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Performance Analysis of PEGASIS and Leach Routing Protocol in WSN

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Abstract: **In a wireless sensor network, routing algorithms collect data from a sensor node and send it to the base station. The position of the sensor node and base station affects the performance of routing algorithms. If the distance between a node and the base station is more at this condition the data-gathering process takes more energy. The efficiency of any network is also dependent on the scenario of the sensor node, static or dynamic. Taking both concepts, we apply the PEGASIS routing protocol and LEACH protocol and change the position of the base station, simulate both routing protocols on MATLAB, and find out the PEGASIS routing protocol is better than the LEACH protocol.**

Keywords: **WSN, PEGASIS, LEACH, static network, random network.**

I. INTRODUCTION

In recent times no technical field remains where sensor network technology wireless is not used because it works very efficiently, less power is consumed for network communication, and very easy to establish networking. The wireless sensor network works with two main components: the first is the sensor node and the second is a base station. With respect to power consumption, the first term is that the distance between the sensor node and base station is very high and the second is always trying to try to apply a good routing algorithm that designs the optimal path between the sensor node and the base station. The third is chain formation which is also helping to optimize the wireless sensor network and the last is the head node selection process that is responsible for transferring the gathered data from its chain sensor node to the base station.

In this paper, Mohammad RobihulMufid& M. Udin Harun Al Rasyid (2018) discuss two basic and very optimal routing algorithms on PEGASIS and LEACH routing algorithms. A PEGASIS is one of the most important routing protocols that is widely used in a wireless sensor network. PEGASIS is a hierarchical-based routing where the network is divided into many chains each and every chain has a chain head. All chains gather the data from the neighbor node and gather data at the chain head and the chain node is responsible to transfer to the base station. The LEACH protocol is used in our proposed model which is a very popular routing algorithm. It is a hierarchical routing algorithm where in the LEACH protocol the sensor network is divided into clusters and each cluster has a cluster head. All clusters send the data directly or indirectly to the cluster head and after cluster head directly sends the data to the base station.

Compare to PEGASIS and LEACH, PEGASIS is better than LEACH because PEGASIS removes the overhead problem, PEGASIS has to keep a limited number of nodes in its chain, and the biggest advantage is the PEGASIS chain set to send the data to the base station one time in one round but in LEACH, cluster head sends the data to

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the base station much time in one round. A PEGASIS saves energy in every round and the lifetime of PEGASIS is more to the LEACH protocol.

II Related Work

Selva Kumar et al (2017) wireless sensor network has used the sensor node and base station; the base station has the unlimited power resource and big computation power but the sensor node has the limited power resource and limited computation power and other limitation limited sensing capability so sensor node spends maximum energy to sensing the network and data transmission phase. Therefore, it becomes a challenge for the sensor node. In this context, we use a good data aggregation technique for a wireless sensor network. The designer presents a cluster chain mobile agent routing that works successfully in LEACH and PEGASIS that routing technique divides the wireless sensor network into some cluster that is run in two steps one is cluster and the other cluster head as same PEGASIS, a form a chain inside the cluster that performs data aggregation from start cluster head to the farthest node within the cluster further that concept find the efficiency on network lifetime, instead of designing the cluster head to transmit the data to the base station. The mobile agent gathers data from the network which reduces the energy loss during the data transmission that leads to network failure. Hence the proposed routing design overcomes the cluster design in the LEACH algorithm [17].

Shokat Ali et al (2022) in a wireless sensor network are interconnected with each other through a wireless medium. According to wireless sensor network terms and conditions wireless sensor networks suffer many types of problems such as energy resources, processing capability, wireless communication range, etc. All wireless sensor networks have some issues such as the life of nodes with respect to energy. Try to search for a way to improve the above wireless sensor network-related problem. In this paper, designers present a distortion-free wireless network on cluster head selection through the firefly algorithm. In grid-based clustering select a cluster head from the cluster. The main aim of the selection of cluster heads from the cluster is to reduce energy consumption with the help of a swarm-inspired optimization algorithm after the selection of cluster head route is designed by taking proficient routing-based PEGASIS routing protocol. To find the distortion in the network designer uses active distortion control artificial neural networks that find the optimal route within the network. The proposed method is best utilized with respect to energy consumption [2].

