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Enhance Energy Utilization in WSN by using Chain Based Protocol

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Abstract— Implementation and analysis of Existing chain based protocol in Matlab Environment. An improvement to the chain based protocol decision making parameter to select the next node in chain. Nodes in Wireless Sensor Network (WSN) are energy-constrained and have limited bandwidth. PEGASIS (Power-Efficient Gathering in Sensor Information Systems) presented is an excellent solution on energy efficiency where each node communicates only with a close neighbor and takes turns transmitting to the BS(Base Station). In this dissertation "An (IEECB) Improved Chain Based Protocol to Enhance Energy Utilization in WSN" that is an improvement over existing PEGASIS. IEECB uses distances between nodes and the BS and remaining energy levels of nodes to decide which node will be the leader that takes charge of transmitting data to the BS. Also, IEECB adopts distance threshold to avoid formation of LL (Long Link) on the chain. Simulated results show that IEECB outperforms existing PEGASIS in the lifetime of WSN. The proposed PEGASIS is used for eliminating the overhead of dynamic cluster formation, minimizing the distance non leader-nodes must transmit, limiting the number of transmissions and receives among all nodes, and using only one transmission to the BS per round.

Keywords- *PEGASIS, WSN, DSN*

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I. INTRODUCTION

Sensor nodes are used for event detection, continuous sensing and local control of actuators. There are many applications due to the wireless connection and micro-sensing features of WSNs [1]. For example in military applications, WSNs enable commanders to constantly monitor the status of their troops. Moreover, information about the condition and availability of the equipment in the battlefield could be obtained by using WSNs. Health applications are other examples of applications of WSNs that highlight the importance of research in this area. Accidental falls are especially hazardous to the health of elderly people. Such accidents could be monitored by the installed sensor networks. The installed sensor network could also be used for detecting heart attack as well as monitoring blood pressure. However, for developing useful and efficient, applications, the challenges and obstacles apparent in the design of such networks should be properly addressed and solved. One such challenge is particularly important and relates to the development of energy efficient WSNs. Sensor nodes in WSNs' applications are battery constrained thus innovative techniques are needed to eliminate energy inefficiency that shorten the network lifetime. From the military perspective, critical data may be required at certain point in the future from nodes where energy levels are low. Therefore the identification of certain nodes which their energy level is less than a threshold is needed. Without a means to visualize the energy levels of each node, it is difficult to assess the energy distribution in the WSN and node failures may be lead to catastrophic results. A tool to visualize the residual energy of each node provides a method to avoid such events. In the medical field, a tool to visualize the residual energy of WSN nodes may also prove useful [1]. As explained in the healthcare example previously, the monitoring of patients requires constant collection of crucial data to detect, for example, falls, imminent heart attacks or dangerous blood pressure levels. Monitoring the residual energy level of each WSN node with a chain based protocol to increase the life time of node [2].Wireless Sensor network is an ad-hoc network of tiny sensors. Each sensor is defined with some energy. As the data is transferred over the network each sensor spends some energy in receiving data, sending data and forwarding data. Because of this network life depends on how much energy spends in each transmission. Due to the energy constraints, wireless sensors usually have a limited transmission range, making multi hop data routing towards the PN (processing node) more energy efficient than direct transmission (one hop) [3],[4].

II. RESEARCH METHODOLOGY

LEACH balances the energy cost by clustering; sensor still needs relative large energy to transmit data to its cluster head. The main idea of PEGASIS is that nodes are formed into a chain where each node receive from and transmit to closest neighbor only [6]. The distance between sender and receiver is reduced as well as decreasing the amount of transmission energy. To construct a chain, PEGASIS uses a greedy algorithm that starts from the farthest node from the base station.

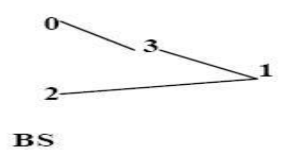

Figure 1. Chain is constructed using the greedy algorithm

In Figure.1 the algorithm starts with node 0 that connects to node 3. Then, node3 connects to node 1 and node 1 connects to node 2, which is the closest one to the base station. Because nodes already in the chain cannot be revisited, the neighbor distance will increase gradually. When a node dies

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due to its battery, the chain will be reconstructed by repeating the same procedure and bypass the dead node [5]. In one round of transmission, a randomized node is appointed to be the leader to transmit data to BS. If the BS locates outside the range of this node, multi-hop transmission will be employed.

