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Optimization Algorithms for Energy Consumption in Wireless Sensor Networks

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***Abstract* – In this thesis, we evaluated a clustering based method for homogenous wireless sensor networks. In this method we used PSO method for finding the best route for the transmitting of the information to base station. Then we compared our protocol performance with distributed energy-efficient clustering and LEACH protocol.**

***Keywords* – Wireless Sensor Network, PSO, Energy Consumption.**

I. INTRODUCTION

There are several kinds of data aggregation method such as clustering-based approach, tree-based approach, centralized approach, In-network aggregation etc [1].

In [2], they analyzed and proposed the schemes for energy consumption balancing in nodes and guarantee improving in network lifetime by balancing data traffic load as equally as possible they assumed that network lifetime is defined to be the instant when the first sensor node dies. They also studied energy balancing strategies to prolong the lifetime of sensor network. Depending on load balancing techniques, they obtain an ideal solution and use an experimental technique that comparison with, other routing techniques like shortest-path routing.

In [3], they developed a new algorithm, E3D (Energy Efficient Distributed Dynamic Diffusion routing algorithm), and compared it with two other algorithms, i.e. random clustering, and directed communication algorithm. The purposed algorithm has been developed through the use of cost of set up with the energy efficiency analyzing and favorable sensor network lifetime. Also they compared the purposed algorithm with the performance of optimum clustering and an optimum counterpart algorithm. This algorithm takes advantage of astronomical prohibitive synchronization costs. The comparison of the new algorithm is done in terms of the network system lifetime, power dissipation distribution, cost of synchronization and algorithm simplicity.

Depending on the amount of energy needed to transfer data directly proportional to the number of nodes. To balance energy costs across the network and to increase strength in order to improve the lifetime of WSN is a key issue the researchers. Due to the high dimensions of an epidemic model of WSN on a general scale free networks, it is quite difficult to close study of the dynamics of the network. They develop a model based on free network WSN reduce the scale of the epidemic [4].

In [5], they presented an overview on increasing the network lifetime in WSNs. Where the data transmit route is selected in such a way which the whole energy used along the path is reduced. For this concept of clustering they used cluster to helps energy usage in limited resources which prolongs and improve network lifetime.

In [6], defined WSNs as sensing machine next generations and structures with restricted battery energy as greatest problem of sensor nodes. For distributing the energy in the WSNs, the load of data transfer in the sensor nodes must be balanced properly. Clustering algorithms is one of the important methods for balancing the commutations load. Sometime clustering algorithms may cause in clusters that have more node members than other clusters in the sensor network and unbalance size of clusters impact adversely load balancing in the WSNs. The proposed approach improve cluster algorithm to ensure load balancing in generation of clusters. Efficiency of wireless sensor networks is measured by the aggregate distance between sensor nods to the base station and transferred data amount. The totally responsible for the creating cluster and cluster nodes is cluster head and is may affect the performance of cluster. They create cluster algorithm which selected master node and alternative master node for sub areas and areas. To determine master node the region is divided and they determined the midpoint of region, by this center point master node is selected. For each partitioned parts is divided once more partition if required and which depends on master node and nodes in that divided parts.

In [7], a new technique based on reliable network routing (GBRR) is provided. The achieve in [8], they improve an optimal scheduling algorithm, which order the time slots through which packets must be transmit by the sensor nodes. The scheduling methodology guarantees that all the packets will be sent within a defined time slot and so delay constraints is satisfied and also identical packet loss probability is provided for each node.

In [9], present a new strategy which is use sleep-scheduling. This strategy designed for wireless sensor networks with old fashioned sensor nodes. In this strategy multiple overlap backbones is formed to work alternatively to extend the lifetime of sensor network. The traffic is promoted only by supporting sensor nodes, and all other remaining nodes radios turn off to save battery energy. The multiple backbones turning round grantee that the energy used is balanced in all sensor nodes, which energy fully consumed and a longer network lifetime is achieved in comparison to the other existing techniques.

In [10], they presented virtual scheduling backbone technique performance by combining between local replacement and virtual scheduling graph based algorithm

so the combined algorithm is called as virtual scheduling backbone replacement algorithm technique. In which node renewal according their battery energy plays a key role in sensor network lifetime improvement.

II. Radio Model and PSO Method

We use radio model which shown in figure 1.

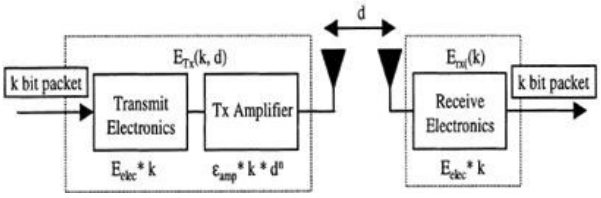

Fig. 1. Radio Model

Whole of sensors need energy to transmit packet of k bits information to a distance d and to receive an information packet of k bits, is given as:

$$E_{Tx}(k,d) = E_{Tx-elec}(k) + E_{Tx-amp}(k,d) \quad (1)$$

$$E_{Tx}(k,d) = E_{elec} \times k + E_{amp} \times k \times d^{n}$$

The n value is depended on the distance between threshold distance values. If the distance is big than the threshold value n will equal to 4 and if the distance is less than the threshold value n will equal to 2.

$$E_{Rx}(k) = E_{Rx-elec}(k) E_{Rx}(k) = E_{elec} \times k \quad (2)$$

$$E_{Rx}(k) = E_{elec} \times k$$

A basic variant of the PSO algorithm works by having a population (called a swarm) of candidate solutions (called particles). These particles are moved around in the search-space according to a few simple formulae. The movements of the particles are guided by their own best known position in the search-space as well as the entire swarm's best known position. When improved positions are being discovered these will then come to guide the movements of the swarm. The process is repeated and by doing so it is hoped, but not guaranteed, that a satisfactory solution will eventually be discovered.