Deepak Mehta et al (2020) wireless sensor network is a very broad network technology that is responsible for giving accurate and numerous valves. At the time WSN covered a lot of areas such as Surveillance, Monitoring, Machine Learning, Smart Home, AI Infrastructure, the medical field, and more places the area used. Wireless Sensor Network works without human interference. The main problematic characteristic is to have a short lifetime because Restricted Battery power thus is the main challenge of the wireless sensor network. The Important term is how to choose the clustering and the other is how can choose the optimal path for that sensor made to sink. The designer presents a multi-object-based clustering and statics optimizer routing method that reduces the energy of the wireless sensor network.The cluster head selection process uses an effective fitness function that is based on multiple objectives that minimize energy consumption and reduce the dead node from the wireless sensor network. The proposed routing algorithm compares with Grey Wolf optimization, Genetic algorithm, Ant lion optimization, and particle swarm optimization. The proposed model finds out the result with respect to energy consumption, packet delivery ratio, network lifetime, and throughput in NS2. The simulation result of the proposed routing protocol is better than the above routing protocol [10].

A. Overview Of the Proposed Model

In the proposed model we will discuss two routing protocols, PEGASIS, and LEACH for wireless sensor networks. Every wireless sensor network work with two main components one is the sensor node and the other is a base station. The sensor node collects the data from the neighbour node and the base station receives the data. The base station has limited capability and the base station has unlimited capability. According to my proposed model data transmission is completed in three steps discussed in detail.

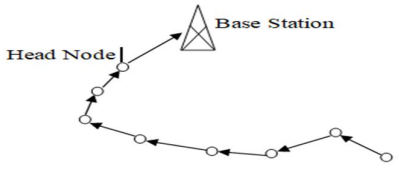

Fig.1 Simple PEGASIS Protocol

1) Chain formation

In the chain formation sensor nodes are randomly spread all over the network that is in the radio range. The start node to the furthest node is connected with the neighbor node and makes a chain that is distinguished from each other; there is no relation between the other chain. Both conditions are followed in PEGASIS and LEACH. PEGASIS is work on the basis of chain and LEACH is work on the basis of clusters.

2) Leader node selection

The leader node selection process starts from the base station, where the base station sends a radio signal into the network. Sensor nodes measure the strength of the radio signal. The leader node is selected on the basis of radio signal strength. If the value is greater than the predefined threshold valve that node becomes the head node. Meaning which node is nearest to a base station that node becomes the head node or cluster head node. If the base station is a corner, then the near corner node may be the head node. If the base station is in the middle, then near the middle node may be the leader node. This means the leader node is the basis on the base station position.

3) Data transmission

Data transmission in PEGASIS and LEACH are different, PEGASIS data transmission starts from the farthest node to the base station in a single chain, where the head node of that chain sends a token to their chain to the farthest node, the farthest node sends the data to their chain and chain head node send the data to the base station. In the LEACH algorithm data transmission starts with a cluster where the network has many clusters and all clusters have a cluster head via cluster head all clusters send the data to the base station.

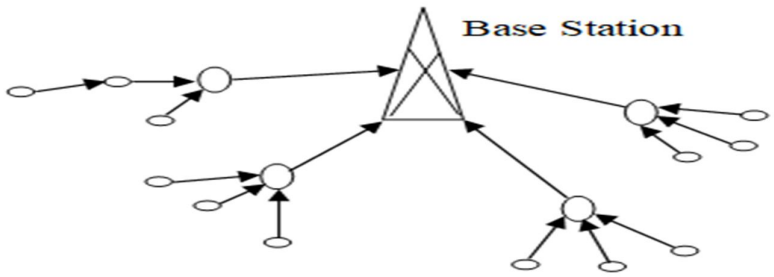

Fig.2 Simple LEACH Protocol

III System Design

In this phase, we are going to discuss both routing protocols PEGASIS and LEACH, and simulated on ns2.For simulation, some pre-parameters are needed. That is given below.

1. In this we take 100 nodes for simulation in a wireless sensor network.
2. Initial energy of the node for work on the network is 0.25jule.
3. The amount of data sent by each node in every round with respect to the size of the packet is 4000 bits.
4. The network area for node placement is 100m*100m.
5. Maximum number of rounds with 100 nodes is 1200 rounds taken.
6. Node mobility and placement are static and random.
7. The base station is established at mainly three positions, inmaybe middle, or maybe outside the network, or may be the corner of the network.

A. Node topology of the proposed model

In this section, we will try to show and implement a new network topology for a wireless sensor network in PEGASIS and LEACH. The efficiency of the network is dependent upon some parameters such as the distance between the sensor node and base station and which type of routing algorithm we apply. So, covering the distance between the sensor node and the base station we are doing some topological changes. The first change is to set the base station in the middle and second change is to set the base station at the corner and the last change is to set the base station outside of the network. All topological models are discussed in detail in figure1.