III. RESULTS

In simulation, the performance of improved protocol is evaluated in terms of network lifetime, number of dead nodes, and number of alive nodes. The simulation result of modified PEGASIS is compared with existing protocol [10]. The result refers to the measurement of network life time. Following figures shows the output of existing protocol, modified PEGASIS protocol and comparison between existing work and modified result [8]. The work is implemented on a random network. The graphical view of the node setup is shown as

A: A network is designed with ten nodes having following assumptions used for simulation:

Table I. Parameter assumptions for PEGASIS protocol

Parameter	Value
Number of Nodes	10
Probability of Selection	.1
Energy	0.5
Transmission Energy	50*0.000000001
Receiving Energy	50*0.000000001
Forwarding Energy	10*0.000000001
Topology	Random

Scenario 1: PEGASIS Protocol

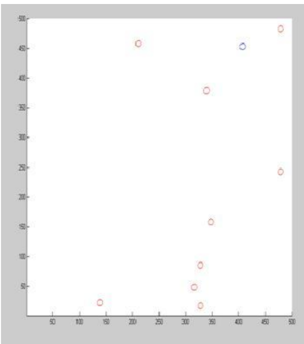

Figure 2. Network designed with 10 nodes

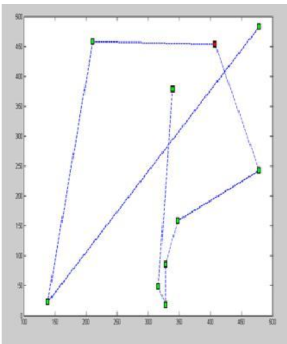

Figure 3. Identified Aggregative Path

As shown in figure 2, a network is setup with 10 nodes where the blue node represents the receiver node and red nodes are the intermediate nodes over the network. The network area is 500 X 500 and nodes are placed randomly. The figure 3 is showing the aggregative path identified by the PEGASIS protocol based on distance and energy comparison [9]. The communication is performed between the sender node 1 and receiver node 10. The identified path is

7 => 2 => 6 => 8 =>10 => 4 =>1 => 5 => 9 => 3

Node 7 is the initial node and node 3 is the terminal node.

The total distance covered by the path is 7.5416e+00

The total Energy Consumed by the path is 290.8232

Scenario 2: Modified PEGASIS Protocol

The network designed with 10 nodes is shown as in figure 4.

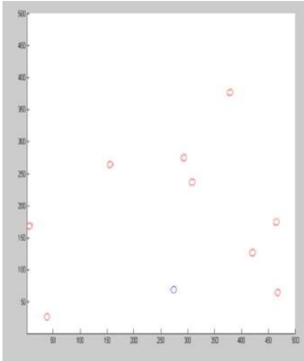

Figure 4.Network designed with 10 nodes

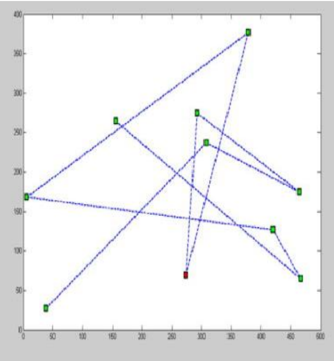

Figure 5.Identified Aggregative Path

As shown in figure 4, a network is setup with 10 nodes where the blue node represents the receiver node and red nodes are the intermediate nodes over the network. The network area is 500* 500 and nodes are placed randomly. The figure 5 is showing the aggregative path identified by the PEGASIS protocol based on distance and energy comparison. The communication is performed between the sender node 1 and receiver node 10.

The identified path is

10 => 8 => 2 => 9 => 6 =>1=> 5 => 3 => 4 => 7

Here Node 10 is the initial node and node 7 is the terminal node.

The total distance covered by the path is 8.3147e+005

The total Energy Consumed by the path is 260.9631

B. A network is designed with hundred nodes having following assumptions used for simulation:

Table II. Parameter assumptions for PEGASIS protocol

Parameter	Value
Number of Nodes	100
Probability of Selection	.1
Energy	0.5
Transmission Energy	50*0.000000001
Receiving Energy	50*0.000000001
Forwarding Energy	10*0.000000001
Topology	Random

Scenario II: PEGASIS Protocol

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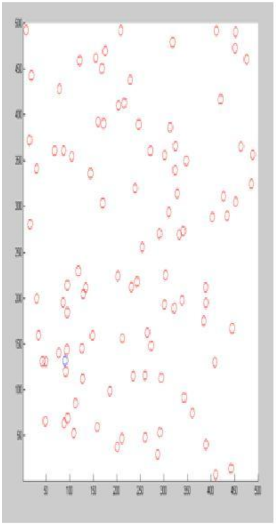


Figure 6: Network designed with 100 nodes

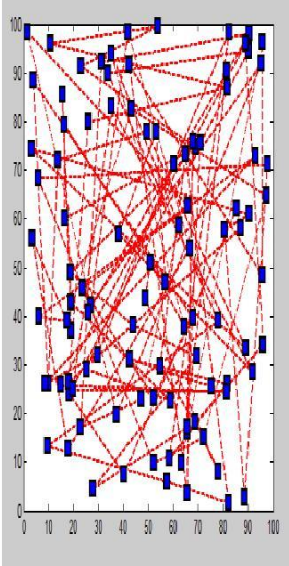


Figure 7: Identified Aggregative Path

As shown in figure 6, a network is setup with 100 nodes where the blue node represents the receiver node and red nodes are the intermediate nodes over the network. The network area is 500 *500 and nodes are placed randomly. The figure 7 is showing the aggregative path identified by the PEGASIS protocol based on distance and energy comparison. The communication is performed between the sender node 1 and receiver node 10.

