International Journal on Emerging Technologies (Special Issue on *RTIESTM-2016*) **7**(1): 50-54(2016)

ISSN No. (Print) : 0975-8364
ISSN No. (Online) : 2249-3255

Energy Optimization in Wireless Sensor Network using Back Propagation Neural Network

Pallavi Bansal**, Gurbinder Singh Brar** and Mandeep Singh Sandhu**
**M. Tech. (CSE) student, A.I.E.T, Faridkot, (PB), INDIA*
***Assistant Professor, Department of C.S.E, A.I.E.T, Faridkot, (PB), INDIA*

(Corresponding author: Pallavi Bansal)
(Received 04 October, 2015 Accepted 04 November, 2015)
(Published by Research Trend, Website: www.researchtrend.net)

ABSTRACT: Neural Networks are effective systems for Wireless Sensor Networks. Neural Networks have the capacity to learn entangled mapping in the middle of info or they can group data information in an unsupervised way. A percentage of the calculations inside the traditional manufactured neural systems can be effectively embraced to remote sensor system stages and meet the necessities for sensor system. Back Propagation neural network in this paper is implemented to figure out the failure node in the network and reduce energy consumption of the network deducting the failure node. The node at fault affects the entire network. The metrics Energy consumption, throughput, end to end delay and error rate are optimized. Neural network optimizes Energy consumption by 5J, throughput by 19%, error rate by 7.9 and end to end delay by 4.32ms.

Keywords: Wireless Sensor System, Back Propagation Neural Network

I. INTRODUCTION

Wireless sensor Network consists of small sensing devices called sensor nodes interconnected by wireless links. Nodes are configured automatically in a remote environment which needs to be monitored. The hub of sensor nodes collectively and cooperatively senses the data around and communicates with each other to send the data to the base station. An application decides the number of sensors in WSN. Wireless sensor networks are capable of observing a variety of conditions like temperature, humidity, pressure, noise levels, detecting certain kinds of objects etc [1]. This is the main reason why WSNs are used in large number of functionality in various applications like environment monitoring, military operations, medical supervision, different types of industries and home appliances.

A. Neural Network in WSN

Unified nature of WSNs in which all information from the sensor hubs regularly must be sent to a (normally outer) Base Station, Neural Networks can predict sensor readings at Base Station, which diminish unneeded interchanges and recovery extensive energy.

The other critical inspiration to utilize neural system based systems in WSNs is the similarity in the middle of WSNs and ANNs [2]. As creators in unequivocally accept that ANNs show precisely the same construction modelling as WSNs since neurons relate to sensor hubs in processing and perceiving capability and associations compare to radio connections. They likewise reason that applying of the neural system standard in the setting of sensor systems can prompt increase more profound understanding and more discernment. With this perspective point, we can see the entire sensor arrange as a neural system and inside of every sensor hub inside the WSN there could run likewise a neural system to settle on the yield activity. Neural networks have features like auto-classification, low computation, fault tolerance etc which are the requirements for WSN [3]. The hybridization of computational intelligence tool neural network and WSN can be very effective.

Neural networks can be trained to perform a particular task in two ways:

1. Supervised training: In this both input data set and target data set are given and the weights are adjusted so that the calculated and target result are as close as possible [4].

2. Unsupervised training: In this only input data set is given to the network and network itself settle to some stable state.

B. Back Propagation Neural Network

Back propagation algorithm is a supervised learning algorithm where the target of input is predetermined. It uses gradient descent to reduce the error and accordingly adjust the weighted connections between layers [5]. These are ideal for simple pattern recognition and mapping tasks.

The training is accomplished with a set of examples having inputs and desired outputs called training samples. Desired outputs teach the network what we want it to do so that it can change the network weights according to requirement.

Training involves the following main steps:
1. Initialize weights among different layers by random numbers.
2. Forward pass – apply Input and calculate output
3. Calculate error – difference between the desired and actual output.
4. Adjust weights so that the error is minimized.
5. Repeat steps 2-4 with all inputs of the training set.

The algorithm is stopped when the error has reached a significant small value. Each training cycle is called an epoch. The weights are updated in each cycle.
When training is finished the network gives the required output for a particular input outside training sample. The main idea of back propagation algorithm is to minimize the error of the network.

