International Journal on Recent and Innovation Trends in Computing and Communication ISSN: 2321-8169
Volume: 5 Issue: 12 95 – 99

Research Paper on Firefly Optimized Leach to Reduce Energy Consumption

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Abstract- The recent advances in information and communication technologies enable fast development and practical applications of wireless sensor networks (WSNs). The operation of the WSNs including sensing and communication tasks needs to be planned properly in order to achieve the application-specific objectives. The WSNs consist of a number of sensor nodes equipped with microprocessor, wireless transceiver, sensing components and energy source. These sensor nodes operate as autonomous devices to perform different tasks including sensing, communication and data processing. We made this protocol more efficient by using optimization algorithm to choose the cluster head optimally amongst all nodes in the cluster. A new evolutionary firefly Algorithm (FA) is used which is advanced than efficient PSO algorithm and more fast converging and accurate algorithm. We optimised the cluster head based on energy and distance from other neighboring nodes by this FA algorithm and achieves high residual energy than PSO optimised LEACH and conventional LEACH protocol for the same network parameters.

Keyword:-*Wireless sensor network,LEACH protocolfirefly Algorithm (FA) etc*

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I. INTRODUCTION

A proficient design and to implement the wireless network is become an most interesting issue in present scenario. These researches are carried out because of the vast area of wireless application in present world. As in wireless network we use small nodes that are much efficient in data transmission and can implement instead of traditional ways. Another application of wireless sensor network is the field of medical monitoring. This area of wireless sensor network is very wide which begins from monitor the patient in hospital using the wireless sensor like removing the various constraints to the large devices which is to monitor the patient in serious conditions. By the use of WSN we can regularly monitor the patient health which helps to detect the future health problems. In present scenario the sensors are varied from small miniature to the outside sensor like video cameras or locating devices. In such a difficult environment it is more desirable to make much flexible and reliable application to meet these challenges. For example lets take a PDA devices that accept the data from various sensor to monitor the health. The monitoring gives information about possible health problems and stores the data in its database. Since almost every sensor used in health devices are operated from battery and have wireless network inbuilt in that. So from this it can be said that these devices need and networking protocol for wireless transmission which is reliable efficient and secure.

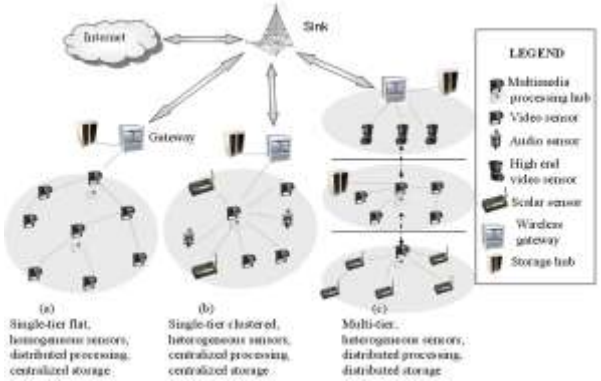

Figure 1.1: Wireless sensor networking

Because of semiconductor devices, fast internet and many network technology are comes in small devices. With the increment in the semiconductor devices world is becoming more interconnected. So we need to secure our information in both wireless and wired networks. Both of them are different at technical level and both have the different security mechanisms to secure their information. Wired networks are more secure than wireless because they are connected via Ethernet and have dedicated connection. Wireless networks need more security to secure others in the limited transmission range of routers, switches and bridges as the information is shared.

II.BASIC FUNDAMENTAL ALGORITHM USED

2.1 Optimization

Optimization generation lets in analysts to look for most desirable answers to complex enterprise and engineering troubles. Optimization software permits you to locate the nice solution to questions which includes [20]:

- What is the maximum return on budgets allocated to exceptional uses, given unsure product call for, machine reliability, and uncooked cloth availability?
- What is the best configuration of machines for production scheduling underneath variable situations of demand and operation?
- What are the most effective region and release sequencing of uncooked materials to decrease ready time?
- What are the most useful paintings force allocations to decrease lead time and labor charges?
- What are the most beneficial allocations for an investment portfolio?

They are greater strong than conventional methods based on formal logics or mathematical programming for plenty actual world OR/MS troubles. Evolutionary computation techniques can address complicated optimization issues higher than conventional optimization strategies. However, maximum papers on the utility of evolutionary computation strategies to Operations Research /Management Science (OR/MS) issues

have scattered around in one of a kind journals and convention proceedings.