The identified path is

47	39	99	96	7	55	36	22	45	35	69	56
44	75	97	86	31	48	80	98	71	76	83	33
63	95	94	42	17	19	89	57	74	29	88	78
50	3	40	14	21	11	73	100	59	4	43	16
20	34	18	41	91	46	67	60	38	62	93	13
28	65	15	27	9	26	30	85	2	66	81	49
87	70	51	1	82	79	54	5	32	25	12	10
24	84	58	37	64	23	8	90	72	6	92	53
52	61	68	77								

Here Node 47 is the initial node and node 77 is the terminal node.

The total distance covered by the path is 6.3391e+006
The total Energy Consumed by the path is 523.8336

Scenario III: Modified PEGASIS Protocol

As shown in figure 8, a network is setup with 100 nodes where the blue node represents the receiver node and red nodes are the intermediate nodes over the network. The network area is 500* 500 and nodes are placed randomly. The figure 9 is showing the aggregative path identified by the PEGASIS protocol based on distance and energy comparison. The communication is performed between the sender node 1 and receiver node 10.

The identified path is

70	11	65	58	37	77	54	8	12	39	68
16	80	20	23	98	18	74	48	19	14	46
34	56	31	100	45	22	6	97	53	72	42
29	76	7	64	94	89	61	24	41	50	83
67	63	51	3	25	73	27	99	28	55	75
21	32	10	4	33	47	81	60	13	38	93
35	5	26	91	62	88	84	95	92	69	79
9	90	59	49	44	86	30	66	87	96	36
43	52	82	85	15	1	71	57	17	40	78
2										

Here Node 70 is the initial node and node 2 is the terminal node.

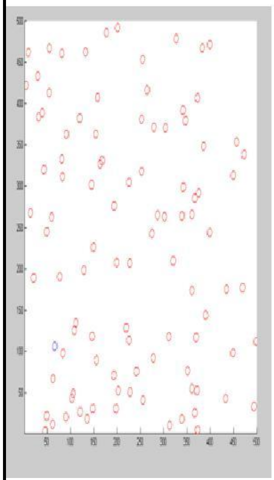


Figure 8. Network designed with 100 nodes

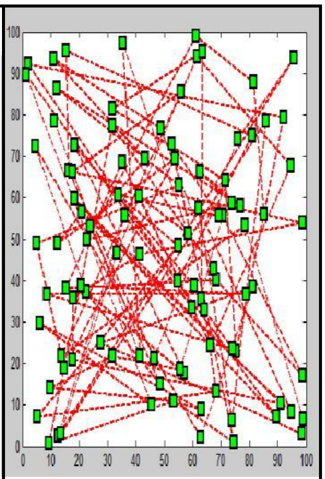


Figure9. Identified Aggregative Path

The total distance covered by the path is 8.7890e+006
The total Energy Consumed by the path is 508.8014

Figure 10 shows that there are about 98 nodes get dead after 3000 rounds and Figure 11 shows that there are about 92 nodes get dead after 3000 rounds. Figure 12 shows that there are about 02 nodes left alive dead after 3000 rounds and Figure 13 shows that there are about 08 nodes left alive after 3000 rounds

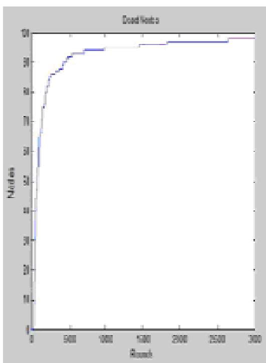


Figure 10.Dead Nodes PEGASIS

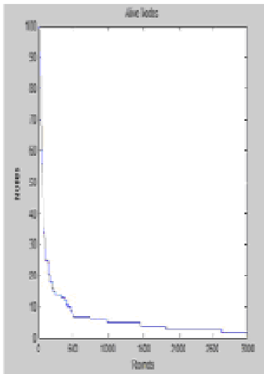
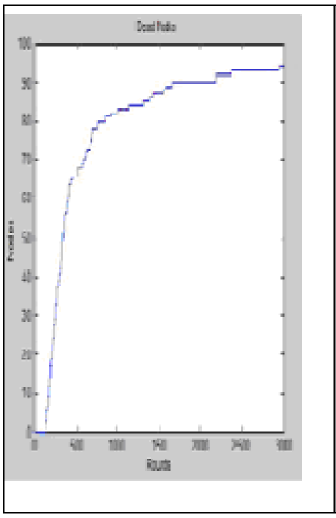