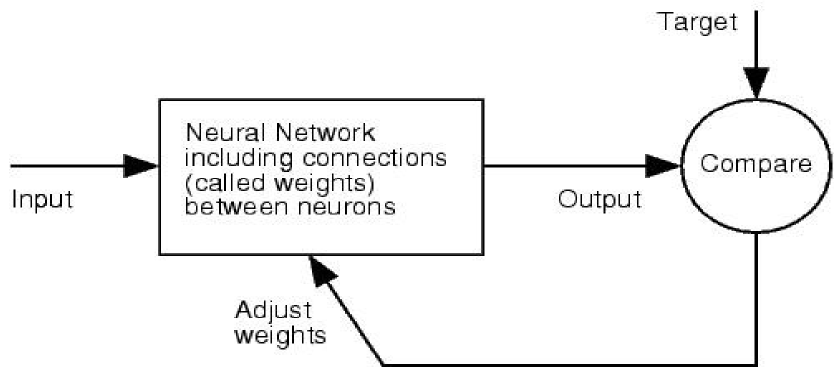

Fig. 1: Back Propagation Neural network block diagram.

II. PROBLEM STATEMENT

Energy consumption is one of the constraints in Wireless Sensor Networks. The key issue in WSN is that these networks suffer from packet overhead which is the root cause of more energy consumption in sensor networks. The wide utilization of Wireless Sensor Networks (WSNs) is obstructed by the severely limited energy constraints of the individual sensor nodes. This is the reason why a large part of the research in WSNs focuses on the development of energy efficient routing protocols.
When a node runs out of energy, a node is said to be dead or failed. This affects the neighbors of the dead node. The neighbors continue to transfer data to failure node irrespective of its failure. As the path traversed contains failure node path and energy required to send data to failure node is wasted thus node sending data to failure node consumes more energy to transfer data to destination than required.
In the proposed work, use of Back Propagation Neural Network will be done to figure out the failure node so that energy consumption can be reduced and will have high throughput of the network so that the network lifetime will be increased. The parameters we will consider to enhance the lifetime of the network are Throughput, End to end delay, Error rate and Energy consumption etc.

III. PROPOSED WORK

The proposed work uses Back Propagation Neural Network to optimize Energy in Wireless sensor network. Different other QoS parameters also are optimized like throughput, end to end delay and error rate. Neural network operates in two modes: training and testing. Neural networks classify pattern or establish identical behavior. Whenever node failure occurs it affects the entire sensing network. In proposed work neural network is trained to figure out the failure node by passing energy consumption of every node in each round as a parameter and decrease the affect it triggers. The number of neurons in the hidden layer is given 10. It gives appropriate results.
The proposed scheme is implemented in MATLAB. Neural network tool box of Matlab is utilized. The transfer function in hidden layer of neural network is transit and in the output layer is purelin. The step by step working of the proposed work according to the flowchart depicted in figure 2.
(i) The network of 1000 × 1000 area is formed and deployed with N nodes randomly on arbitrary points.
(ii) The network collects for 5 rounds and establishes path between source and destination for each round.
(iii) In each round source and destination are selected randomly. Both belong to the hub of sensor nodes.
(iv) To establish path between source and destination, coverage set of each node is drawn including nodes that are within coverage range of that node.
(v) Coverage range assumed is at a distance equal to or less than 20% of the width of the network.
(vi) Evaluation of "Energy", "Throughput", "End to end delay" and "Error rate" metrics of network as well as for nodes is performed.
(vii) Neural network is initialized giving energy consumption of different nodes in different rounds as an

input parameter and 10 number of neurons in the hidden layer.

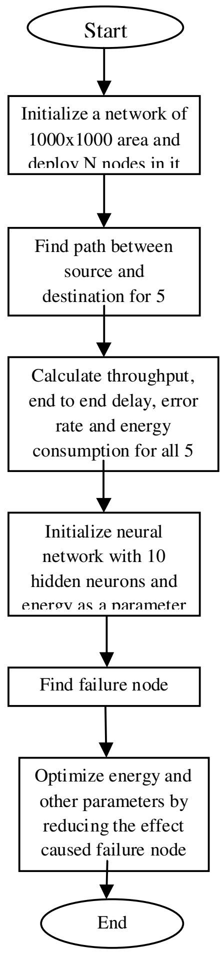

Fig. 2. Flowchart of proposed scheme.

