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A Survey on Node Placement for Wireless Sensor Network Using Pso Algorithm

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ABSTRACT: *A wireless sensor network is a group of low cost, low power, multifunctional and small size distributed networked sensors. These sensors work together to sense the environment with a little or no human intervention. Developers of WSNs face challenges that arise from communication link failures, memory and computational constraints, and limited energy. Particle Swarm Optimization (PSO) is a simple, effective and computationally efficient optimization algorithm. It has been applied to address WSN issues such as optimal deployment, node localization, clustering and data-aggregation. Node placement is an important task in wireless sensor network Particle swarm optimization is one of the latest population based evolutionary optimization techniques which is based on the behaviours of bird flocking and fish schooling. PSO algorithm based framework has been proposed in this paper.*

Keywords:*Node Placement Problem, Particle Swarm Optimization, Wireless Sensor Network.*

I. INTRODUCTION

Sensor networks have a long history, which can be traced back as far as the **1950's**.The first sensor network was the Sound Surveillance System (SOSUS) [1, 2]. Evolution of technologies has driven sensor networks away from their original appearance. With theemergence of integrated sensors embedded with wireless capability, most of current sensor networksconsist of a collection of wirelessly interconnected sensors, each of which is embedded with sensing,computing and communication components. These sensors can observe and respond to phenomena in the physical environment [3]. Such sensor networks are referred to as wireless sensor networks (WSNs).
A Wireless Sensor Network (WSN) is a group of various small, low power, inexpensive sensor nodes working together for gathering information from an environment. In **2001**, Intel Research Lab at Berkeley focused on WSN. Developers of WSN face challenges that arise from limited energy, communication link failures and memory constraints [4]. A WSN has some resource and memory constraints. The major resource constraints are coverage, connectivity and energy consumption. WSN issues such as localization, node deployment, energy-aware clustering and data-aggregation are formulated as optimization problems [5].
In past few decades, the applications of WSNs have increased considerably. Depending upon the application and types of sensors in WSNs, nodes may be deployed either randomly or deterministically. The random node placement is used in some applications such as disaster recovery and forest fire detection. For expensive nodes deterministic node placement is used. The position of nodes affects different parameters of the WSNs. The most important parameters are power consumption, network coverage and connectivity. Several algorithms have been proposed as methods for handling these issues. In this paper Particle Swarm Optimization (PSO) algorithm was used to address node placement problem. Node placement is an important task in wireless sensor network. It also presents issues in node placement and a brief survey of PSO algorithm.

1.1 Node Placement Problem

The method of creation for a sensor network is a network with nodes at regular intervals, in which case nodes are simply placed at grid (or hexagon, etc.) locations. A more subtle technique is required to form a network with random node locations while preserving connectedness.

Random seed node networks

One method of network generation places a seed node at the origin. An angle is selected at random in $[0\ 2\pi]$ and a distance at random in $[0\,R]$. The second node is then placed at the selected angle and distance from the first. The third node is placed according to the same criteria relative to either of its predecessors (selected at random) and so forth. The downside to this method is that nodes situated near the origin (typically those placed first) will generally have increased connectivity relative to those farther away (placed later). This results in a normal distribution of connectivity in the network - in order to simulate fairly.

Sequential seed node networks

A variation places a node exclusively relative to its direct predecessor (i.e. node 4 placed relative to node 3) in a 2D random walk. This has the effect of spreading the network out over a larger geographical area, maintaining a Gaussian distribution centered at the origin and with a standard deviation of 1.55R.

The node density is only one factor that affects network topology. The actual placement of nodes is also significant. The placement of nodes affects the ability of a network to correctly sense an event while it also affects the number of possible disjoint paths towards the sink(s). Thus, we claim that the placement of sensor nodes on a monitored field is a factor that it is possible to affect the overall performance of the network.

Placement of nodes in a network can be divided into three major categories concerning the way that nodes are placed in the field. These are the deterministic node placement, the semi- deterministic node placement and the non- deterministic (stochastic) node placement. The nodes are placed in four different placements in order to cover all categories. A deterministic placement (Grid),a semi-deterministic (Biased Random) and two non-deterministic (Simple Diffusion and Random).

