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INCREASE RELIABILITY OF PEGASIS MESH NETWORK USING SUBSTITUTION METHOD

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ABSTRACT

Energy improvement and reliable communication are two of the main considerations for building a new routing protocol. Almost every routing protocol uses energy in its data gathering process, chain head selection process, and sensor node failure. To address this sort of issue, we built the PEGASIS mesh replacement approach. In the IRPSM sensor, nodes are grouped into rows and columns, and connections follow the network architecture in the PEGASIS routing algorithms. All nodes have the same capacity, so you can simply pick the master node that is nearest to the base station. The data collecting method is determined by the network topology. The data travels in two steps: the data of the first step is transferred via its own chain to its own head, and the data of the second step is communicated to the nearby node. The first incoming data is accepted, the other data is rejected. Our suggested routing algorithms employ a fallback mechanism in terms of chain head selection. If the top node fails for whatever reason, then the second node becomes the master node. Leveraging the replacement approach and using the network architecture to route PEGASIS, we discover various benefits, such as failure tolerance and overhead concerns. The instantaneous average throughput of the PEGASIS network architecture is marginally better than the chain routing protocol.

Keywords: *Chain Based routing protocol, wireless sensor network (WSN), substitution method, Wireless mesh network, PEGASIS.*

1. INTRODUCTION

Nowadays, the wireless sensor community is extensively utilized in all areas and has a great position since it is highly quick and produces precise data. A routing protocol plays a very vital function in any form of network. The routing protocol of WSN is different from other networks and the conditions are also different to create the routing protocol of WSN. Also remember that the sensor node will always change the position of the sensor node, and the sensor node has less power. The WSN routing protocol sees all types of terms and conditions, so it is very important to design an efficient routing protocol. The sensor network in such a state consumes more energy than rapid deployment of nodes, sleep mode, and long-distance data transmission. In another way, if the sensor node is in an idle state, it consumes less energy in data transmission. We always strive to improve performance with the view to lowering energy consumption in all critical conditions. So we will propose an efficient routing algorithm. In chain-based routing, at its simplest, a node sends information to its downstream node, which may be very close to it. The entire community is organized into 1 or more chains in a total chain-based topology, and the series is usually very long with a large number of jumps from one to another within the chain. As a result, information transmission wishes a massive delay with a large number of hops [14][19][21].

The PEGASIS routing algorithm and the use of fixed chain topology stop the head node voting process over and over again. In long chains, data transfer may be delayed. PEGASIS creates a chain and starts transmission, but lately some nodes are dead in the chain. Another data transmission ceased. For this reason,the total energy will be decreased, such as in chain construction and certain forms of data transfer, when re transmission circumstances will occur. So keep the network reliable to limit some of the contributions from this document. To ensure dependability, the two nodes h1 and h2 of the decade of our chain and each sensor node transfer data between the two chains. After the data reaches the master node h1 and h2, the master node with high priority will transfer the data to the BS, while the other master node will reject the gathering date [5

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][8]. In a string-based topology, one or more strings are generated to transfer statistics. In the chain, the leader that conducts the assignment of statistical rows is picked as a sink. Statistics are transmitted on-chain and in the long term to the

1.1 Wireless Mesh Network

We understand that in a chain network, when one sensor node is dead, then the sending node consumes extra energy to send the records to the next node, but in a mesh topology, if any sensor node is dead, then we understand that the same records are also propagated to any other major sensor node, so there will be a switch with no major power problems. And every other benefit is that if any master node fails, the same information is received in another head, and the records are forwarded to the base station [11] [3] [6] [11]. In this study, we suppose that if both master nodes die, then the sensor nodes that may be beneath the master node operate as the master node.