Figure 11.Alive Nodes PEGASIS



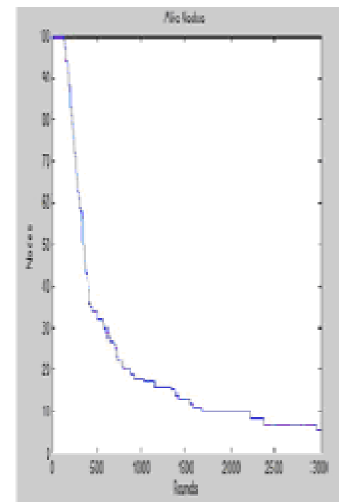
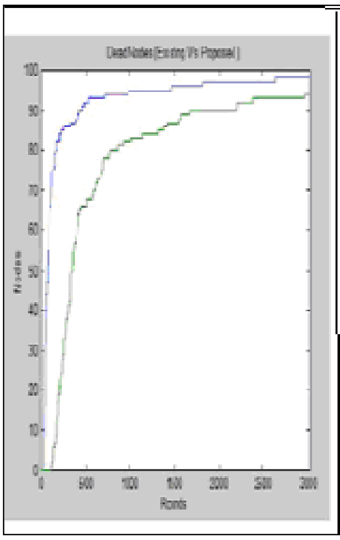


Figure 12.Dead Nodes Modified PEGASIS

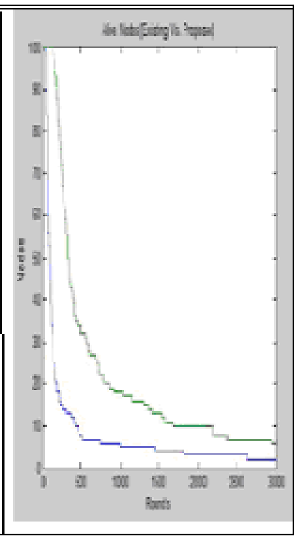
Figure 13.Alive Nodes Modified PEGASIS

Figure 14.



Comparative Analysis (Existing Vs. Proposed) Dead nodes

Figure 15.



Comparative Analysis (Existing Vs. Proposed) Alive nodes

Figure 14 and Figure 15 shows the comparative analysis between the existing PEGASIS protocol and Modified PEGASIS protocol. Figure 14 shows that in existing PEGASIS protocol about 98 nodes get dead after 3000 rounds but in case of Modified PEGASIS protocol around 92 nodes get dead. So this shows that Modified PEGASIS protocol works better than existing protocol.
Figure 15 shows that in existing PEGASIS protocol about 02 nodes left alive after 3000 rounds but in case of Modified PEGASIS protocol around 08 nodes left alive. So this shows that Modified PEGASIS protocol gives better results than existing protocol.

IV. CONCLUSION

Nodes in Wireless Sensor Network (WSN) are energy-constrained and have limited bandwidth. PEGASIS (Power-Efficient Gathering in Sensor Information Systems) presented is an excellent solution on energy efficiency where each node communicates only with a close neighbor and takes turns transmitting to the BS (Base Station). In this dissertation "An (IEECB) Improved Chain Based Protocol to Enhance Energy Utilization in WSN" that is an improvement over existing PEGASIS. IEECB uses distances between nodes and the BS and remaining energy levels of nodes to decide which node will be the leader that takes charge of transmitting data to the BS. Also, IEECB adopts distance threshold to avoid formation of LL (Long Link) on the chain. Simulated results show that IEECB outperforms existing PEGASIS in the lifetime of WSN. The proposed PEGASIS is used for eliminating the overhead of dynamic cluster formation, minimizing the distance non leader-nodes must transmit, limiting the number of transmissions and receives among all nodes, and using only one transmission to the BS per round. The proposed work is implemented on Wireless Sensor network to improve the network life in case of chain based protocol. The main problem with cluster network is to find the next neighbor for communication. Here the improvement is done for existing PEGASIS protocol. In this work we have include one parameter to select the next neighbor. The work is about to identify an energy efficient aggregative path to communicate over the network.

V. FUTURE SCOPES

In this work the improvement over the PEGASIS is proposed that will save the energy while performing a chain based communication over the network. This work is performed on homogenous network. The work can be extended to work on heterogamous network. The heterogeneity will be in terms of type of sensor nodes, environment and the node parameters.

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VI. BIOGRAPHIES

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