© 2017 IJSRSET | Volume 3 | Issue 5 | Print ISSN: 2395-1990 | Online ISSN : 2394-4099
Themed Section: Engineering and Technology

The Neural Network based Technique for Fault Tolerance in Wireless Sensor Networks

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ABSTRACT

Wireless sensor network is the self-configuring network where any sensor node can join or leave the network when they want. In Wireless sensor network no central controller is present. Wireless sensor nodes are responsible for data routing in the network. Wireless Sensor nodes are very small in size and have limited resources. In such far places it is very difficult to recharge or replace the battery of the sensor nodes. In such conditions, we focus to reduce the battery consumption of the sensor nodes. In this work, a new technique is proposed to reduce battery consumption. It will be based on the dynamic clustering using neural network. Before data transmission sensor nodes form the cluster dynamically using Boltzmann learning of the neural network and weights are adjust according to the situation and it also enhance the efficiency of the dynamic clustering. Experimental results show that new proposed technique is more efficient, reliable and provide more throughput as compare to the existing technique.

Keywords: WSN, Neural Networks, Boltzmann learning

I. INTRODUCTION

Within a wireless sensor network, there are numerous nodes spread across an area for monitoring the surroundings present. There is a sensor hub present within the network that comprises of sensors, actuators, memory, and a processor and facilitates communication amongst the nodes. The wireless mode of communication is utilized for transmitting the data across the sensor nodes with the help of radio frequencies, infrared etc. and does not include any wired connections within it [1]. A random fashion is set across the nodes and the messages are transferred which thus provides an ad-hoc network environment within the networks [2]. The battery present within the nodes of WSN is of smaller size. Also the nodes are located at really far distances where human is not able to reach. So the major concern within the WSNs is the usage of battery within them. This also affects the overall lifetime of the nodes and thus the deployment of the network. The sizes of various constraints such as battery size, processors, information storing memory and so on are important within these networks. The consumption of energy is required to be advanced within the networks with the help of various optimization algorithms. Various time constraints are present within the detected and routing information sent across the WSNs [3]. Generally sensor nodes rely on a battery with restricted lifetime, and their replacement is impractical because of physical constraints. Moreover the architecture and protocol of sensor networks must have the capacity to scale up any number of sensor nodes. Since the battery lifetime can be extended on the off chance that one figure out how to reduce the measure of communication [4]. In the sensing subsystem energy consumption can be reduced by utilizing low power components.

The clustering includes grouping nodes into clusters and choosing cluster heads periodically such that individuals from a cluster can speak with their cluster heads and these cluster heads send aggregated data received from its individuals to a base station. In every cluster has a cluster head and rest nodes are individual from that cluster. Clustering results in a two-level order in which cluster heads shape the higher level while part nodes frame the lower level [5]. Since the cluster head regularly transmit data over longer separations, they lose more energy compared to part nodes. The clustering procedure is utilized to minimize the energy consumption. By utilizing clustering, it reduces the packet collision and channel contention it increases the network throughput under high load. Clustering enhance

the network lifetime of the sensor networks [6]. Clustering algorithms for wireless sensor networks can be further separated into two principle classifications depending on cluster formation criteria and parameters utilized for cluster head election. The first is the Probabilistic (random or hybrid) clustering algorithms which includes Low Energy Adaptive Clustering Hierarchy (LEACH), Energy-Efficient Hierarchical Clustering (EEHC), Hybrid Energy-Efficient Distributed Clustering (HEED), etc. The second is the Non probabilistic clustering algorithms which involves Node Proximity and Graph-Based Clustering Protocols, Weight-Based Clustering Protocols, Biologically Inspired Clustering Approaches.

II. LITERATURE REVIEW

Bilal Abhu et.al proposed [7] in this paper the LEACH-SM protocol. An ideal energy-saving is provided by this protocol for controlling the spare selections within the networks. The spare selection stage is added to the LEACH with the help of drain SM. There are comparisons made related to the energy consumption and WSN lifetime of both the protocols. The experimental results show that the proposed method has provided enhancements within the previous proposed works.