1.2 Multi-Hop Wireless Network

In multi-hop wireless networks, there are one or more intermediary nodes along the way that collect and forward packets over wireless hyperlinks. Multi-hop wireless networks offer various perks. Compared to single-wireless networks, multi-hop wireless networks may enhance community coverage and improve connection. Additionally, transmission across numerous "quick" connections may need less transmission energy and power than is required over "long" linkages. In addition, they allow for better recording fees, resulting in faster throughput and additional efficient use of wireless media. Multi-hop wireless networks save substantial wiring and may be established in a cost-effective way. In the event of dense multi-hop networks, different pathways may be available that may be exploited to increase community robustness [3][5].

2. REVIEW OF LITERATURE

Much scientific effort has been done in the topic of wireless sensor networks. However, related research works on PEGASIS and Cluster Based Routing Protocol are included, which conduct efficient work on dead nodes in the chain, eliminate the overhead on the cluster head, and master node. Data aggregation is stopped using the complete transfer procedure. For complete chain-based routing, it has an easier topology compared to standard cluster-based routing since this form of topology isstraightforward to construct and maintain. minimize energy consumption from other nodes in the chain to the base station.

Sadhana S, Sivaraman E, and Daniel D in 2021 proposed the E-PEGAGIS routing protocol. The routing protocol enhances the PEGASIS routing protocol in three phases. The first is to establish a chain in which the nodes are scattered throughout the network, and the network utilize a greedy method to build the chain. The second portion is the random E-PEGASIS nodes that become master nodes that communicate statistics to the base station. The third step is the data transmission phase, which commences after the conclusion of the prior two stages. This phase employs a token passing mechanism and implements TDMA methods in handover chains to the base station.

Haydar Abdulmeer Marhoon and colleagues in 2018 presented overall performance progression of CCM (Chain Cluster Blended) and TSCP (Two-stage Chain Protocol) routing protocols under/without statistics merging in WSNs. It comprises of three essential steps: constructing a chain, picking a chain head, and, above important, choosing a head, choosing a leap, and collecting data. CCM employs the chain head to send messages to each end node in the chain to alert them to start reporting statistics to their peers. The benefits of this strategy are that it enhances the lifespan of the network, decreases the complexity of joining and routing records, reduces the number of duplicated nodes, and so on.

Shalli Rani and colleagues in 2015 suggested a chain - total cluster cooperative protocol that splits an area into sub- areas and goes with cluster heads and cluster coordinators totally dependent on distance and strength. Routing was mostly dependent on a specified path. The key benefit of this strategy is the decrease of the conversational distance owing to the usage of a cluster coordinator for intra cluster communication and relay nodes in the cluster.

In 2014, Juan Feng et al. suggested a robust and power- efficient fact-accumulating WSN. To increase the robustness of the machine and balance the energy intake, this work offers a robust and energy-efficient record accumulation method (REEDG) that is advanced in chain- complete and grid-based community systems in the sensor information gathering system.

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In 2010, Feilong Tang et al. suggested a sequential cluster based on a comprehensive routing method for wireless sensor networks. It takes full use of LEACH and PEGASIS and gives a step advance in overall performance. It separates the WSN into many chains and runs in a layer. Inside the first level, a sensor node in each chain sends data in parallel to their own chain head node utilizing an upgraded chain routing protocol. Inside phase 2, all the chain head nodes arrange themselves In to a cluster in a self- prepared way where they transport the joined records to the voted cluster head utilizing complete cluster-based routing. Haydar Abdulmeer Marhoon and colleagues in 2016 presented a DCBRP consisting of three mechanisms: the Backbone Production Mechanism, Chain Head Selection (CHS), and the following Hop Connection Mechanism. DCBRP may be utilized in any deterministic node deployment plan, including smart cities or smart agriculture, to decrease energy depletion and increase the lifespan of WSNs.

Tang et al. (2010) study to identify the delayed force and calculate the deployment of a node in the chain solely based on and deferred in the network. This study analyses the differences between fusing and non-fusing information in a chained primary-based routing protocol and will employ CCM and TSCP.

3. METHODOLOGY

This study focuses on how to accomplish trustworthy verbal communication in WSN. This is a novel notion in information collection in which statistical series may be done via the closest main nodes. All sensor nodes are placed in series, and each sensor node is in a two- dimensional form in the measurement. All master nodes methodically assign tracks in the collection.

