Modified I-Leach Algorithm to Improve Performance & to Reduce Energy Consumption in Wireless Sensor Network Using NN (Neural Networks)

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Abstract-WSN is major field among researches to get better and enhanced life time for network, one of the main fields is to calculate CH more precisely and accurately to get better results. In this paper, an energy efficient routing algorithm is proposed which saves a significant portion of inner network communications energy. To do this, the proposed routing algorithm selects sensor nodes with higher residual energy, more neighbors, and lower distance from the Base Station (BS) as Cluster Head (CH) nodes. Then, it manages sensor nodes appropriately and constructs clusters such a way to maximize WSN lifetime. To evaluate the proposed routing algorithm we use Neural Network and various simulations have been carried out by using of MATLAB simulator. The proposed routing algorithm is compared to the previous proposed algorithms like LEACH, I-LEACH, DBS, and LEACH-C algorithms. Results of the simulations show that the proposed routing algorithm has been improved the WSN performance.

Keywords- Wireless Sensor Network; Cluster-based Routing Algorithm; Network Lifetime; Base Station; Cluster Head; Neural Network.

I. INTRODUCTION

Wireless Sensor Networks (WSNs) are among the widely used types of Adhoc wireless networks [1]. The main objective of WSNs is identifying, receiving, and processing the information within a monitoring area [2] [3]. WSNs are composed of hundreds or thousands of sensor nodes that are randomly distributed in the monitoring geographical area [4] [5].It dose not require a fixed network support, so it can be Widely used in many fields such as military reconnaissance, medical care, monitoring the physical or environmental phenomenon like: temperature, sound, vibration, pressure, and motion at different locations and other special areas [6] [7].

A Wireless Sensor Network may consist of multiple sinks. Consider a scenario where more than one sink generates the same query into the Wireless Sensor Network. For such a scene each sink will have its own path developed to the source node which is somehow not required or there can be a way which avoids this. For handling such issues caching comes into picture. To realize the helpfulness of the using caching consider a tree of multiple levels and think of there leaf nodes are communicating to a common child internal node rather than the root node. Means we can cache the results in some intermediate nodes such that each sink will not have to communicate directly to the source node. This obviously saves time and avoids obsolete data traffic in the network. Caching could reduce a lot of data traffic and hence helps in saving response time and energy consumption.

Wireless Sensor Networks are prone to node failure due to power loss. In order to provide reliable service through the network, the network should be self adjusting and must have adaptable properties as required from time to time. A bottleneck node may encounter failure due to limited battery life. In such case the network protocol should be intelligent enough to handle such failures and keeps the network operational.

Sensor nodes rely on a battery with limited lifetime, and their replacement is not possible due to physical constraints. Moreover the architecture and protocol of sensor networks must be able to scale up any number of sensor nodes. Since the battery lifetime can be extended if we manage to reduce the amount of communication, caching the useful data for each sensor either in its local store or in the neighborhood nodes can prolong the network lifetime.

Several works has been proposed by the authors exploiting caching the data either in some intermediate nodes or at a location nearer to the multiple sink in the Wireless Sensor Networks. Indeed providing solutions to optimally caching the data has been a big area to be focus on, several proposed schemes performs well. Nowadays Wireless Sensor Network is being used for application level services like Multimedia application. Moreover caching multimedia data is giving new direction to the saga. Caching has been used for number of applications like fault tolerance, improving the TCP over Wireless Sensor Network, multicasting applications, and improving the performance.

