International Journal of Application or Innovation in Engineering & Management (IJAIEM)
Web Site: www.ijaiem.org Email: editor@ijaiem.org
Volume 5, Issue 5, May 2016 ISSN 2319 - 4847

A Novel Technique to reduce Fault Tolerance Using Neural Network Approach in Wireless Sensor Network

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ABSTRACT

The wireless sensor network is the type of Ad hoc network. Wireless sensor network is the self configuring networks; any sensor node can join or leave the network when they want. In Wireless sensor network no central controller is present, wireless sensor node are responsible for data routing in the network. Wireless sensor network is used to monitor the environmental conditions like temperature, pressure etc. Wireless sensor network is deployed in the far places like forests, deserts etc .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 our work, we are proposing a new technique 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 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: Learning, Neural Networks, Clusters, Boltzmann learning

1. INTRODUCTION

Wireless sensor networks comprise of many individual nodes which interconnect to form a system That operates as one. These sensor nodes play the main task of sensing the environmental conditions and maybe control them too. We need a collaboration of large number of such sensor nodes as it is not possible for a single node to cover large geographical areas. Sensor networks perform two main operations; they are data dissemination or spread of queries throughout the network and second is the data collection or gathering from individual sensor nodes and pass it on to sink [9]. The nodes use wireless communication, mostly wireless radio, to connect with each other and also with base station. The data collected is rarely processed by the nodes due to memory and battery limitations; hence it is passed on to remote device where it is analysed, processed upon or stored. The sensor nodes may differ in their physical size but the cost of these depends upon the complexity of each node.

1.1 Challenges for WSN: There are many issues of WSN. These are as follow:

1. Type of service: The service type as perceived by a conventional communication network mainly involves moving bits from one place to another. For a WSN moving of bits is not the actual purpose but just a means to an end. What is expected out of WSN is to provide meaningful information and/or actions about a given task [5].

2. Quality of Service (QoS): QoS generally refers to the quality as perceived by the user/application while in the networking community. In other words QoS is accepted as a measure of the service quality that the network offers to the applications/users. QoS is characterised as a set of service requirements to be met when transporting a packet stream from the source to its destination. In this scenario, QoS refers to an assurance by the Internet to provide a set of measurable service attributes to the end-to-end users/applications in terms of delay, jitter, available bandwidth, and packet loss [10].

3. Fault tolerance: Due to any factor, which may be physical damage to the node or dead battery, a node may run out of service. This leads to a broken link. Overall functioning of the network should not be affected by this. One way to overcome such a glitch is by deploying redundant nodes [7].

4. Scalability: Number of nodes in action is mostly application dependent. Since such number varies from hundreds and thousands of nodes per WSN, the employed architectures and protocols must be able scale to these numbers [8].

5. Battery Consumption: Sensor nodes are very light weighted and more in number. It is very difficult to replace battery again and again. It is considered its main issue.

2. LITERATURE REVIEW

Ying Miao (2005) has presented different types of applications in the field of wireless sensor networks. Wireless sensor network is used in military applications, home appliances, health applications, environment applications. All these applications have the different impact on each field [1].
Michael J.Cavaretta (2010) in their paper**,** "Neural Network" has discussed about neural networks, its objective and scope. Then discussed need of a neural network, its current applications where it can be applied [2].
Dr. M.K Rai (2013) discussed the main task in WSN is to reduce power consumption of sensor nodes.Wireless Sensor Networks (WSN) consists of large number of sensor nodes. The sensor nodes are battery powered devices, they communicate over a wireless medium and consumes energy during data transmission. It is possible by caching the data to minimize power consumption in WSN . In caching, sink is located inside the sensing region and it sends the queries to sensor nodes. Sensor nodes collect the data about queries and send back to sink. Cooperative caching reduces the situations like non availability of data, energy consumption, by storing the event information in the cache memory of nodes. To make data access faster it utilizes the benefits of caching because in WSN sensor nodes consume less power during processing as compare to data transmission [3].
Leandro Aparecido Villas (2013) proposed "DRINA: A Lightweight and Reliable Routing Approach for In-Network Aggregation in Wireless Sensor Networks" in his paper. Large scale dense Wireless Sensor Networks (WSNs) will be increasingly deployed in different classes of applications for accurate monitoring . Due to the high density of nodes in these networks, it is likely that redundant data will be detected by nearby nodes when sensing an event. Since energy conservation is a key issue in WSNs, data fusion and aggregation should be exploited in order to save energy. In this case, redundant data can be aggregated at intermediate nodes reducing the size and number of exchanged messages and, thus, decreasing communication costs and energy consumption. In this work, we propose a novel Data Routing for In-Network Aggregation, called DRINA, that has some key aspects such as a reduced number of messages for setting up a routing tree, maximized number of overlapping routes, high aggregation rate, and reliable data aggregation and transmission. The proposed DRINA algorithm was extensively compared to two other known solutions: the Information Fusion-based Role Assignment (InFRA) and Shortest Path Tree (SPT) algorithms. Our results indicate clearly that the routing tree built by DRINA provides the best aggregation quality when compared to these other algorithms. The obtained results show that our proposed solution outperforms these solutions in different scenarios and in different key aspects required by WSNs [4]. **Guoqiang Peter Zhang (2000)** has presented a focused review of several important issues and recent developments of neural networks for classification problems. These include the posterior probability estimation, the link between neural and conventional classifiers, the relationship between learning and generalization in neural network classification, and issues to improve neural classifier performance. Although there are many other research topics that have been investigated in the literature, we believe that this selected review has covered the most important aspects of neural networks in solving classification problems. The research efforts during the last decade have made significant progresses in both theoretical development and practical applications. Neural networks have been demonstrated to be a competitive alternative to traditional classifiers for many practical classification problems. Numerous insights have also been gained into the neural networks in performing classification as well as other tasks [5].