3.1 PEGASIS as a Chain:

In chain topology, one or more chains are formed to

transmit records. In this series, the pacemaker that executesthe data gathering operation is designated as a

Furthermore, all data is received by the main node andforwarded to the BS. If data is received by its own chain,

sink. Information is added along the Chain and ed by a eventually to tl

system. For chain routing, it has a simple topology compared to conventional cluster-based routing since this form of topology is simpler to construct and maintain. In chain routing, the most efficient node transfers records to its next node, which may be quite near to it. The complete community is structured into 1 or more chains in a chain- based topology, and often, the sequence might be quite extensive with a high number of hops from one end to an alternate in the chain. For this reason, the information transmission requires a big latency with a long hop range.

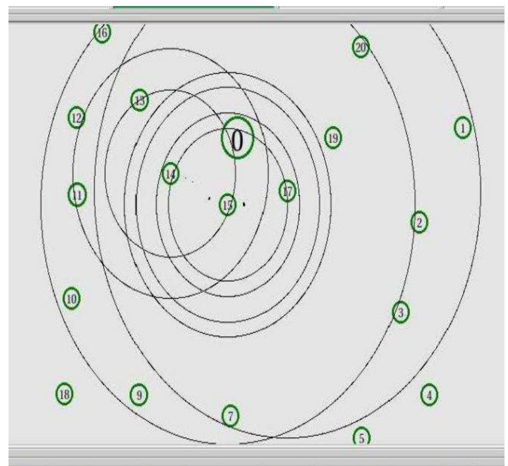

Figure1: Simulation of as a Chain

The main principle of utilizing PEGASIS is that it employs all nodes to broadcast or contact their closest neighbour nodes. All nodes that gather the fuse information received via a neighbouring node relay it to the adjacent neighbour. Each node in the community
with its own chain and great dependability under allscenarios.

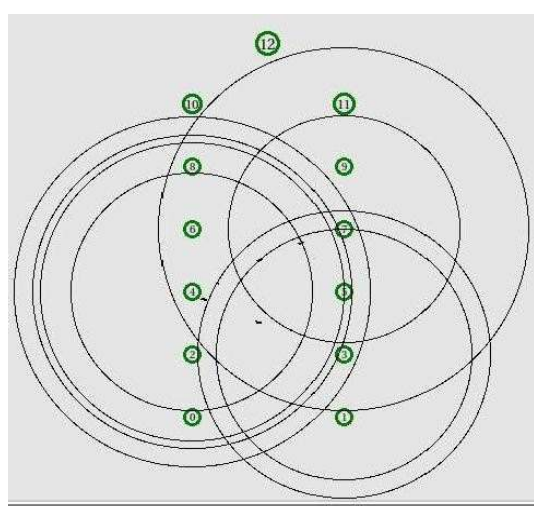

Figure2: Simulation of PEGASIs

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At the time of collecting data from any chain, some event arises, such the sensor node is dead or there is no response from any node in the chain, and then we apply certain approaches to the chain for reliable Communication. We suggest the method in three
key phases, which are stated below:

1. Chain formation.
2. Choose the sequential chain head node.
3. Data Transmission in a Chain.

3.3 Chain Formation:

takes turns as the chain pioneer and is exclusively
responsible for communicating all the combined data acquired by the node chain to the downstream station. In this method, the overall amount of energy consumed by each node is lowered. Grasping algorithms are employed to guarantee that every single node is utilized while forming the chain. A grasping method is employed to build a queue between all nice nodes that are within one
with its closest neighbour nodes. To develop the PEGASIS surrogate protocol, all sensor nodes follow a mesh network design. All end nodes provide data to their own allocated head node in c ain form, as s (1, 1) s (1, 2) s (1, 3).. (1, N)
(1, N). s(2,1) s(2,2).. (N), we want
nodes to be accountable for transmitting records to their allocated chain head, and nodes with first priority deliver
hop of each other and of the downstream station. If the

furthest node is picked, it begins broadcasting statistics, sends a signal to the nodes within the community to locate the closest neighbour, and provides the recorded statistics [6][21][22].