2.2 Evolutionary Optimization Algorithms

- Provides a trustworthy, bottom-up method that assists the reader in acquiring a clean—but theoretically rigorous—information of evolutionary algorithms, with an emphasis on implementation
- Gives a careful treatment of currently advanced EAs—which includes opposition-based mastering, artificial fish swarms, bacterial foraging, and many others— and discusses their similarities and variations from greater well-installed EAs
- Includes chapter-end problems plus a answers guide available on line for instructors
- Offers simple examples that provide the reader with an intuitive know-how of the idea
- Features source code for the examples available on the writer's internet site
- Provides superior mathematical strategies for studying EAs, along with Markov modeling and dynamic machine modeling.

2.3 Firefly Algorithm

Now we will idealize a number of the flashing traits of fireflies with a view to increase firefly-inspired algorithms. For simplicity in describing our new Fireflies Algorithm (FA), we now use the subsequent 3 idealized rules: 1) all fireflies are unisex in order that one firefly might be interested in different fireflies regardless of their intercourse; 2) Attractiveness is proportional to their brightness, therefore for any flashing fireflies, the less brighter one will circulate toward the brighter one. As the iterations continue, the fireflies could converge into all of the nearby optima (including the worldwide ones) in a stochastic manner. By evaluating the nice solutions among these types of optima, the global optima can without problems be finished. At the moment, we are seeking to formally prove that the firefly set of rules will approach international optima while $n \to \infty$. In fact, it converges right away, commonly with much less than 50 to 100 generations, and this may be tested the use of numerous trendy take a look at features later on this paper. There are crucial proscribing instances whilst $\gamma \to \infty$. For$\gamma \to 0$.The splendor is consistent $\uparrow \beta \to \beta_0$ and$\Gamma \to \infty$. This is equivalent to mention that the mild depth does now not decrease in an idealized sky. Thus, a flashing firefly can be visible anywhere inside the domain. Thus, a single (commonly international) most desirable can without problems be reached. This corresponds to a special case of particle swarm optimization (PSO) mentioned earlier. Subsequently, the performance of this special case is similar to that of PSO.

III. Proposed Method

In our work, we focused on energy consumption minimisation of sensor nodes in WSN. In WSN, while transmitting the data, a sensor node has to consume energy and same is the case in reception of data. The problem is that sensor node is battery powered device and it has limited power source. So it is required to increase the life span of a sensor node, which is possible by reduction of energy consumption. To reduce the energy consumption a hierarchy is followed. Sensor nodes select a head with maximum energy residual in each round out of nearby nodes. This selected sensor node transmits the data to sink node. This transmission is done in TDMA fashion. This kind of process is followed in LEACH (Low-energy adaptive clustering hierarchy) protocol. In it two tier topology is followed in which clusters of nodes are formed with cluster head in the first tier. These cluster heads are responsible to pass the sensor information to the sink node. Clusters are formed on the basis of distance amongst nodes. Nodes with minimum distance are considered in a single cluster and these nodes are farther from nodes in other cluster.

3.1Firefly optimization of LEACH protocol

In our proposed scheme FA optimized technique is used which is advanced than PSO (Particle Swarm optimization) optimization algorithm which requires an objective function to minimize. FA is a global search optimization technique which has very less probability of premature termination unlike PSO; convergence speed is also increased along with more intensive search of global minima point. It performs well in case of multi objective function or multi constraint function. FA algorithm is based on the motion of fireflies in a searching space and PSO is based on behavior of swarms as discussed in previous chapter. The counterpart of fireflies in FA in our work is the tuning variables. The position of a single firefly is defined by the number of tuning variables.

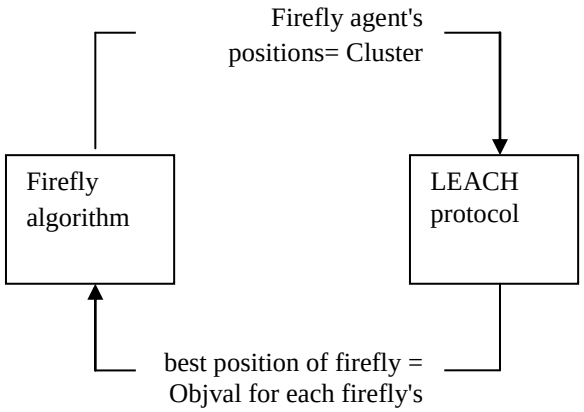

Figure 3.1: Representation of equilibrium of Firefly algorithm optimization and LEACH protocol's cluster head selection

Steps of proposed algorithms are described as:

Step1. Initialize all initial parameters for the LEACH protocol like number of nodes, their position, channel bandwidth, frequency etc. to model it. All these network values are indicated in table 5.3.