(viii) Training is followed by testing of neural network by giving current energy of all nodes as input.
(ix) Neural network will generate output as number of node that has failed and is affecting the network.
(x) Optimizing of "Energy" and other parameters is done by reducing the value used by failure node.

IV. RESULT

The results of applying neural network to wireless sensor network are shown in the form of graph in MATLAB. The figure 3 shows the deployment of 100 nodes in the area of 1000 ×1000. All the nodes are randomly placed in each round. Path is established between source and destination using these nodes. The path is formed using coverage range of 20% of the width of network. The nodes are deployed randomly at a random distance from each other. The figure below shows the different parameters corresponding to 5 rounds and draws comparison between network without optimization and with optimization. In the end a table is drawn depicting the average value of metrics considered during the research. The data is collected for 5 rounds and the figure shows the deployment of 100 nodes for the last round.

The "energy consumption" parameter of the network without optimization and with optimization using neural network is plotted for 5 rounds in figure 4. It is seen that energy consumption is reduced significantly when neural network back propagation technique is applied. The extra energy which is used by failure node is deducted from the overall energy of the network.

Throughput of the network is number of packets sent over a given time. Graphs depicting percentage of throughput in 5 rounds when failure node is not known and when affect of failure node has been reduced.

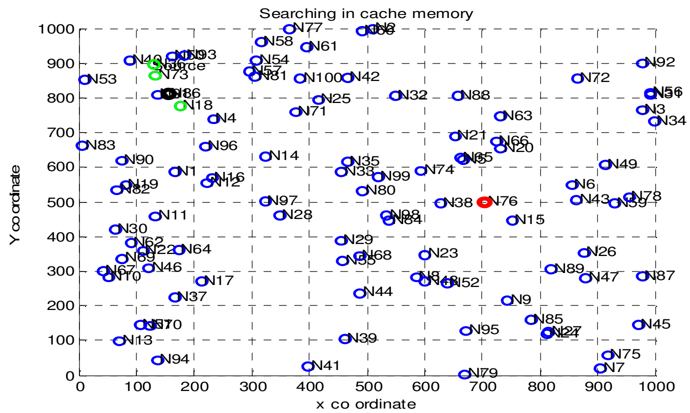

Fig. 3. Nodes deployed in network.

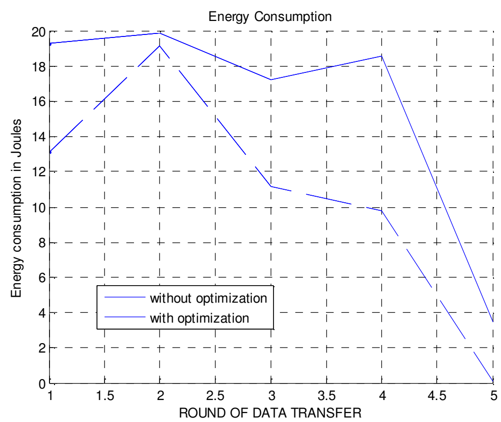

Fig. 4. Energy consumption of network.

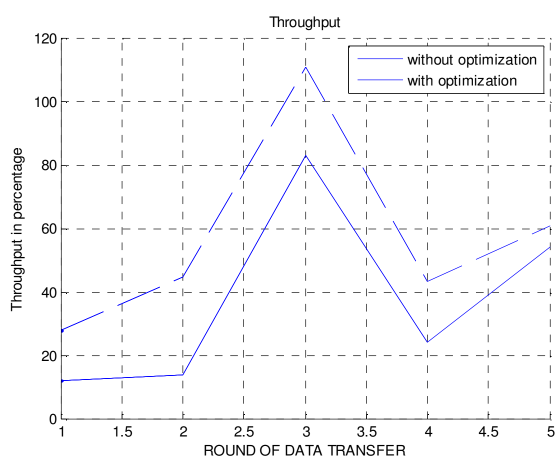

Fig. 5. Throughput of Network.

