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Clustering technique in WSN using PSO algorithm

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ABSTRACT

The lifetime maximization of the network is taken into account because of the major task while deploying a WSN. Some sort of protocols was designed to satisfy the necessity. Clustering technique is taken into account collectively of the necessary technique for the topology control to attain the target. This paper focuses on the lifetime maximization of the nodes by using Particle Swarm Optimization (PSO) algorithm. The proposed protocol shows higher ends up in a well-balanced clustering system that improves the network lifetime. Analysis, MATLAB Simulation, and the Experimental result were illustrated in this paper.

Keywords: *WSN, PSO, Clustering*

1. INTRODUCTION

The WSN is a self-organized system having a number of nodes. It is an infrastructure based comprising of sensing(measuring), computing and communication elements that give an administrator the ability to observe and react to the events in a specified environment[]. Within the WSN, lots of money of tiny, battery-powered sensor nodes are scattered throughout a physical area. Each sensor in the network collects data, as an example, sensing vibration, temperature, radiation- along with other environmental factors. WSNs rapidly deployed in many practical applications, including home security, battle-field surveillance, monitoring movement of wild animals in the forest, healthcare applications etc... WSN includes 100s to a large number of multifunctional sensor nodes with low power, operating within the environment which is unattended, and having computation, sensing and communication capabilities.

Network setup can be carried out without fixed infrastructure is a typical advantage of WSN. Suitable for the non-reachable places such as over the sea, mountains, rural areas or deep forest. WSN is less secure because hackers can enter the access points and obtain all the information. Also, the speed is less when compared to a wired network. And gets distracted by various elements like blue-tooth.

Clustering is one of the most important methods for prolonging the network lifetime in WSN. In clustering architecture the sensor noes are organized into clusters, the clustering can reduce the power usage in the routing protocols. Clusters in which cluster heads are there to provide information to the base station.

There are a variety of algorithms that have been used in WSN accordingly. Different algorithms have their own task in WSN. The Particle Swarm Optimization (PSO) algorithm is a type of algorithm in which it deals with the WSN in an efficient manner.

In this paper, lifetime maximization of the WSN using the PSO algorithm is explained, at present, the studies on WSN, mainly focus on the clustering technique, and the main factor PSO algorithm. Therefore, this paper applies the PSO algorithm to wireless sensor networks, to increase the network lifetime and proposes clustering technique in wsn using pso algorithm.

The proposed algorithm is very suited for finding the fitness values as compared with other protocols. The number of iterations is higher in this proposed algorithm.

The remainder of this paper is illustrated as follows. The architecture of WSN is explained in Sections II. The clustering technique is presented in III. The PSO algorithm is explained in section IV. Finally, the simulation results are given in Sections V and Experimental results are given in section VI to verify the features of the proposed algorithm.

2. ARCHITECTURE OF WSN

Wireless Sensor Networks are the collection of a large number of nodes, consisting of distributed devices using sensors to monitor physical or environmental conditions. Environmental factors such as temperature, humidity, pressure, sound etc… Applications include military, healthcare, home security etc.

Fig.1 shows the architecture in which: the sensor nodes could be a multi-functional, energy efficient wireless device. The applications of motes in industrial are widespread; a set of device nodes collects the information from the environment to attain specific application objectives. The communication between motes is done with one another using transceivers.

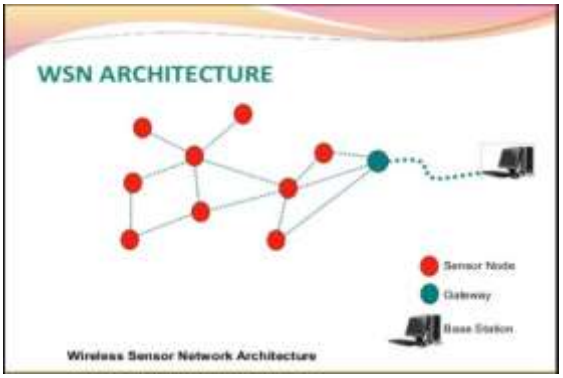


Fig.1: WSN architecture

3. CLUSTERING TECHNIQUES

Clustering algorithms are often classified as Distributed clustering & centralized clustering. Distributed clustering techniques are again classified into four sub types based on the cluster formation criteria and parameters used for CH selection as Identity primarily based, Neighborhood info primarily based, Probabilistic, and iterative respectively.

