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Wireless Sensor Node Energy Optimization by Packet Routing and Clustering

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Abstract- **Wireless network depends on life of battery as communication depends on calculation. Many of data collection activity depend on sensors continuous information collection. Hence energy optimization required for the long life of network. So nodes communications need some intelligence for sending data to the base station. This paper has developed a clustering approach for nodes energy optimization as genetic algorithm adopts dynamic situation without any guidance. Paper has developed invasive weed optimization algorithm which select cluster center from the available nodes and reduce energy losses. It was obtained that proposed model has utilized node node energy and position in fitness function for cluster center selection. Experiment was done on different number of nodes and network area size. Result shows that proposed model has increase the life span of WSN.**

Keywords- **Energy Optimization, Wireless Sensor network Genetic algorithm, packet transfer.**

I.INTRODUCTION

WSNs or Wireless Sensor Networks comprise devices that have qualities such as low task processing, low energy consumption, low storage capacity, and limited battery life. Such networks are easy to deploy, implement, and are self-configuring qualities. In such networks, low energy is utilized by using the concept of multiple interferences by the communication channels together with computing capabilities. The sensor nodes should provide efficient communication with reduced delay together with the least consumption of energy to provide reliable and accurate information. [1].

But energy consumption of such networks has become a critical issue owing to their low or limited battery power. It is also important to keep track of the life span of the nodes in these communication channels to avoid regular human intervention due to certain harsh environments. For example, areas of such study include home networks, natural behavior, medical industry, battlefield, risk areas, and agriculture. [2].

The implementation of energy-saving should be simple, resistant to topographical changes, and enduring as such considerations are critical in a network. All such factors greatly influence the performance of the network. In this particular study, an energy model is designed with the purpose to achieve less energy consumption at the nodes that are present within the network. [3]

Receiving packets, turning on, sending packets, microcontroller processing, channel auditing, and switching activities are some operation that needs energy. The uniqueness of this model is that it gives a simple and clear design that is capable of converting the energetic behavior of the network where there is an increase in energy conversion [4].

II. RELATED WORK

In [5] given an energy model to calculate the consumption of the energy of MPH or Multi-Parent Hierarchical protocol and other five other routing sensors such as Power-Efficient Gathering in Sensor Information Systems (PEGASIS), Ad-hoc On-demand Distance Vector (AODV), Low Energy Adaptive Clustering Hierarchy (LEACH), Dynamic Source Routing (DSR), and ZTR or ZigBee Tree Routing [6] given a unique model to obtain better EBAR or for Energy-Efficient Load Balancing Ant-based Routing Algorithm WSNs networks.

This EBAR uses an improved trailing update and finds a pseudo-random route to maintain the energy consumption of the nodes. For this, it uses a heuristic algorithm based on greedy expected energy to utilize the route establishment properties. Lastly, EBAR uses an energy-based broadcasting scheme to reduce the consumption of energy.

In [7] given an improved version of the ant colony algorithm that has qualities of low-energy consumption and the sensor nodes of the network possesses enough residual energy within them. Additionally, the data balance transmission model and the energy model are balanced by using a verified WSN transmission function. The experiments prove that with the help of an improved ant colony algorithm it was easier to determine the location of the public node and to use this information for effective routing to the target location.

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In [8] authors given LEACH-FC or LEACH-Fuzzy Clustering protocol which uses a fuzzy-logic-based cluster selection that maximizes the overall lifetime of the network. A centralized approach was used rather than distributed ones for selecting the cluster head and their information. The fuzzy logic technique was also implied that is again a centralized approach. The given algorithm was found effective in balancing the energy load of the nodes and thus improving the reliability of WSN.

In [9] to provide satisfactory service mobility of sensors was analyzed to guess the stability of the path and to collect the required information. Service mapping pre-process was also proposed t reduces the flow in the service layer to save the excess energy that is spent during the service mapping process. All this process is done to satisfy the request that is generated in optimal sensors related to service mapping in the network layer of the transmission. Results proved that the work was able to achieve goals such as load balancing, energy conservations, lifetime extension of a network while guaranteeing the request, and overall better performance successfully.