1.1.1 Deterministic node placement

In deterministic node placement, nodes are placed on exact, pre- defined points on a grid or in specific parts of the grid. Usually, deterministic or controlled node placement is specified by the type of nodes, the environment in which the nodes will deploy, and the application. Therefore, in applications like Sensor Indoor Surveillance Systems or Building Monitoring, nodes must be placed manually.

1.1.2 Semi- Deterministic node placement

Semi- deterministic placement is the placement, where, although individual nodes are placed in a non-deterministic way on the grid (e.g. random) the areas where nodes are going to be spread are deterministic. This means that in a microscopic way the placement of nodes is non- deterministic while in a macroscopic way the placement is deterministic.

1.1.3 Non- deterministic node placement

Deterministic placement is not so realistic when many sensor nodes are placed in a large area. In such a situation, stochastic placement is needed. There are two stochastic placements, Simple Diffusion and Random placement

Simple Diffusion: This node placement emulates the distribution of nodes when they are scattered from air e.g. from airplane.

Random Placement: This is a commonly used topology and sensor nodes are placed so that their density is uniform.

II. RELATED WORK

Several node placements have been proposed in literature concerning WSNs.

In **2004** authors evaluate the tolerance against both random failure and battery exhaustion from the viewpoint of stochastic node placement. They consider three typical types of stochastic sensor placement: Simple diffusion, Constant Placement and R- Random placement.
In **2008**, Younis et al ([6]) present a survey for strategies and techniques for node placements in WSNsand provide a categorization of the placement strategies into static and dynamic, dependingon whether the optimization is performed at the time of deployment or while the network isoperational.
Toumpis et al ([7]) provide an optimal deployment of large wireless sensor networks so as tominimize the number of nodes that is needed in order to transmit data from multiple sourcesto multiple sinks.
In ([9]) authors studied the problem of determining the critical node density for maintainingk-coverage of a given square region. They have considered three different deploymentstrategies: Poisson point process, uniformrandomdistribution and grid deployment and haveshown that the two random strategies have identical density requirements for k-coverage.They also showed that grid deployment requires less node density than the two randomdeployments strategies in order to achieve the same level of coverage degree.
In **2010**, authors study the energy utilization performance of HTAP algorithm underspecific node placements, in correlation with Directed Diffusion ([9]) algorithm. Simulationsresults show that the performance of HTAP, a "resource control" algorithm, is improved whennodes are densely deployed near hotspots.

1.2 Particle Swarm Optimization

Particle Swarm Optimization (PSO) is a simple, effective and computationally efficient optimization algorithm that optimizes a problem by iteratively trying to improve a solution. PSO was introduced by Kennedy and Eberhart in **1995**, inspired by social behaviour of bird flocking or fish schooling. PSO has been used in various distribution networks, structural optimization, environmental monitoring and military applications. PSO is a population based approach for solving discrete and continuous optimization problems. PSO is initialized with a group of random particles (solutions) and then searches for optima by updating generations. In every iteration, each particle is updated by two best values:

i) Best solution (fitness) it has achieved. This value is called pbest.
ii) Best value, obtained by any particle. This best value is global best and called gbest.

After finding the two best values, the particle updates its velocity and positions with following equation (1) and (2).

v[] = v[] + c1 * rand() * (pbest[] - present[]) + c2 * rand() * (gbest[] - present[]) (1)
present[] = persent[] + v[] (2)

v[] is the particle velocity, persent[] is the current particle (solution). pbest[] and gbest[] are defined as stated before. rand () is a random number between (0,1). c1, c2 are learning factors. usually c1 = c2 = 2.

The pseudo code of the procedure is as follows

```
For each particle
   Initialize particle
END
```

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Do
   For each particle
      Calculate fitness value
      If the fitness value is better than the best fitness value (pBest) in history
         set current value as the new pBest
   End