Maciej Nikodem et al. [8] concentrates on the theoretical parts of clustering in wireless sensor networks as intend to enhance network lifetime. We investigate whether clustering itself (without any data aggregation) can enhance network lifetime specifically application when compared to non-clustered networks. We utilize integer linear programming to break down 1D and 2D networks, taking into record abilities of real-life nodes. Our results demonstrate that clustering itself can't enhance network lifetime so additional strategies and means are required to be utilized as a part of collaboration with clustering.

LI Jian-qi et al. [9] proposed enhanced clustering routing calculation which need to energy efficiency. To begin with, generate cluster head by random competition in the nodes which have advantage in energy; next determine the internal structure of clusters by calculating dynamically snugness coefficient of every cluster, after that, upgrade transmission path between cluster heads through enhanced multi-objective particle swarm calculation.

Yu Wang et al. [10] proposed energy productive and delay tolerant cooperative transmission calculation which demonstrate simulations approve that EDTCT outperforms the store-hold up forward way regardless of in E2E sleep dormancy and E2E energy consumption. Specifically, our plan is adaptive to thick network and it works effectively in low-obligation cycled WSNs.

Degan Zhang et al. [11] proposed a technique forward aware component (FAF-EBRM).this strategy is utilized for the following hop node chose according to the forward energy thickness and link weight .The FAF-EBRM compared with LEACH and EEUC. The proposed technique adjusts the energy reduction, function lifetime and give great nature of service and reduces the likelihood of progressive node breakdown.

Nicolas Gouvy et al. [12] proposed PAMAL (Path Merging Algorithm) new topographies routing calculation for mobile node .the proposed first routing protocol which is found and uses paths crossing to adapt the topology to reduce the network traffic thusly while still upgrade energy efficiency. The protocol makes the intersection to move far from the destination, getting nearer to the sources, allowing higher data aggregation and energy saving. It enhances the network life time 37% than exiting.

III. RESEARCH METHODOLOGY

Re-clustering the grids with the help of neural networks is the main concern of our proposed work. In the existing technique the clustering of grids is static but in our proposed work, the clustering of grids is dynamic. The situations arising can change and adjust them accordingly. According to the situation and the calculations made on the basis of battery consumption the node data sent is easily adjustable. The major concern here is to avoid the battery wastage. The cluster head selection is also done on the basis of minimum battery consumption through election algorithm.

Algorithm:

START ()

1. Deploy sensor network with fixed number of sensor nodes
2. Apply location based clustering to cluster sensor nodes
3. Select cluster head in each cluster using LEACH protocol
4. If (link failure occurred in the network)
   {
   1. Weight=0,bais=0, input=0

2. R=max(x)
3. While the whole data get classified into two classes in the for loop do
4. For i=1 to CS(n) do
5. If $Y_i(<W_i,X_i> +bias)< 0$ then
6. $W_{k+1}=W_k+Y_iX_i$
7. K=k+1;
8. End if
9. End while
10. Return Classified data K, The k is the number of classes and x is the data in the classes
11. Recover path through sensor nodes which has higher rating

}

Else

{

1. Start communication from source to destination

}

STOP

IV. RESULTS AND DISCUSSION

The proposed and existing algorithms are implemented in NS2 and the performances of both algorithms are tested in terms of energy, throughput and packet loss.