III. PROPOSED METHODOLOGY

Explanation of proposed Genetic Optimize Cluster Center (IWOA) algorithm was done. So reading this part make clear understanding of whole work in detail. In this work a approach was adopt for finding the best set of cluster center by using Genetic approach was incorporate in this step [9, 10]. Here whole work is depends on the dynamic condition of the available energy present in different nodes. In this work heterogeneous energy nodes were taken and this makes an important feature for the cluster center selection.

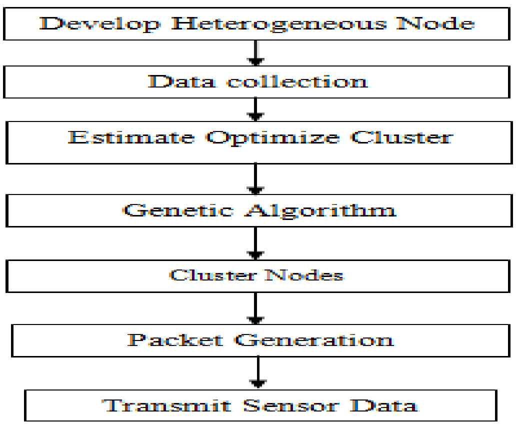

Fig 1. Block diagram of IWOA.

1. Develop Heterogeneous Node Environment:
Develop an MxM region place N number of nodes present in the region shown in fig. 3.1. Each node in the region may have different energy level in battery, this make heterogeneous system. Relegate their starting energy level before transmitting and getting any bundles. Here energy utilization per unit node is required to be evaluated. The transmission energy (ETx) and accepting energy (ERx) can be processed as pursues:

$$\mathbf{E_{Tx}\ (L, d) = E_{elec}\ x\ L + a\ x\ Lx\ d^{b}}$$

$$\mathbf{E_{Rx}\ (L, d) = E_{elec}\ x\ L}$$

Where L is the information bit length, d the space among source and goal node, Eelec the energy utilization per bit. The estimations of a and b rely upon the estimation of d. On the off chance that d <= d0, a and b will be afs and 2, Else, they will be aamp and 4. Note that afs and Aamp are the amplifier energy cost [11].

For a target that is situated at a longer distance than d0, the amplifier should expend considerably more energy to achieve it. In outline, the objective of the grouping issue of a WSN is to amplify "the alive sensors" and "the rest of the energies" of the considerable number of sensors.

2. Estimate Optimize Cluster:
So as to ascertain the k number of cluster value that limits the aggregate energy utilization, this work compute the subsidiary of Etotal with k and set the subordinate as zero so as to prompt the ideal number of bunches kopt to limit the absolute energy utilization of the system [12].

$$K_{opt} = \sqrt{\frac{N \times \varepsilon_{fs} \times M^2}{2\pi(2E_{elec} + E_A)}}$$

Where ε_fsis amplifier power consumption of the free-space, EA is energy consumption required for nodes to fuse k-length data.

3. Genetic Algorithm:
This work utilize Invasive weed optimization algorithm (IWOA), as some of nodes are need to be select as cluster center. This selection of cluster center was done by IWOA. In ths algorithm weeds were optimized [13].

4. Generate Weed:
In this work some probable solutions which are set of nodes act as cluster center are termed as chromosomes. Randomization of this population was done by Gaussian function shown in eq. 1 [14]. This can be understand as let the number of cluster be m and number of initial population is P, then one of the possible solution is Cc ={N1, N5, N7…..Nm} this can be assume as the solution set.
While P = [Cc1, Cc2 …Ccn] is a population obtain randomly by eq. 1. Nodes who are participant act as energy greater than TE (Threshold of Energy), where m is number of cluster center and n is number of chromosomes.

$$\mathbf{P \leftarrow Rand\ (m, n)}$$

5. Fitness Function:

For finding difference two chromosomes function are use first is total energy consumption required for transmitting and receiving packets in region under selected cluster set. The objective function is a variant of that described in [22], which can be divided into two parts. The first part is the normalized energy consumption.