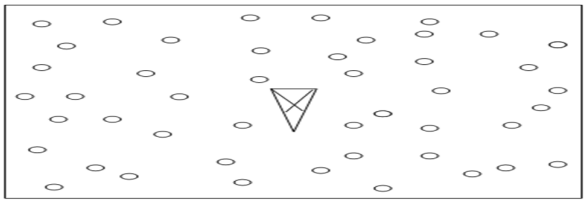

Fig.3 the Base Station Is Located in the Middle

Base station position has considered the energy efficiency of the network. If the base station is in the middle of the network, then at this condition according to PEGASIS routing algorithms, the base station sends a radio signal to the sensor node. At this condition, all sensor nodes are strongly connected with the base station at a minimum distance. If the distance is small then the algorithm takes a little amount of energy for data transmission and all clusters, cluster head near to base station. So, both PEGASIS and LEACH routing protocols give maximum efficiency at this topology.

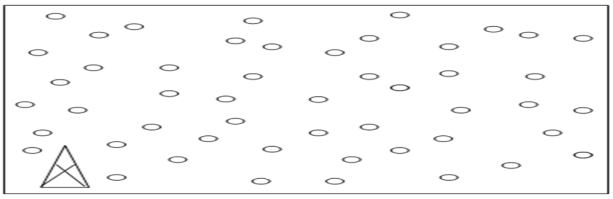

Fig.4 the Base Station Is Located at the Corner

In the second phase, the base station is at the corner of the sensor network. In this, the PEGASIS and LEACH suffer the long link problem because the distance between the sensor node and base station is more in comparison to the first module. The sensor node is also suffering from a weak radio signal problem. If the distance is more between the sensor node to the sensor node and the sensor node to the base station then takes more energy for data transmission

The topological change in the wireless sensor network is the base station is established outside the sensor network. It is a very energy-consuming topology for wireless sensor networks because the sensor node is away from the base station. Base stations send the radio signal to their sensor area if the sensor distance is more than the desired threshold value then a weak signal problem in this condition the sensor node depletes the energy power very fast.

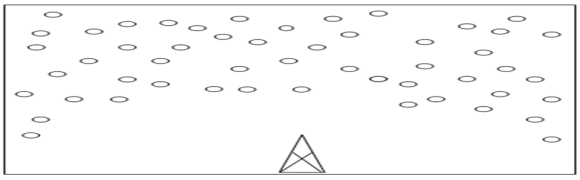

Fig.5 the Base Station Is Located Outside the Network

B. Analysis of simulation

In this phase we are taking the system design rule, and all phases of topology and applying it to MATLAB, to find out that the PEGASIS routing algorithm is better than the LEACH routing protocol. When the base station is middle at this condition the PEGASIS gives the better result and when the base station is at the corner at this topological change the result is slightly less if the base station is outside the sensor network environment, then at this condition, the simulation result is very less than other.

With the help of simulation, we find a simulation graph. In graph (A) the base station is located in the middle and checks how many rounds the PEGASIS and LEACH nodes are alive in the network. We find out that if the base station is located in the middle at this condition the PEGASIS Alive node is more in comparison to

LEACH. If the base station is located at the corner or outside the network at this condition the PEGASIS is also better than LEACH.

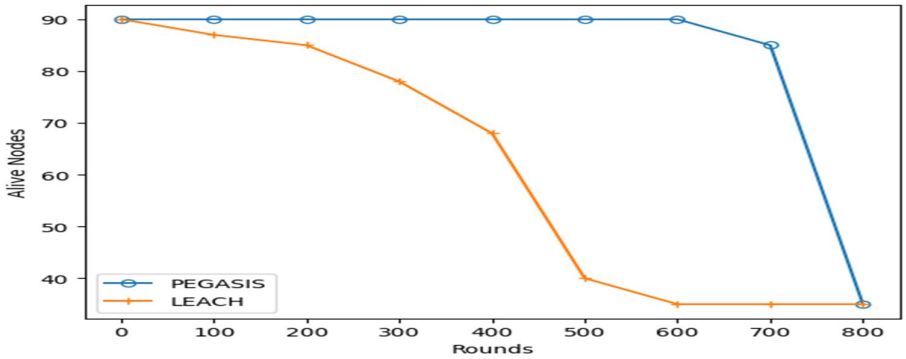

Fig.6 Number of Alive Node Simulations In The Static Network Field And The Base Station Is Located At A Middle

Another simulation is recorded in random node topology and finds out the alive node vs. round and finds out that the PEGASIS algorithm is better than the LEACH. Where the LEACH algorithm starts communication after lose all nodes in round 520. In the comparison between static and random node topology, the static random node topology is better than the random node topology.