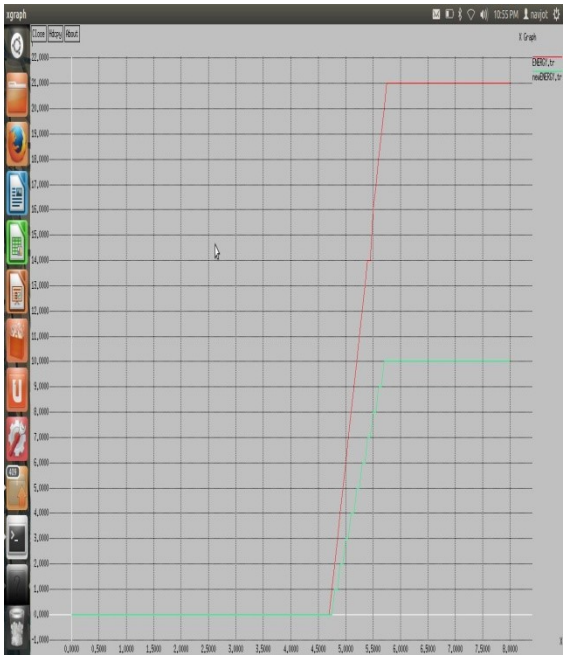

Figure 1: Energy Graph

As shown in figure 2, the energy consumption of the previous and new proposed work is compared. Due to the more fault in the network, the graph clearly shows that the energy consumption is more in the previous network. When fault is removed from the network, energy consumption is reduced from the network.

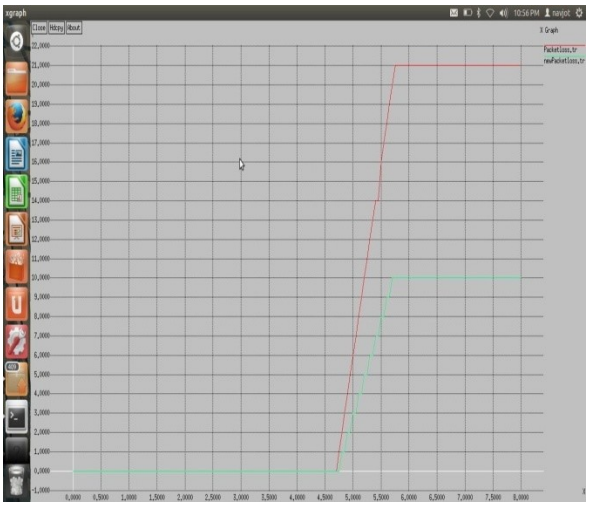

Figure 2: Packet loss Graph

As shown in figure 2, packet loss for the previous and new proposed work is compared. It is clearly seen in the graph that the packet loss in the previous work is more. It is due to the fault in the network and when this fault is removed from the network, the packet loss also gets reduced.

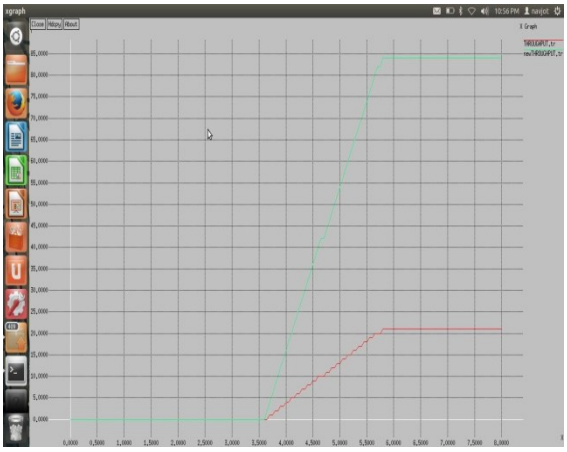

Figure 3: Throughput Graph

As shown in the figure 3, the throughput of the new and the previous work is compared. The throughput of the old scenario is reduced due to the fault in the network. If the fault of the network is recovered, the throughput of network increases accordingly.

V. CONCLUSION

In this work, a novel technique has been proposed which is based on neural network and other techniques. To reduce the overhead in dynamic clustering and to increase lifetime of the sensor network, cluster heads

are changed using the approach of neural network technique has applied like Knowledge Based Learning to decrease battery consumption of the network. Here main concern is to avoid battery depletion. The cluster head is also choosing according to the minimum battery consumption by applying election algorithm. There are three clusters having three cluster head. Cluster heads are chosen according to the maximum sending capacity and minimum battery consumption of the node. The implementation of this research work has done in Ns2 and simulation results show that novel technique has increased the network throughput and network lifetime.
In future we can apply the Two-Layered Feed-Forward Neural Networks to improve the performance of the system in terms of packet loss and energy consumption.

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