The energy consumption for non-CHs is defined as:

$$E_{non\text{-}CH} = \sum_{i=1}\sum_{j=1} (E_{Tx} (L, d(CH_i, N_j)) \times Xij$$

Where k is the number of CHs; N the number of nodes; l the packet size; and d (CHi; Nj) the distance between the ith CH and the jth node. The value of xij will be set to 1:0 if Nj belongs to CHi; otherwise, it will be set 0:0.

For finding difference between two nodes Eludician Distance formula was used. The Euclidean distance d between two nodes X and Y feature vector distance was used in this calculated by

$$d = [SUM ((X-Y).\text{^}2)]\text{^}0.5$$

The energy consumption for CHs is defined as:

$$E_{CH} = \sum_{i=1}(Lx|Cij|x(E_{DA}+E_{Rx})+E_{Tx}(L, d(CH_i, BS))$$

Where jCij is the number of members belonging to the ith CH, and EDA is the energy consumption for data aggregation. In this study, we assume that data from different nodes can be compressed and aggregated into l bits.

$$D = E_{CH} + Enon\text{-}_{CH}$$

So the matrix D contain all the values of the centriod distance from the nodes present in one cluster then find the minimum distance which will evaluate specify best possible solution.

6. Weed Crossover:
Top possible solution after sorting will act as the local best weed for other possible solutions. Now selected teacher will teach other possible solution by replacing fix number of centroid as present in teacher solution. By this all possible solution which act as other chromosome that will learn from best solution.

7. Final Solution:
In this work after sufficient number of iteration best possible cluster centers are obtained and assign nodes to those clusters. Here each cluster is represent by its cluster center.

8. Cluster Nodea:
In this step selected cluster center node is consider as the cluster center of that cluster. As node position feature was used to cluster other nodes. This clustering was shown in fig. 3.5 where each cluster was shown in separate color and all cluster nodes are shown in red color.

IV. EXPERIMENT AND RESULTS

So as to lead test and measure assessment results MATLAB 2012a platform was used. This area of paper show experimental arrangement and results. The tests were performed on a machine having configuration of Intel Core i3 machine, outfitted with 4 GB of RAM, and running under Windows 7 Professional. Four sets of environment were utilized to assess the working of the IWOA. The main benchmark is 100 sensor nodes in a region of 100m x100m, the subsequent environment have 150 nodes in 100 x 100m area. While third setup has 100 nodes having 150x150m region, finally fourth have 200x200m region with 150 nodes.

1. Evaluation Parameters:

1.1 Number of Rounds: One cycle of sending packet from non cluster center node to Base station is considered as Round. Here numbers of round are count for each comparing methods.

1.2 Packet Transfer: This is the number of packet transfer done in the WSN while all the node get discharge, so wireless arrangement having maximum number of packet transfer is good solution.

2. Results:
Here proposed methodology was compared with existing methods in [10]. Results of the IWOA were evaluated on above parameters.

Table 1. Comparison of First Node Loss Different Area and Nodes.

Region size	Nodes	LEACH-FC	IWOA
100x100	70	21846	26387
100x100	100	14529	26061
150x150	100	3596	26939

Table 1 shows that IWOA has improved the number of rounds for first node loss in the network. Here it was obtained that IWOA efficiently select the cluster center so losses will be reduced and node survive for long duration.

Table 2. Total number of packet transfer count based comparison.

Region size	Nodes	LEACH-FC	IWOA
100x100	70	1115267	1834173
100x100	100	1614627	2586599
150x150	100	533961	2634932

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Table 2 shows that IWOA has improved the number of packets in all set of situations of area and nodes. Here MST based algorithm reduce number of iteration for the efficient cluster center selection. Here large experimental area increment separation between nodes which builds energy requirement for moving same packet size.

Table 3. Number of rounds count based comparison of IWOA.