Step2. Place the nodes randomly in geographical region of 100*100

Step3. divide all nodes into clusters. We take 5% of total nodes as clusters to be formed. So for 100 nodes, 5 clusters will be created using k-means algorithm.

Step4. Initialize the random positions of fireflies in FA.

Step5. Consider the searching space dimension as number of clusters to be tuned. If there are 100 nodes then 5 cluster heads to be elected. So we will tune 5 variables which indicate the node ID out of 100 and these nodes will be treated as cluster heads.

Step6. Initialize the weighting parameters of firefly as 10.8,1 and 0.01.

Step7. Evaluate the objective function value for each firefly for the first iteration and the output is saved.

Step8. Update the position of each firefly again by defined formula in section 3.7.3 and calculate the fitness value from the objective function for these new positions in the next iteration and save them again.

Step9. Compare the best fitness value obtained in the previous step for firefly with the previous best fitness value of firefly. If fitness function value is less for this new position than previous position then it will be assigned as new.

Step10. This process will keep on repeating till all iterations are reached or termination criteria is matched.

Step11. The best position in last iteration is termed as optimum position of luster heads and final residual energy and dead nodes are calculated for these cluster heads using LEACH protocol.

IV. RESULTS

We have worked to assign optimum cluster head in an hierarchical WSN network with two tier communication. LEACH protocol here is used to reduce the energy consumption due to node to cluster head communication and cluster head to sink node transmission. This protocol's energy consumption is dependent upon the distance between nodes as in equation 4.2., so we optimized this distance using firefly optimization algorithm. The route search scheme is based on the selection of node which is at minimum distance from the source node and the final path located must also have minimum distance amongst all available path options for same source and sink. The values of these inputs are tabulated in table 5.2.

Table 4.1: input variables set in firefly optimization

Input	Value
Total number of fireflies	10
Total iterations	100
Range	[1,100] in meters

During the firefly implementations we have to provide the input of number of agents, total number of iterations and range to the firefly.m script.

Table 4.2: WSN and LEACH protocol's variable's values

Initial Energy	0.5 Joules
Number of Nodes	100,200,300
Rounds in LEACH	10,50,100,150,200
Energy for transferring of each bit (Etx)	50 nJ
Energy for receiving of each bit	50 nJ
Transmit Amplifier Free space energy (Efs)	10nJ
Transmit Amplifier MultiPath energy (Emp)	13nJ
Aggeragation Energy (Eda)	5nJ
Packet Length	6400

To test the results we have created some test case with different number of nodes and rounds and results in each test case are compared with PSO optimized LEACH algorithm and conventional LEACH protocol for same WSN network.