II. RELATED WORK

Several cluster-based routing algorithms are proposed in the literature that among them, LEACH algorithm [8] is the most famous algorithm. This algorithm uses a random model to selects CH nodes then, non-CH nodes join to the clusters using one-hop transmissions with Time-Division Multiple Access (TDMA). LEACH algorithm does not consider the remaining energy and geographical position of sensor nodes in the CH selection process [2] [6]. This leads to the early death of sensor nodes and the decrease of WSN lifetime

PEGASIS algorithm [9] forms chains of sensor nodes rather than clusters to transfer information packets to the BS, so that each sensor node sends receive data from its close neighbor. However, high complexity of this algorithm discourages designers to use it in real applications. HEED algorithm [10] extends the basic idea of LEACH algorithm by incorporating residual energy and sensor node proximity to its neighbors in the CH node selection; but it does not pay any attention to the distribution or density of sensor nodes. LEACH-C algorithm [4] uses same steady-state algorithm as LEACH algorithm, but it organized clusters centralized by BS, unlike LEACH algorithm; this can indeed select a reasonable CH node, but it will increase energy consumption greatly as a result of exchange of data between the BS and the sensor nodes. In DBS algorithm [11], adaptive clustering of sensor nodes is based on their distance from the BS

In this paper, a cluster-based routing algorithm is proposed Which uses the concept of Neural Network to selects CH nodes more efficiently based on sensor nodes factors geographical position, energy remaining, and number of neighbors. It also manages the sensor nodes and clusters to reduce the energy consumption within the WSN. Similarly, in he proposed algorithm, the operation of selecting the route with minimal energy cost is effective in increasing the WSN lifetime. The results of the simulations show that the proposed algorithm has been improved the network lifetime, reduces the energy consumption of the network, and improves the successfully delivered packet ratio as compared to the previous algorithms.

III. PROPOSED WORK

In our proposed work sensor nodes are first deployed randomly in a given area. For optimized cluster head election we use Neural Network fitting tool and then we train the neural network for a given area. Given set of values has been stored as a data set which has to be provided as an input to the Neural Network. The second input of the Neural Network becomes the file which has to be uploaded to be tested for its category. Five Sensor Nodes in an area of 10*10 has been taken to be tested. Our research work has mainly following points of problems

A) Our problem definition also includes cluster head election in each cluster manually.

B) Our problem definition Results of the simulations show that the proposed routing algorithm has been improved the WSN performance, reduces the energy consumption of the WSN, and improves the successfully delivered packet ratio as compared to the previous routing algorithm.

IV. SIMULATIONS

The simulations have been done in MATLAB R2014b which involves the following steps. The multilayer feed forward neural network is the workhorse of the Neural Network Toolbox software. It can be used for both function fitting and pattern recognition problems..

The work flow for the general neural network design process has seven

Primary steps:

1 Collect data
2 Create the network
3 Configure the network
4 Initialize the weights and biases
5 Train the network
6 Validate the network (post-training analysis)
7 Use the network

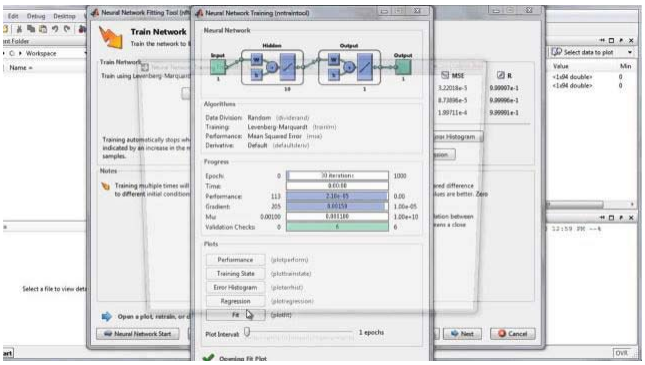

Figure 1: Training neural network

V. IMPLEMENTATIONS

In order to evaluate performance of the Modified I-LEACH algorithm, a MATLAB simulator has been used. Table 1 contains the values of environmental parameters used in the simulation [17]. Simulated network model is used.

A) Random Deployment of sensor nodes

In the first stage all the sensor nodes (200 sensor nodes) is randomly deployed in a given area of 200m*200m. Base station in placed in the center.After that Zoning is done,which divides the network into equal number of clusters.