   Choose the particle with the best fitness value of all the particles as the gBest
   For each particle
      Calculate particle velocity according equation (a)
      Update particle position according equation (b)
   End
```

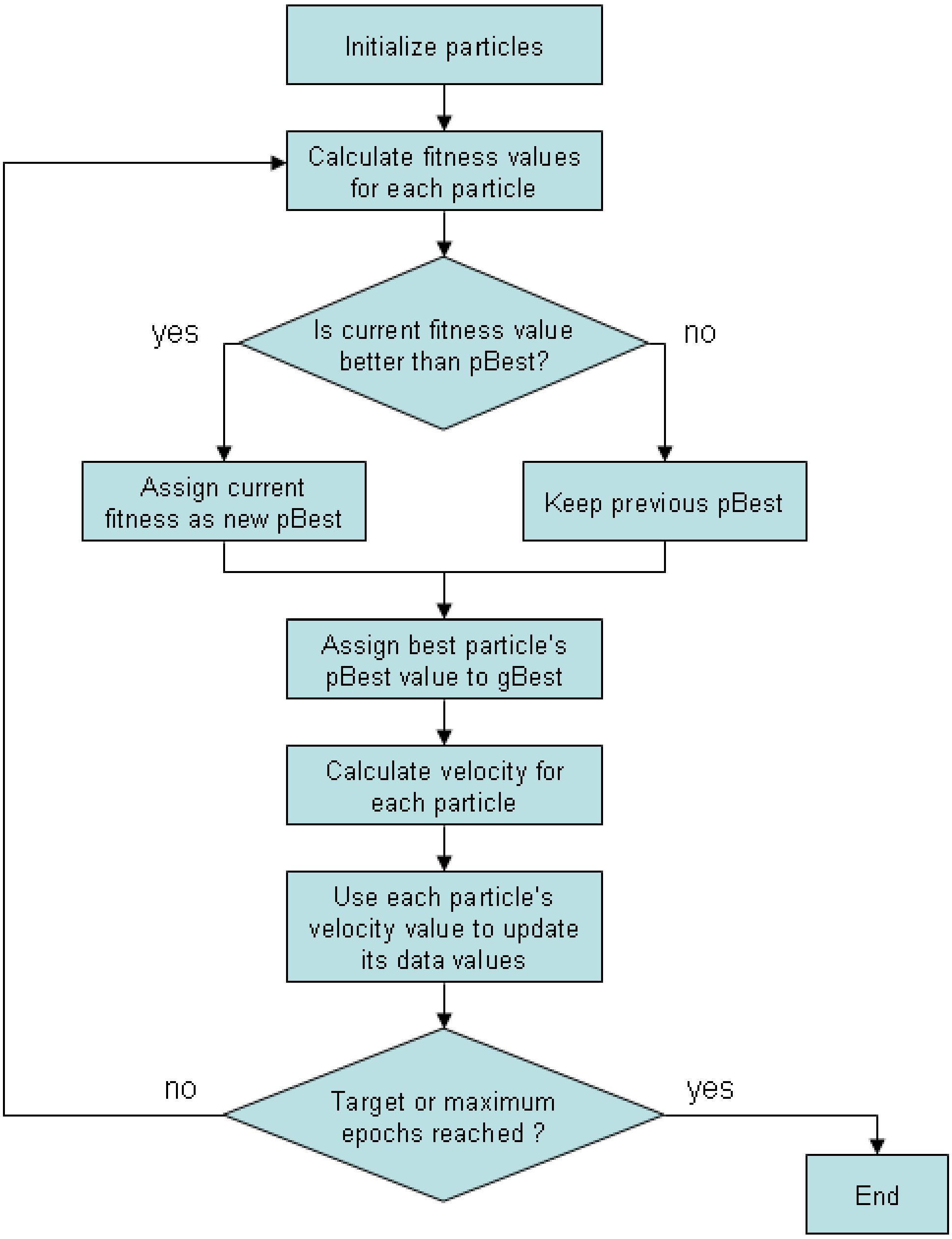

Fig.1. Flow diagram illustrating the particle swarm optimization algorithm.

1. Other Algorithms

The computational complexities of traditional optimization methods grow exponentially with the problem size. The cost of mathematical programming engines and resource requirements make them unattractive for resource constrained nodes. This is the motivation for heuristic algorithms such as Genetic Algorithm (GA), PSO, Bacterial Foraging Algorithm (BFA) and Differential Evolution (DE). DE is similar to GA, but it uses a differential operator. BFA models the foraging behaviour of bacteria that use a combination of straight line and random movements to reach nutrient rich locations. GA facilitates evolution of the population generation by generation using operators. PSO is similar to the Genetic Algorithm (GA) means that these two evolutionary heuristics are population-based search methods.

2.1 Comparisons between Genetic Algorithm and PSO

Most of evolutionary techniques have the following procedure:
1. Random generation of an initial population
2. Recording of a fitness value for each subject. It will directly depend on the distance to the optimum.
3. Reproduction of the population based on fitness values.
4. If requirements are met, then stop. Otherwise go back to 2.

From the procedure, we can learn that PSO shares many common points with GA. Both algorithms start with a group of a randomly generated population, both have fitness values to evaluate the population. Both update the population and search for the optimum with random techniques. Both systems do not guarantee success.

However, PSO does not have genetic operators like crossover and mutation. Particles update themselves with the internal velocity. They also have memory, which is important to the algorithm. Compared with genetic algorithms (GAs), the information sharing mechanism in PSO is significantly different. In GAs, chromosomes share information with each other. So the whole population moves like a one group towards an optimal area. In PSO, only gBest (or lBest) gives out the information to others. It is a one -way information sharing mechanism. The evolution only looks for the best solution. Compared with GA, all the particles tend to converge to the best solution quickly even in the local version in most cases.

III. CONCLUSION