The other 2 parameters End to end delay and Error rate are also drawn on graph for both techniques. Thus neural network technique marks a great importance in optimizing the network by using Back Propagation algorithm.

The effect of node at fault is deducted in all the parameters of the network. The average value of all the QoS parameters corresponding to 5 rounds is summarized in the table 1.

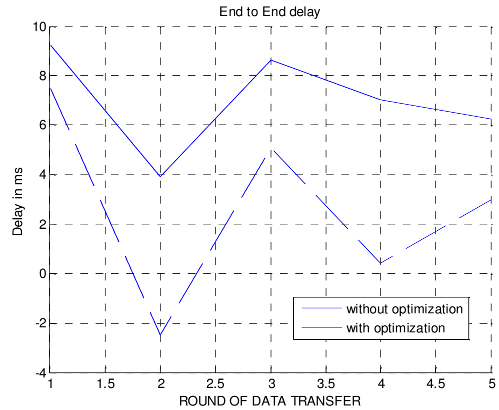

Fig. 6. End to end delay of network.

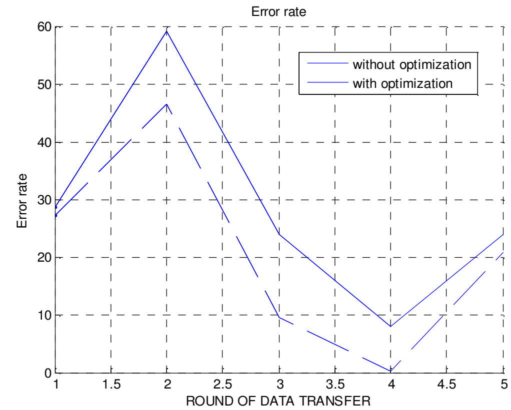

Fig. 7. Error rate of network.

Table 1: Average value of metrics corresponding to 5 rounds.

Parameters	Without optimization	With optimization
Throughput	37%	56%
Energy consumption	15.6J	10.6J
Error rate	28.7	20.8
End to end delay	7ms	2.68ms

V. CONCLUSION

In this paper, Neural Network algorithm has been implemented to optimize energy consumption and other QoS parameters. Wireless sensors network are mainly studied to save energy so that it survives for long time. So any optimization technique should focus on decreasing energy consumption to enhance WSN life time.

In our proposed algorithm the neural network has been utilised to optimize various QoS parameters like end delay, error rate, throughput and energy consumption. Evaluation of parameters has been done without optimization as well as with optimization in WSN architecture. In the end comparison has been made to compare results with optimization as well as without optimization method and it has been concluded that with usage of neural network all above mentioned parameters are optimised effectively. The approximate difference of various parameters using both the methods are: Error rate = 7.9, End to end delay = 4.32 ms, Throughput = 19% and Energy consumption = 5J.

REFERENCES

[1]. Verma Richa, (2013). "A Survey on Wireless Sensor Network Applications, Design Influencing Factors & Types of Sensor Network" *International Journal of Innovative Technology and Exploring Engineering (IJITEE)* ISSN: 2278-3075, Vol. **3**, Issue 5, October 2013.

[2]. Oldewurtel, Frank, Mahonen, Petri, (2006). "Neural Wireless Sensor Networks", *International Conference on Systems and Networks Communications, ICSNC '06*, pp.28-28.

[3]. Enami Neda, Askari Moghadam Reza, Dadashtabar Kourosh , Hoseini Mojtaba, (2010). "Neural Network Based Energy Efficiency In Wireless Sensor Networks: A Survey", *International Journal of Computer Science & Engineering Survey (IJCSES),* Vol. **1**, No.1, August 2010, pp. 40-55.

[4]. Bhardwaj Shikha, (2013). "Ann For Node Localization In Wireless Sensor Network", *International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering* Vol. **2**, Issue 5, May 2013, pp. 1724-1731.

[5]. SUN Ling-Yi, CAI Wei, HUANG Xian-Xiang, (2010). "Data aggregation scheme using neural networks in wireless sensor networks", *Future Computer and Communication (ICFCC), 2010 2nd International Conference on,* Vol.**1**, *IEEE*, pp. V1-725 - V1-729.