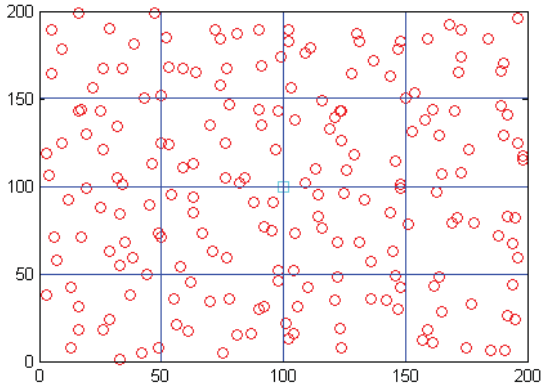

Figure 2: Randomly deployment of sensor nodes in a given area

In Fig.2 O represent non-CH nodes. The marked × is showing the location of the BS.

B) Training the NNfitting tool

The parameters of the trained samples are trained using the Levenberg-Marquardt back propagation algorithm. Neural fitting app will help to select data, create and train a network and evaluate its performance using mean square error and regression analysis.

C) Recognizing trained network and Evaluation of the optimal cluster head in each cluster

The trained network is recognized and implemented on a given network for optimal and fast cluster head election. Sensor nodes in each cluster then transmit sensed data to their cluster head and further Cluster head from each cluster transmits its own data and data from other sensor nodes to Base Station. [16] [17].

VI. METHODOLOGY

a) Random deployment of sensor nodes in a given area.
b) Base station is placed in the center.
c) Training of the network is done using Levenberg-Marquardt back propagation algorithm in nnfitting tool.
d) Creation of the feature vector which consists of features (Properties of the files). More number of feature extractions will lead to a better matching algorithm formation.
e) Cluster Head is elected from each cluster
f) Neural network would be used at the time of the testing. The neural network would take two inputs:
1. The network to be tested by the user
2. The database of feature vector which has been created using Levenberg-Marquardt back propagation algorithm.
g) Compute and compare the results with the base paper

A. Used Energy Model

Like most of previous papers [4] [8] [18] [19][20], paper the radio model of energy consumption of the network has been Consider ed, as shown in Fig. 2.
In this model, k represents the transmitted data packet size; d is the transfer distance; *ETX* is the required energy Consumption for data transmition which is dependent on the two parameters of k and d, and *ERX* is the required energy consumption for data receiving that is dependent on the value of k. The following equations are energy consumption relations.

$$E_{TX}(k,d) = \begin{cases} kE_{elec} + k\varepsilon_{fs}d^2 & , d < d_0 \\ kE_{elec} + k\varepsilon_{amp}d^4 & , d \geq d_0 \end{cases}$$

$$d_0 = \sqrt{(\varepsilon_{fs}/\varepsilon_{mp})} \quad (5)$$

$$E_{RX}(k) = kE_{elec}$$

Eelec is the energy consumption of electronic circuits.

B. Simulation Settings

In order to evaluate performance of the Modified I-LEACH algorithm, a MATLAB simulator has been used. Table 1 contains the values of environmental parameters used in the simulation.

Parameters	Value
Field size (M×M)	200m×200m
Location of BS	(100,100)
Number of sensor nodes,N	200 nodes
Cluster-Head probability	0.1
Initial energy of sensor nodes,E_0	0.5 J
E_{Tx} and E_{Rx} (E_{elec})	50nJ/bit
Free space (ε_{fs})	10pJ/bit/m^2
Multipath fading (ε_{mp})	0.0013pJ/bit/m^4
The energy for aggregation (E_{DA})	5nJ/bit/signal
The control packet size (c)	32 Bits
The data packet size (k)	4000bits
d_0	87.7 m

Table 1: Network Parameters used in the Simulations

VII. Results And Discussions

To compare the results of the proposed work,the algorithms with the same basic ideas are selected. Basic LEACH algorithm is selected to compare with the proposed algorithm. Beside it, DBS,I-LEACH and LEACH-C algorithm are also selected. DBS algorithm is selected because its CH selection and cluster formation policies are designed based on the distance of sensor nodes from the BS. LEACH-C algorithm is another algorithm that is presented by LEACH algorithm designers and its measure for CH node selection is remaining energy of nodes include WSN Performance, reduced energy consumption of the WSN, and successfully delivered packet Ratio is improved when compared with the previous work.