3.2 PEGASIS Mesh Network as a substitute

The proposed network enhances the PEGASIS routing

energy usage of the PEGASIS routing protocol in mesh networks [18],

3.4 Chain Head Options:

There are straightforward ways for picking a sequence head in WSNs. The first is that the node is nearest to the BS, which is an excellent method to be the master node.
protocol. The PEGASIS mesh network is more fast and

base station. All

sensor nodes are placed in columns and follow the network structure. In each string, the head node is assigned vertically h1, h2, h3...hn for each string. All master nodes produce and transmit two tokens to their own heads, such as h1(s(i..., n) and h2s(i..., n) (s(i++.j)). In response, the last nodes transfer data in the network environment into their own master node with regard to the time when node discovers the combined data first. Then this master node will transfer the data to the BS. If master nodes are dead for any cause, then the next node will assume all the responsibilities of the top node and the selection of the second chain head. The method is stated in step 5 of the algorithms below.

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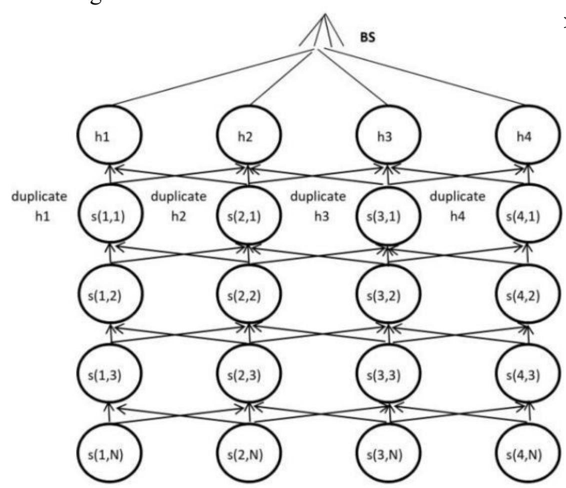

Figure 3: PEGASIS as Mesh Network

information to the base station. hus, to decrease the

3.5 Data Transmission in a Chain:

Data transfer is based on a token mechanism at the beginning of each round. Each master node generates tokens and transfers them to its own chain node and neighboring chain nodes. Using this, both token mechanisms return to the last node of the chain, sending data to itself and the neighbor node to the master node. Then the data reaches the BS through the master node. A network topology is used for the data collection process. The master nodes h1 and h2 are arranged to be of chain node type s(1,1) s(1,2)...s(1,N) and s(2,1) s (2,2) (2,2)
Sensor Node s(1,N) s(2,N) s(n to N++) and s(2,N) (2,N). Sensor nodes deliver data to s (1, N+1), s (2, N+1), and s(3, N++) to master node h, h2, and hn. In the master node, data access is prioritized based on time respect. If h1(x1=y1) >
= h2(x2=y2) (with regard to time), then h1 will transmit the fused data to the BS on the first arrival,comparing with h2 and h2(x2=y2) (rejecting duplicate data from h2's head since it will later get up to h1). h2(x1=y1)) > h1(x1=y1)) (in terms of

The system is explained below in the algorithms in moredependable. Th

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time) (in terms of time). Then h2 sends the fused data to the BS and h1(x1=y1) rejects the duplicate data. Our suggested techniques offer another spare device for the network if the master node fails for whatever reason. Then, from s(i j) through s(i+1.., J), the next lower node becomes a duplicate master node.