Formally, let f: $\mathbb{R}^n \rightarrow \mathbb{R}$ be the cost function which must be minimized. The function takes a candidate solution as argument in the form of a vector of real numbers and produces a real number as output which indicates the objective function value of the given candidate solution. The gradient of f is not known. The goal is to find a solution **a** for which $f(\mathbf{a}) \leq f(\mathbf{b})$ for all **b** in the search-space, which would mean **a** is the global minimum. Maximization can be performed by considering the function $h = -f$ instead.

Let S be the number of particles in the swarm, each having a position $\mathbf{x}_i \in \mathbb{R}^n$ in the search-space and a velocity $\mathbf{v}_i \in \mathbb{R}^n$. Let $\mathbf{p}_i$ be the best known position of particle i and let **g** be the best known position of the entire swarm. A basic PSO algorithm is then:

III. The Simulation Results

In this paper for evaluating of the proposed method we used MATLAB 2017a version. The Total energy consumption at different time slots is shown in figure 2.

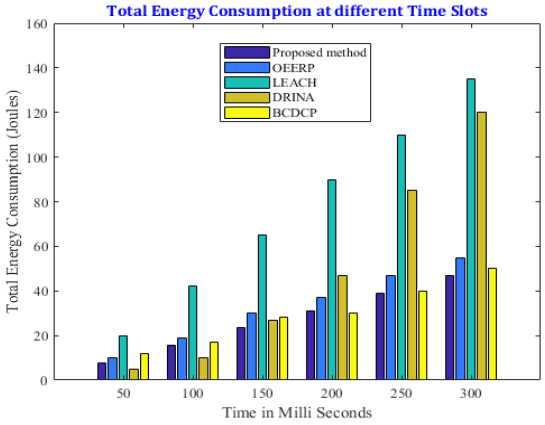

Fig. 2. Total energy consumption at different time slots.

As seen in this figure the highest value for OEERP is got. Also the proposed method has lowest one.

The throughput at different time slots is illustrated in figure 3.

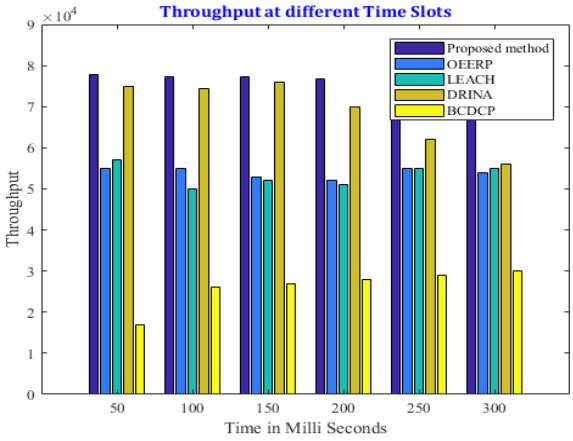

Fig. 3. Throughput at different time slots.

As shown in this figure proposed method has the highest value for the throughput. As shown in this figure the lowest value is got for the BCDCP method.

The Packet delivery ratio at different time slots is shown in figure 4.

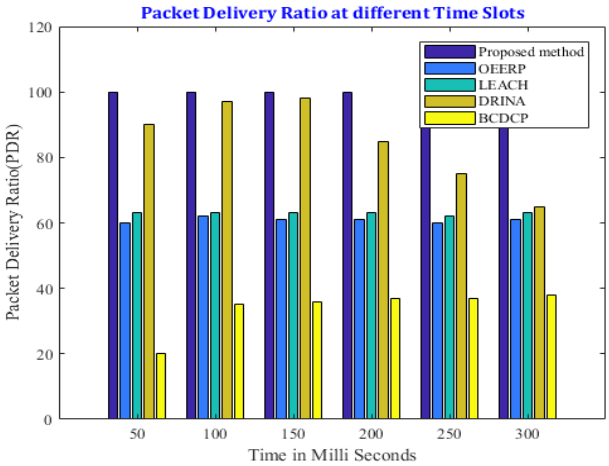

Fig. 4. Packet delivery ratio at different time slots

The proposed method has the maximum value in the packet delivery.

The overall network lifetime at different time slots is shown in figure 5.

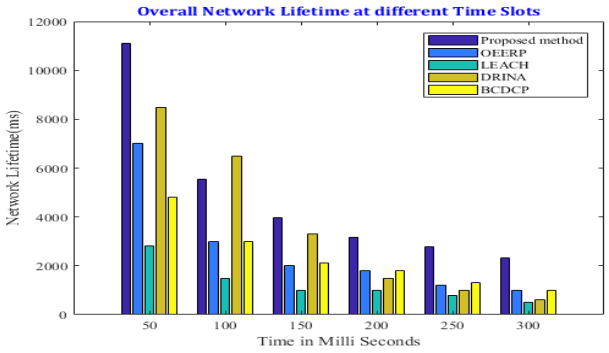

Fig. 5. Overall network lifetime at different time slots

IV. Conclusion

In this paper we saved the energy of the nodes. The important goal of this paper is to reduce the total energy consumption of the wireless sensor network. Changing the cluster head election probability with PSO method is implemented and with more efficiency maked the sensors use low energy and save a lot of energy in whole of network.

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