Particle Swarm Optimization (PSO) is a relatively recent heuristic search method that is based on the idea of collaborativebehaviour and swarming in biological populations. PSO is similar to the Genetic Algorithm (GA) sharing among their population members to enhance their search processes using a combination of deterministic and probabilistic rules. This paper covers the Particle Swarm Optimization Algorithm available for node placement problem.

REFERENCES

[1] Whitman, E.C. Sosus: The "Secret Weapon" of Undersea Surveillance. *Undersea Warfare* 2005, *7*. Available online: http://www.navy.mil/navydata/cno/n87/usw/issue 25/sosus.htm (accessedSeptember 17, 2009).
[2]Chong, C.Y.; Kumar, S.P. Sensor Networks: Evolution, Opportunities, and Challenges. *Proc.IEEE* 2003, *91*, 1247–1256.
[3]Akyildiz, I.F.; Su, W.; Sankarasubramaniam, Y.; Cayirci, E. Wireless Sensor Networks: A Survey.*Comput. Netw.*2002, *38*, 393–422.
[4] SamanehHojjatoleslami, VaheAghazarian, Mehdi Dehghan and NimaGhazanfarihMotlagh, PSO Based Node Placement Optimization for Wireless Sensor Networks, *IEEE,2011.*
[5] Raghavendra V. Kulkarni, Senior Member, IEEE, and Ganesh Kumar Venayagamoorthy,Senior Member IEEE.
[6] Mohamed Younis and Kemal Akkaya. Strategies and Techniques for Node Placement inWireless Sensor Networks: A Survey. *Ad Hoc Networks*, 6(4):621–655, 2008.

[7]Stavros Toumpis and LeandrosTassiulas.Optimal Deployment of LargeWireless SensorNetworks.*IEEE Transactions on Information Theory*, 52(7):2935–2953, 2006.
[8] Mika Ishizuka and Masaki Aida.Performance Study of Node Placement in SensorNetworks.*ICDCSW '04: Proceedings of the 24th International Conference on DistributedComputing Systems Workshopsd*, pages 598–603, March 2004.
[9] H. Zhang and J. C. Hou. Is deterministic deployment worse than random deploymentfor wireless sensor networks? In *INFOCOM 2006. 25th IEEE International Conference onComputer Communications. Proceedings*, pages 1–13, April 2006
[10]V. Vassiliou and C. Sergiou. Performance Study of Node Placement for CongestionControl inWireless Sensor Networks. In *New Technologies, Mobility and Security (NTMS),2009 3rd International Conference on*, pages 1 –8, dec. 2009
[11]CharalambosSergiou and VasosVassiliou.Energy utilization of HTAP under specificnode placements in Wireless Sensor Networks. In *Wireless Conference (EW), 2010European*, pages 482 –487, 12-15 2010.
[12] Rania Hassan, BabakCohanim, Olivier de Weck, Gerhard Venter, A Comparison of Particle Swarm Optimization and The Genetic Algorithm, *Vanderplaats Research and Development, Inc., Colorado Springs, CO, 80906.*
[13] Kennedy, J. and Eberhart, R., "Particle Swarm Optimization," *Proceedings of the IEEE International Conference on Neural Networks*, Perth, Australia 1995, pp. 1942-1945.