Algorithm:

1- The sensor node s(i,j) is assigned as the chain head inside the Jth round. (The node in h1 to Hn top most

node. means head node h1 might be selected from the nodein their chain)

2- h1(s(i,j)) and h2(s(i,j)) generate two tokens and send them to h1(s(i..,n)) and h2(s(i++..,j)) respectively. Permit x=1 and y=n;
If (x no node in h(1) head. Else
No any fused information

3- If(x>y) means data transmission on head nodes. Node s(1,n) data transmit fused data to (i1, y-1),(i2, y-1) and (i^n …,y-1) and so on until (x1=y1) and (y=j) h1(x1=y1)
> = h2(x2=y2) (respect to time) Then h1 transmit fused data to BS of first come comparison to h2. And h2(x2=y2) (reject duplicate data from the head h2 because later reach to h1)

4- Else
h2(x1=y1)) >= (h1(x1=y1)) (respect to time)
Then h2 transmits fused data to BS And h1(x1=y1) rejects duplicate data.

5- If
Head nodes (h1…..hn) are dead for any reason.
Else
s(I j) to s (i+1..,J) become duplicate head nodes .

3.6 Implementation Strategy:

Step 1: Generate a tcl script for both network architecturesusing NSG2.1.
Step 2: Run the tcl file with NS2 and generate a tracefile(name.tr) and a name file (name.nam).
Step 3: Create a performance metrics awk file(name.awk)and save the result.
Step 4: Plot the result using Gnu plot.
Step 5: Analyze the graph and conclude the result.

3.7 Performance metrics:

Use the substitution method to compare the overall performance of the PEGAGIS mesh. We use NS2. The main purpose of this section is to test CBRP's ability to reduce the general end-to-end delay resulting from a single long chain and electricity consumption. After CBRP has completed the design, implementation, and validation steps, it is now important to evaluate the overall performance of the chain-based routing protocol.

Table1. Simulation Parameters

Environment Size	600x600
Channel type	wireless
Packet size	500 bytes
Traffic Type	TCP
Protocol	PEGASIS
Simulation Time	60 sec
Total nodes	21

3.8 End-To-End Delay

End-to-end put off is stated as the time required for a packet to be sent over a network from supply to destination. Delay is regarded the key disadvantage element in a chain routing protocol, thus it is vital to enhance the

delay criterion in any design, and the primary time evaluation metre in the literature may be separated into sub-metrics. Common waits every hundred laps. This kind may be computed by dividing the sum of the end-to- end delays for all packets by the entire range of packets in that round, as shown below.

4. PERFORMANCE ANALYSIS

We did a simulation for this suggested protocol in a self- organized community of 21 nodes in an area of 50 m x
50 m; BS is positioned at (50,300). (50,300). The dimensions of each packet were set at 2 kilo bits. The time it takes to transmit a packet type is considered one delay unit.

4.1 Instantaneous and average throughput

Network throughput is the pace (in bits per second or packets per 2nd) at which packets or bits are effectively transmitted through a network link. The average throughput is computed as the overall number of successful packets received by all nodes divided by a specified period, and when it is measured at a single moment, it is termed the instantaneous throughput.

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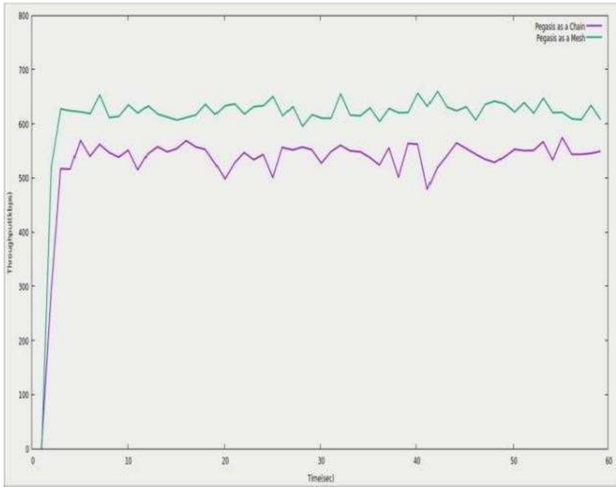

Figure 4: Instant Throughput Comparison between Chain and Mesh Topology.

Table.2 Throughput Comparison.