Clustering is the task of dividing the population or data points into a variety of groups' specified data points within the same groups are more the same as alternative data points within the same cluster than those in other groups. In easy words, the aim is to segregate groups with similar traits and assign them into clusters.

The clustering approach is able to increase network longevity and to improve energy efficiency by minimizing over- all energy consumption and balancing energy consumption among the nodes during the network lifetime [3]. Moreover, it is capable of alleviating channel contention and packet collisions, resulting in better network throughput under high load [1], [2].

Clustering Setup Part

In the sensor network, every node is assigned an index (ID) in accordance with its location, and the algorithm rule of cluster heads and relay nodes is administrated by the bs similar to different protocols. The cluster head in a cluster acts because of the center for the target of coordinative data transmissions. The cluster head sets up a TDMA scheduler and broadcasts the SCHEDULE-MSG message to the common nodes within the cluster moreover because of the corresponding relay node. This avoids collisions among data messages and collectively permits the radio parts of each common node and relay node to be switched off at all times, except once the common nodes transmit messages or relay nodes receive messages. This helps to increase spectral potency and reduce energy consumption by individual sensors.

Data Transmission Part

In this section, the common nodes send info to their cluster head as scheduled by the TDMA scheduler. The nodes are all synchronal through the BS sending out synchronization pulses to the nodes. The cluster head should be awake in any respect times to receive all the data from the common nodes within the cluster, then it aggregates the data to boost the common signal and to scale back the un-correlated noise among the signals. Afterward, the cluster head transmits the aggregate info to the relay node. Through analyzing the TDMA scheduler managed by the cluster head, the sensor nodes can activate or off radio thus on save energy.

4. PROPOSED PSO ALGORITHM

There are a variety of algorithms that have been used in WSN accordingly. Different algorithms have their own task in WSN. The Particle Swarm Optimization (PSO) algorithm is a type of algorithm in which it deals with the WSN in an efficient manner.

Particle swarm optimization (PSO) is a population-based stochastic optimization technique developed by Dr. Eberhart and Dr. Kennedy in 1995, inspired by social behavior of bird flocking or fish schooling.

Particle Swarm Optimization would possibly sound difficult, however, it's extremely a straightforward algorithm. Over a variety of iterations, a bunch of variables has their values adjusted nearer to the member whose value is nearest to the target at any given moment. Imagine a flock of birds circling over a region wherever they'll smell a hidden supply of food. The one who is nearest to the food chirps the loudest and therefore the other birds turn in his direction. If any of the other circling birds comes nearer to the target than the primary, it chirps louder and therefore the others veer over toward him. This modification pattern continues till one amongst the birds happens upon the food. It is an algorithm that is straightforward and simple to implement.

Energy Consumption Analysis

Since the cluster head is close to the common nodes in its cluster, probably the energy dissipation follows the free space model (i.e., $d2$ power loss). Moreover, the expected value of $d2$ (E [$d2$]) is obtained as follows:

$$E[d^2] = m^2 / 2n\prod \quad (1)$$

The energy dissipated within a cluster is given by;

$$E_{cluster} = E_{CH} + E_{RN} + (N/n - 2)E_{CN} \quad (2)$$

The total energy consumed by the sensor network is given by;

$$E_{total} = nE_{cluster} \quad (3)$$

Where CN is referred to as the nodes which are common in the cluster.

5. SIMULATION RESULTS

To verify the features of the proposed converters, simulations based on the open-loop system are performed. In all the proposed converters, the simulation parameters are selected as presented in Table 1.

Table 1: Simulation Parameters

Type	Parameter	Values
Network	Area Initial Energy	(100,100) 1 J
PSO	Particles Iterations	50 100
Radio Model	E_{lec} E_{fs} E_{mp} $d0$	0.01 10pJ/bit/m^2 0.0013pJ/bit/m^3 75m

Simulation of the algorithm

Fitness is used to extend the lifetime and efficiency of the network. The fitness function is calculated by the actual distance from the node to sink or base station.