3. DRINA: DATA ROUTING FOR IN-NETWORK AGGREGATION FOR WIRELESS SENSOR NETWORKS

The main goal of the DRINA algorithm is to build a routing tree with the shortest paths that connect all source nodes to the sink while maximizing data aggregation. This algorithm considers the following roles in the routing infrastructure creation:
1. Collaborator: A node that detects an event and reports the gathered data to a coordinator node.
2. Coordinator: A node that also detects an event and is responsible for gathering all the gathered data sent by collaborator nodes, aggregating them and sending the result toward the sink node.
3. Sink: A node interested in receiving data from a set of coordinator and collaborator nodes.
4. Relay: A node that forwards data toward the sink. The DRINA algorithm can be divided into three stages
In Stage 1, the hop tree from the sensor nodes to the sink node is built. In this phase, the sink node starts building the hop tree that will be used by Coordinators for data forwarding purposes. Stage 2 consists of cluster formation and cluster-head election among the nodes that detected the occurrence of a new event in the network. Finally, Stage 3 is responsible for both setting up a new route for the reliable delivering of packets and updating the hop tree.

4. PROPOSED METHODOLOGY

First of all, nodes are deployed in the network. After that cluster heads are chosen according to the bully algorithm. The nodes in a cluster having maximum energy are selected a cluster head. All the communication from nodes to sink is done through cluster heads. The path which is established for communication is known as predefined path. In DRINA protocol when data transfer to sink through cluster heads, sometimes one cluster heads fails due to battery degradation. Link failure problem occur due to battery degrade. The data loss begins and further communication stops. To overcome this problem a new technique will be proposed based upon relay nodes. In this work, relay nodes are added externally in the clusters. These nodes have the more battery power as compared to other nodes. After that cluster head ask each node of the cluster in the predefined path for its battery power. The node which has highest battery power will be chosen as cluster head. Now this new cluster head will participate in the communication and solve link failure problem in the predefined path of the network.

5.Experimental Results

The whole scenario is implemented in MATLAB.

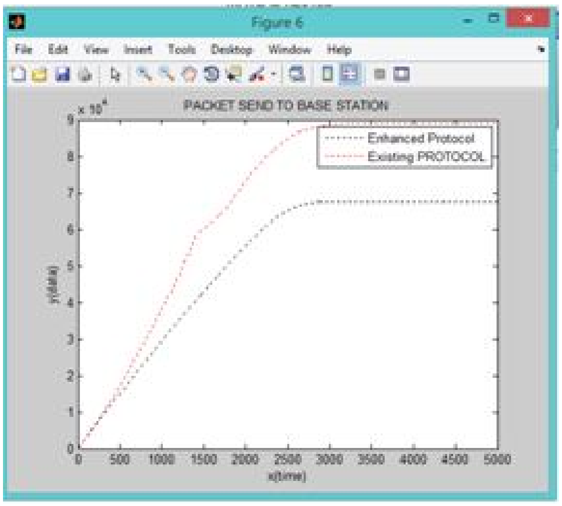

Fig. 5.1 : Comparison of network lifetime

As shown in figure 5.1, The network deployed with finite number 100 nodes and data is transmitted in 5000 rounds. In the existing algorithm 6.9 *10^4 number of packets are transmitted to base station and in enhanced algorithm total number of 8.9 *10^4 number of packets are transmitted to base station.

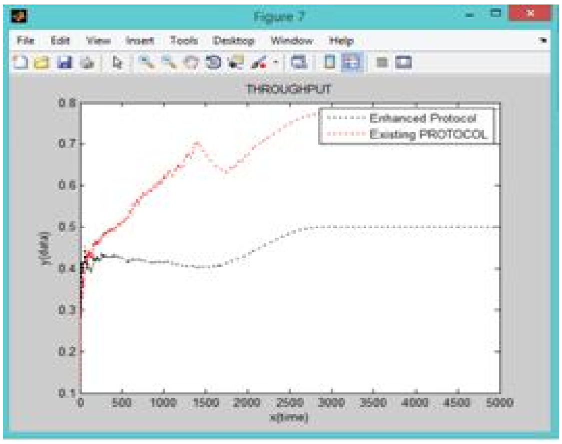

Fig.5.2 : Throuhput Graph

As shown in figure 5.2, the total number of 5000 rounds are required to transmit data to base station. In the existing algorithm less number of packets are transmitted to base station as compared enhanced algorithm. As shown in figure, the throughput of enhanced algorithm is more as compare to existing algorithm.

6.CONCLUSION

In this work, novel technique is 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 like will be applied Knowledge Based Learning and Boltzmann Learning to increase battery consumption of the network. The proposed technique is re-clustering the grid using neural network. In the present work clustering of grid is static But in our clustering of grid is dynamic. It can be adjustable and changeable according to the situation. In this node data which is send can be easily adjustable according to the situation and calculation made on the basis of battery consumption. Here main concern is to avoid battery depletion. The cluster head is also choosing according to the minimum battery consumption by applying election algorithm. Suppose there is a network in which number of batteries a replaced. Each battery has the data send capacity in mill ampere. It is considered that there are number of batteries available and each battery further forward data from source to destination. AODV algorithm is used in it. There are three clusters in which three cluster heads are present. Cluster heads choose according to the maximum sending capacity and minimum battery consumption. The implemented in Ns2 and simulation results shows that novel technique increase network throughput and network lifetime.

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