Region size	Nodes	LEACH-FC	IWOA
100x100	70	21389	27918
100x100	100	22558	27502
150x150	100	13595	28518

Table 3 shows that IWOA has improved the quantity of rounds in various set of experimental setup and number of nodes. As shown that in small region either number of nodes are less or more number of packets are high. Here huge experimental area increment separation between nodes which builds energy prerequisite for moving same packet size.

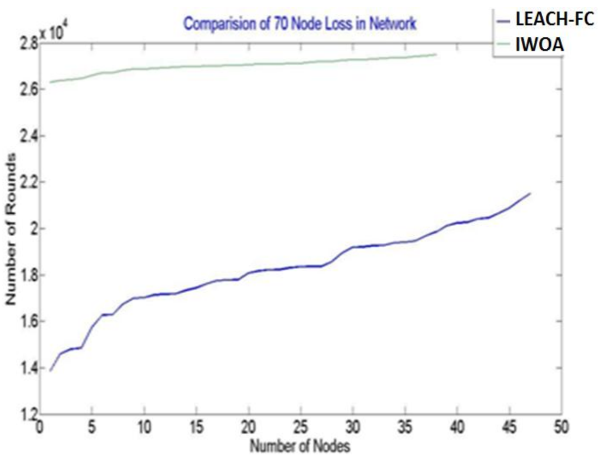

Fig 2. Number of node loss in network having 70 nodes of 100x100m region.

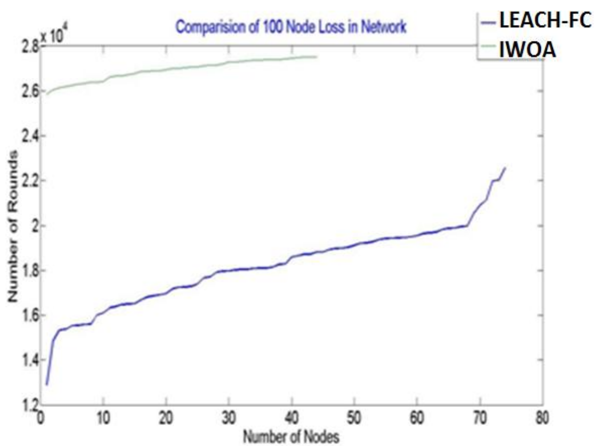

Fig 3. Number of node loss in network having 100 nodes of 100x100m region.

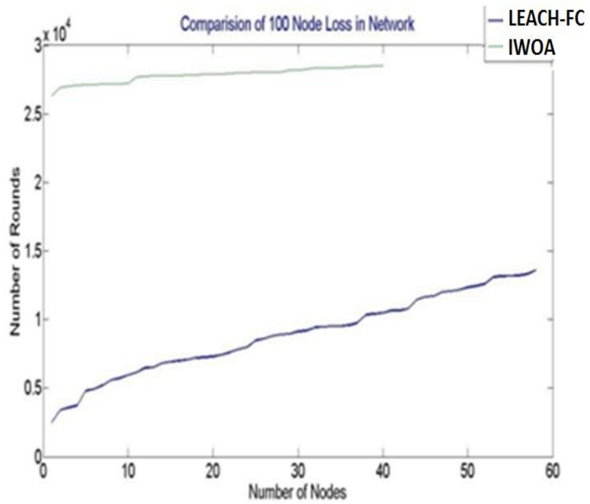

Fig 4. Number of node loss in network having 100 nodes of 150x150m region.

Fig. 1, 2 and 3, shows that IWOA number of rounds for IWOA first node was always high as compared to other existing algorithm. Here a different experimental area result shows that proposed algorithm data analysis for cluster head identification improved the work performance.

V. CONCLUSIONS

This paper has developed a energy efficient wireless sensor network model. It was obtained that proposed clustering approach for packet routing has increased the life span of the network.

This enhancement of model was obtained by the Invasive weed optimization Algorithm (IWOA) where as per node energy and position cluster center was select in the network. Paper has evaluated results in dynamic environment where nodes can move from one place to other at any instant of network life span. Results shown that proposed model has mproved the number of packets transfer as life span was increased by reducing the communication cost. In future scholar can develop a routing of model as well that may further enhance the WSN network efficiency.

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