The results of simulation are compared with these algorithms and are presented in the chart format. Fig. 4 shows the parameters i.e., FND 4 , MND 5 , and LND 6 in the simulation. It can be seen in the graph that the time of the first node death and last node death of the proposed algorithm is later than four other algorithms.

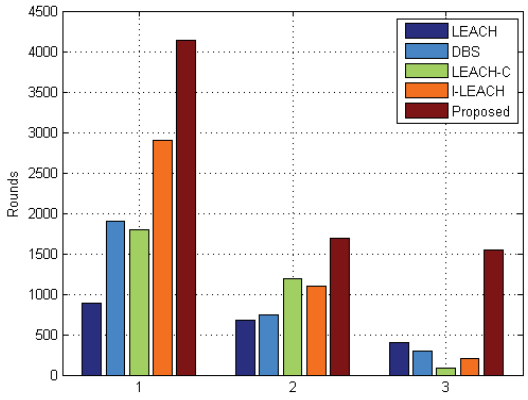

Figure 4. Average time of first, mid, ,and last sensor node to die in the proposed algorithm versus other algorithms.

Fig. 5 shows the energy diagram of Proposed algorithm compared with other algorithms. Energy distribution and load balancing is done simultaneously, using CH nodes selection management strategies and restrictions of the sensor nodes that have a membership fee in the clusters and limiting the sensor nodes that have the capability of being CH node. In other words, the total energy consumption in the network is optimally managed.

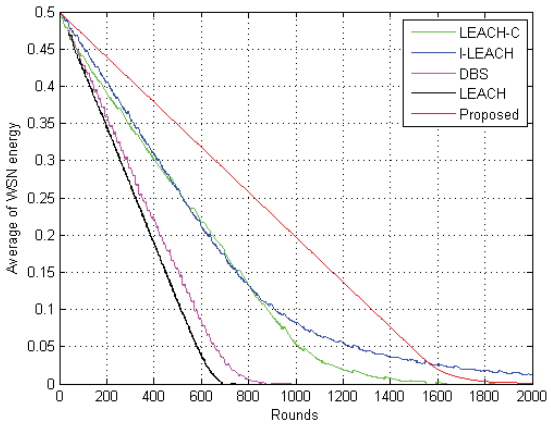

Figure 5. Average of WSN Energy Consumption in the proposed algorithm versus other algorithms.

As can be seen in Fig. 6, the important factors such as location, energy and number of neighbors are considered in the CH nodes selection, in addition lead to the CH nodes optimal selection, directly affects the improves the efficiency of routing algorithm and extends the WSN lifetime.

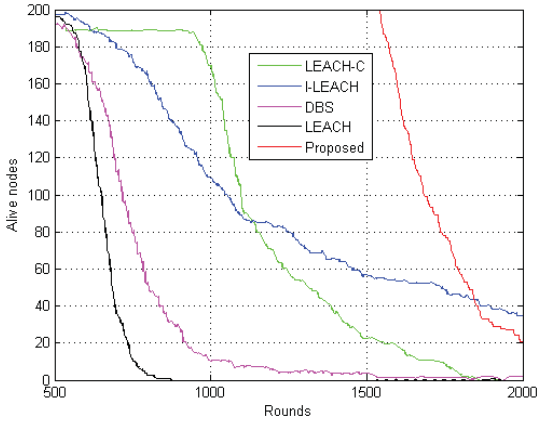

Figure 6. WSN Lifetime in the proposed algorithm versus other algorithms.

VIII. FUTURE SCOPE

In the proposed work we used residual energy and distance from BS to train our neural network, In the future work we may also use more features to train network to enhance its coverage and lifetime like node density and spare probability. We also may use other optimization techniques to predict cluster head hybrid with NN to get more enhance results.

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