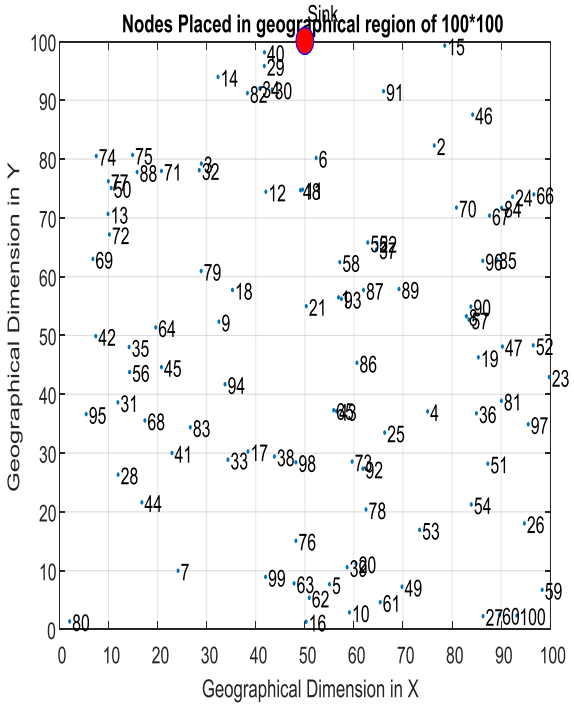

Figure 4.2: WSN network generated for 100 nodes placed randomly

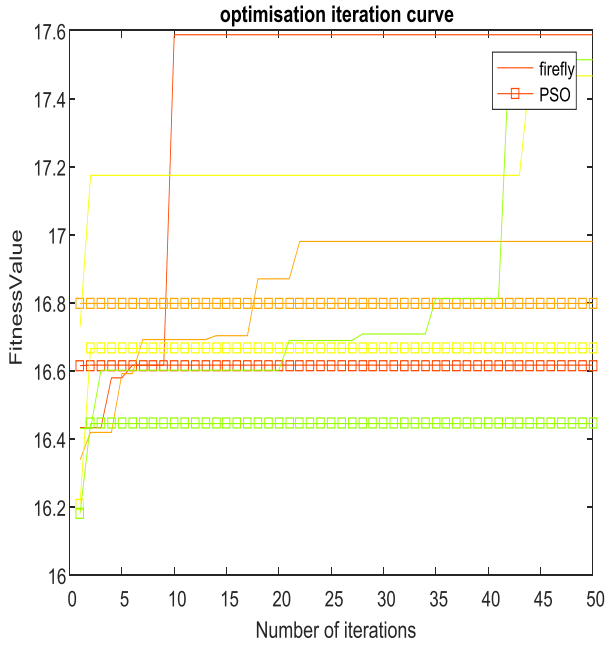

Figure 5.2: Iteration curve comparison for Firefly and PSO for different number of rounds

The difference between RE with number of rounds is increasing in between different algorithms. The slope of decrement in of proposed scheme is least which proves FA optimised cluster head in LEACH protocol is better than PSO optimised cluster head. Figure 5.4 shows the dead nodes curve for all these three but since in 10 round the no node drain out of energy source, so no node will be dead. The dead node is that node which completely drained out of energy and leaves behind with zero energy.

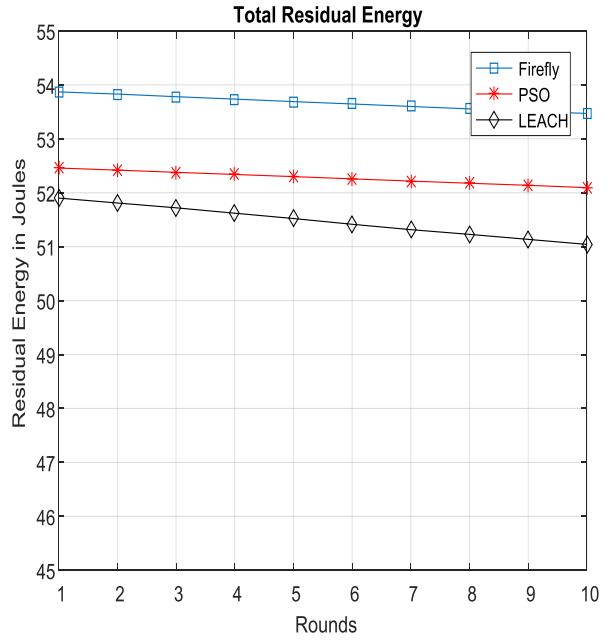

Figure 5.3: Residual energy comparison between FA-LEACH, PSO-LEACH and LEACH

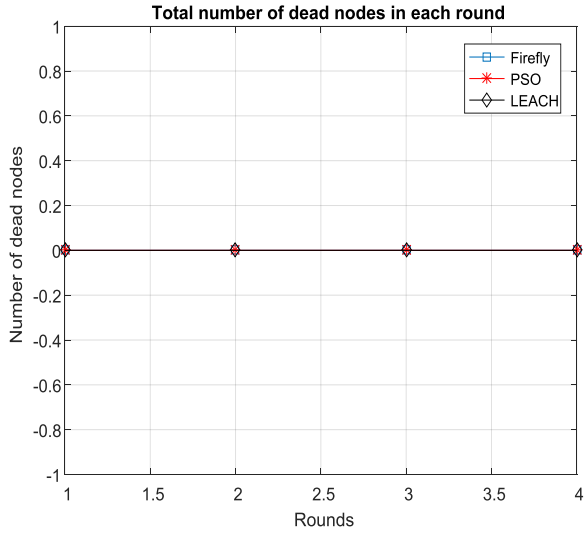

Figure 5.4: Dead Nodes comparison between FA-LEACH, PSO-LEACH and LEACH

IV. CONCLUSION

The present thesis is based on the research taken out to develop the energy saving protocol for the wireless networks. Because of the tiny size of the sensor nodes and there efficiency in data transmission the wireless sensor network are widely opted around the world in various fields. Since the WSN have very limited resources like it has limited memory, constrained computational application. So in terms of energy saving it become much difficult to deploy the WSN in various fields these energy issues limit the WSN application in various fields. As an another source 1EEE 802.15.4 solve this problem upto some extent but it can solved for NWK layer which is the routing layer. In the same there are various other routing protocols are proposed which can be taken place of NWK layer in practice. Expect this other development is also need to be done in this. In our thesis work we worked on LEACH protocol to reduce the energy communication because it's a tow tier protocol which follows the hierarchy of transferring the data from node to sink.

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