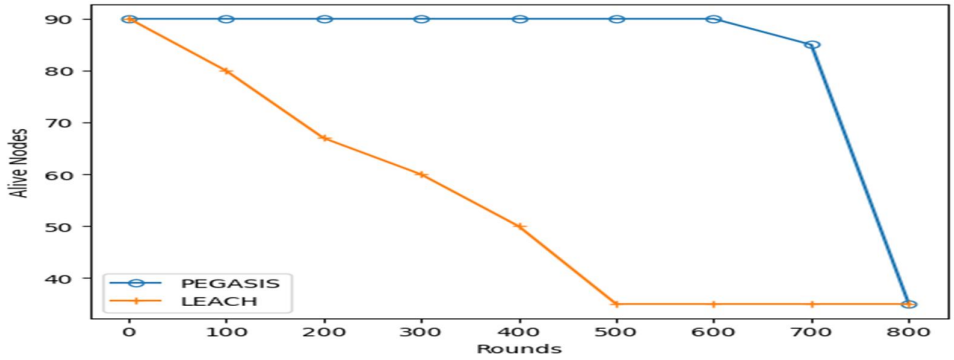

Fig.7 Number of Alive Node Simulations In The Random Network Field And The Base Station Is Located At A Middle

PEGASIS routing is also better than the LEACH routing algorithm. The LEACH algorithm starts to lose all its nodes in round 530.

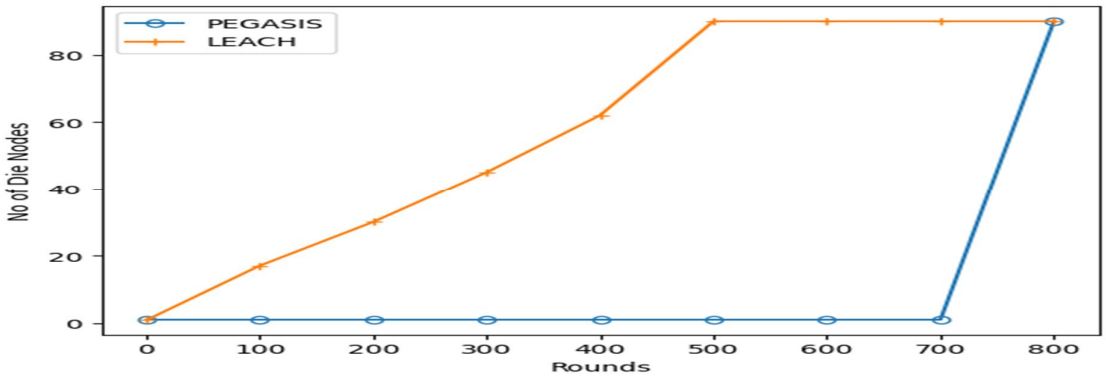

Fig.8 Number of Die Node Simulations In The Static Network Field And The Base Station Is Located At A Middle

We find out the remaining energy of PEGASIS and LEACH routing protocol and the network environment is static for the above routing protocol. With the help of simulation, find out that the PEGASIS algorithm is better than the LEACH algorithm. The LEACH routing algorithm starts to lose the energy of all nodes in round 560.

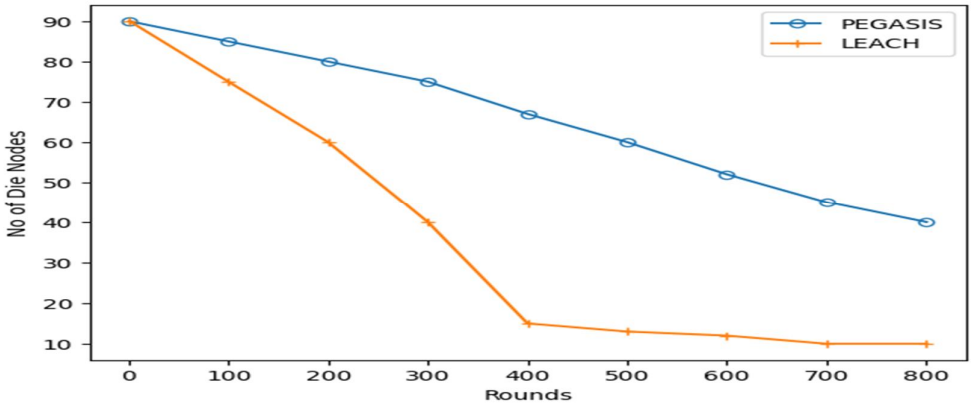

Fig.9 Number of Alive Node Simulations in The Static Network Field And The Base Station Is Located At A Middle

IV RESULT

Wireless sensor networks work with two-component one is a tiny sensor node with limited power resources and the other component is a base station that has a lot of power energy resources. Both communicate by wireless. So, the considerable concept is how to spend minimum energy for communication, behind this the main matter is what is the distance between the sensor node and the base station. If the distance is more than the sensor nose spends more energy in data transmission. By considering this we locate the base station at a different scenario on two basic routing protocols, PEGASIS and LEACH on a MATLAB simulator and find out that PEGASIS is working better in a static environment. The LEACH protocol easily depletes the energy in about 550 rounds.

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