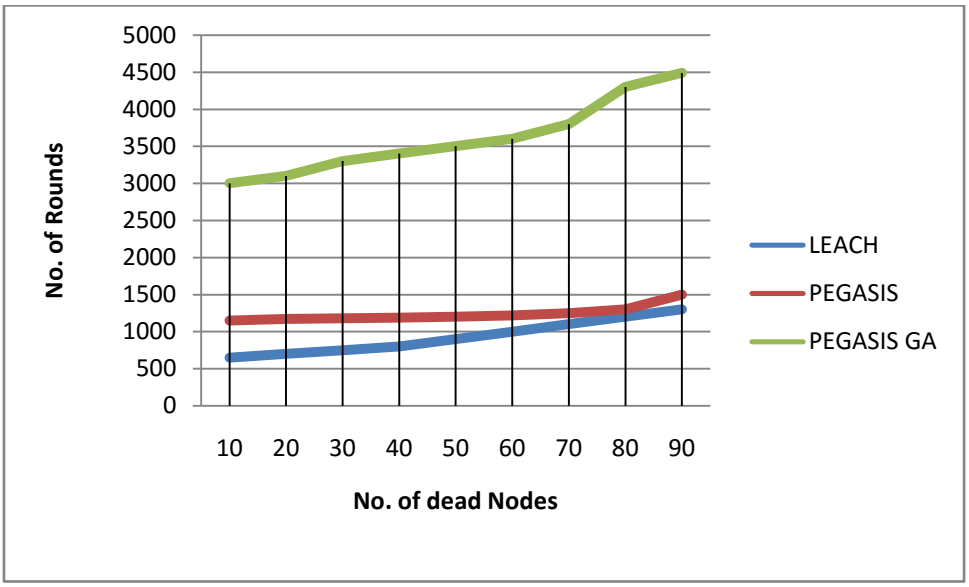

Fig. 2. Comparison of wsn protocols when energy .25

The above results show that for a 100m*100m area the performance of GA is better as number of rounds completed by GA are 4490 when 90% of nodes are dead whereas in case of LEACH it completes only 1300 rounds at the same time and PEGASIS completes 1500 rounds at the same time. Therefore PEGASIS when implemented with GA in sensor network can provide us information for considerably long period of time. With less nodes dead, the quality of information would also be good as compared to LEACH and PEGASIS.

B. Energy is .5

Protocol	10	20	30	40	50	60	70	80	90
LEACH	1500	1550	1600	1700	2000	2200	2300	2400	2600
PEGASIS	2250	2300	2350	2400	2450	2500	2550	2600	2700
PEGASIS GA	2900	3000	3200	3400	3500	3600	3800	4200	4700

Table2. Comparison of wireless sensor network protocols when energy .5

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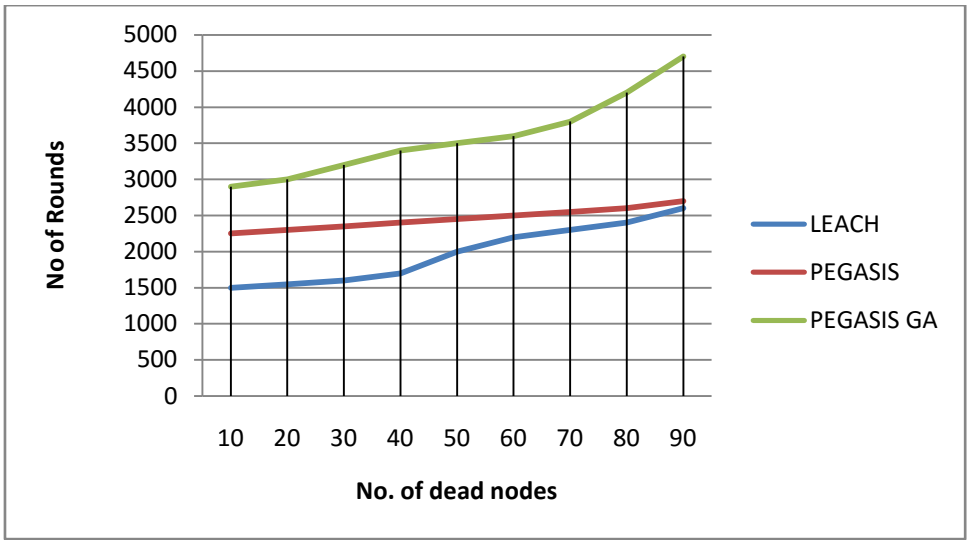

Fig. 2. Comparison of wsn protocols when energy .5

The above results show that for a 100m*100m area the performance of GA is better as number of rounds completed by GA are 4700 when 90% of nodes are dead whereas in case of LEACH it completes only 2600 rounds at the same time and PEGASIS completes 2700 rounds at the same time. Therefore PEGASIS when implemented with GA in sensor network can provide us information for considerably long period of time. With less nodes dead, the quality of information would also be good as compared to LEACH and PEGASIS.

X. CONCLUSION

The PEGASIS protocol considered ensures that a near energy utilization occurs thereby increasing network lifetime. PEGASISimplementedusing Greedy chainshowssome drawbacks like the gradual increase in inter-nodal distances while reaching the end of the chain which is overcome by implementing PEGASIS using Genetic Algorithm (GA). The simulations are carried out in MATLAB which are compared with each other on the basis of energy consumption which is carried out in the form of distance travelled. The results of GA are better as compared to LEACH and PEGASIS. It enhanced the lifetime of sensor network by optimizing routing paths.
Further many schemes could be implemented like Particle Swarm Optimization (PSO) on PEGASIS and compare it with ACO and GA. Packet losses could also be considered and existing model be modified to get desired results under the given circumstances.

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