Topology	Successful Packet Received	TP Value
Chain	13726	1.861180
Mesh	13007	1.763727

From the graph and simulation, it is evident that the Instantaneous and average throughput of the chain topology is somewhat better than the mess topology. If the data is obtained from its own chain, then the PEGASIS network protocol is better than chain routing, and if data is collected from nearby chain, then the chain routing protocol is better than the PEGASIS network

4.2 Packet delivery ratio

The PDR is the ratio of successfully received packets to the total number of packets delivered, and the stop giving up delay is characterized as the time it takes to transfer a packet through the network from the point of delivery to the destination. PDR is the ratio of effectively received packets to the total number of transmitted packets.

Table 3.Packet Delivery Ratio

Topology	Chain	Mesh
Send Packet	14022	13592
Received Packet	13726	13007
Packet Drop	304	583
PDR	0.978890	0.956960
Delay(sec)	0.789759	1.644544

The following simulation demonstrates that the PDR of the chain topology is better than the mesh topology, but there is also less latency in the chain network than the mesh topology. Mesh topology is more dependable than chain topology.

4.3 Residual energy

A node loses a certain amount of energy for each packet transmission, and each packet received decreases the pre- strength value at the node as a result. The current cost of energy at a node after receiving or sending a routing packet is known as residual energy.
This measure was revised to suggest by Lindsey et al in 2001 and has been extensively used by the research community for chain-based routing in WSNs to connect the impact of energy consumption to delay. This fascinating metric may be determined using the equation below.

Energy * delay = E Total E. Cons. in round r * D Delay to deliver all data

Table.4. Residual Energy

Initial Energy	100 joules
Transmission power	1.0 watt
Receiving power	1.0 watt
Idle Power	0.2 watt
Sleep Power	0.2 watt

4.3 Energy Consumption

Energy consumption for all sensor nodes each round is regarded a significant parameter in estimating the total energy dissipated for all sensor nodes per round for the lifespan of the network, as illustrated in the equation below. Average energy consumption of nodes in rounds: this is the study of how lowering

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energy consumption may enhance the lifespan of the network, and this metric can be determined using the equation below.

E AvEneConsu = ∑last round E Consu. all nodes / NTotal no. round

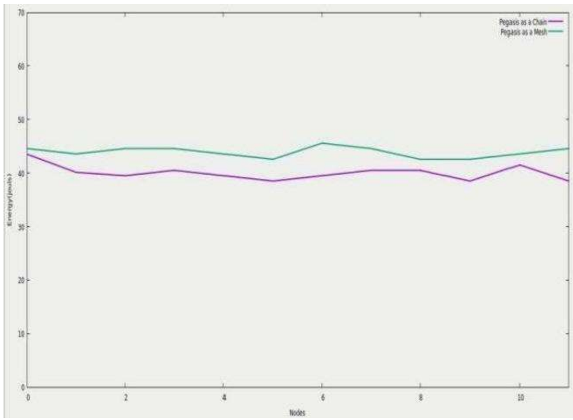

Figure5. Comparison of Chain Topology and Mesh TopologyThe following simulation result reveals that the residual energy of each node is better in the mesh topology, goes in two directions: one is direct, which needs very little energy, and the other is indirect, which takes more energy.

Table5.Power Consumption Comparison

Topology	Average Energy Consumed(joules)
Chain	42.5106
Mesh	45.9006

The following simulation result of mesh topology isbetter then chain topology shown in table.

5. CONCLUSION

Since certain routing strategies drain nodes' energy during data transmission and head selection, researchers' primary objective while building a routing protocol for wireless sensor networks is to disperse energy. The PEGASIS network routing protocol, which is in charge of facilitating quick and simple communication, is used in this article. For load balancing and dependable data transfer for the network, another replacement approach is utilized in our IRPSM network protocol because the PEGASIS network gathered the data from a Chain if Sensor node fails since we know that the identical data is propagating to another second alternate master sensor node in mesh topology, neighboring chain together allow the substitute mechanism in WSN for load balancing and dependable communication. There won't be any extra energy, usage Data is gathered from short strings, therefore data aggregation is faster.

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