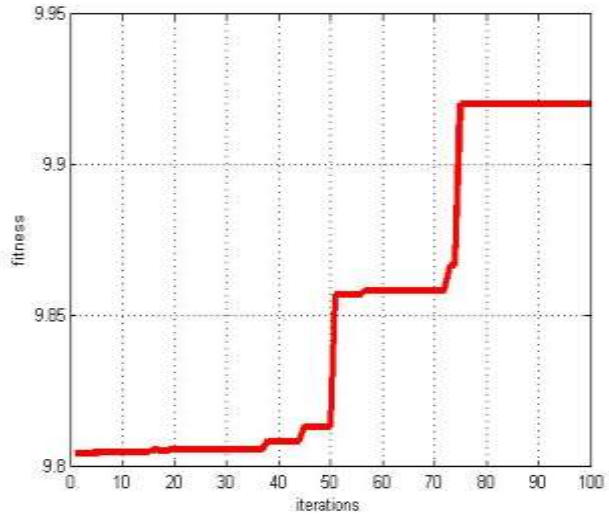
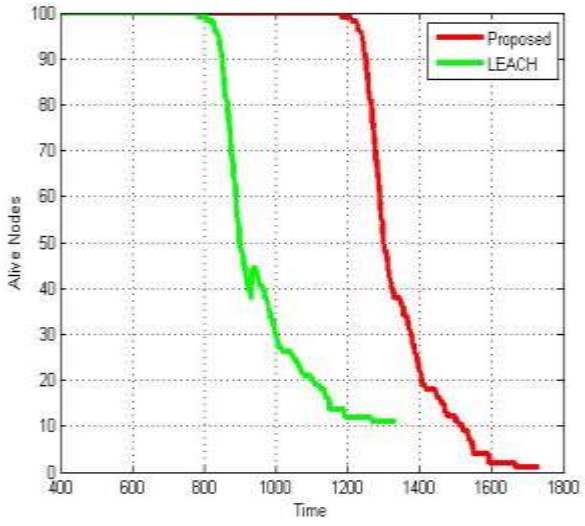


Fig. 2: Convergence of the fitness values

Above graph shows the convergence of the fitness value of the objective function. It is observed that the fitness values converges after 80 iterations. Thus the maximum clusters are formed accordingly. The sum of the distances between the nodes is found out according to the equations mentioned above. After 80 iterations the fitness values of the nodes become constant which can be seen in the graph. Thus we can say that the fitness of the nodes (i.e. fitness of the location) is achieved, and the communication can be done effectively.

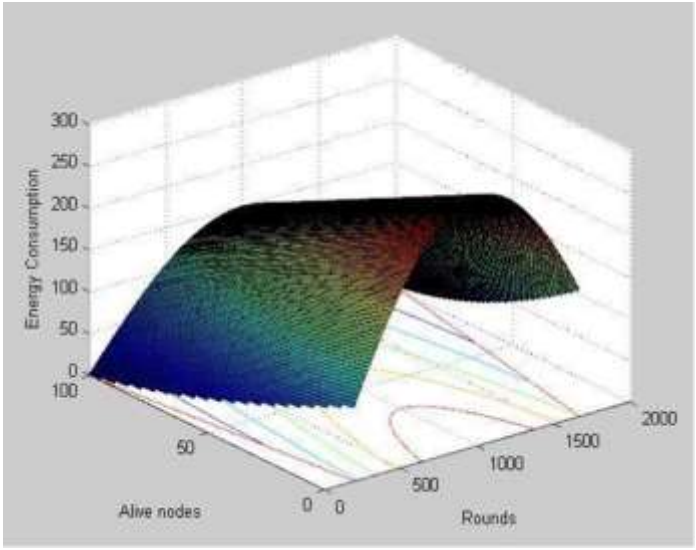
Comparison between protocols

The following figure shows the comparison between the LEACH and the proposed protocol. The figure shows the number of alive nodes during the simulation time in terms of rounds. The proposed protocol performs constantly better than the other protocol. The maximum number of alive nodes is shown by the proposed protocol.



Energy consumption of the network

The total energy consumption of the sensor network versus the number of alive nodes and the number of rounds is shown in a 3D plot. It is seen that the number of nodes dies after 1400 rounds. All nodes are alive for a particular time only, the nodes in which they have a special task. Each and every node is assigned to do the task. From the figure, it is clear that the energy of the nodes is decreased as the lifetime advances.



6. CONCLUSIONS

Particle swam optimization is a heuristic optimization technique based on swarm intelligence. Compared with the other algorithms, the strategy is incredibly straightforward, simply completed and it wants fewer parameters that created it fully developed. However, the research on the PSO remains at the beginning; a lot of issues are to be resolved.

Research on the topology of the new pattern particle swarm which has a better function can be carried out. The neighboring topology of the different particle swarms is based on the imitation of the different societies. It is meaningful to the use and spread of the algorithm to select the proper topology to enable PSO to have the best property and do the research on the suitable ranges of different topologies.

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