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A Survey on Swarm Optimization Technique in Wireless Sensor Network

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Abstract - *Wireless sensor network (WSNs) are getting to be prominent in certifiable applications. Because of the highlights of the asset obliged and battery-mindful sensors; in WSNs energy use has observed to be a noteworthy fascinating subject of research. WSNs create battery-powered nodes which are associated with the base station to for certain activity or assignment. As sensor nodes are battery-powered i.e. will turn out to be dead after the utilization of the battery which is likewise called lifetime of WSNs. So utilizing the energy in efficient way may bring about dragging out the lifetime of the WSNs. Subsequently, it is important to assemble and move the data in an enhanced way which decreases the energy dissemination. The author contribution to this paper is the comparison is made among the swarm optimization techniques i.e. Ant Colony Optimization, Particle Swarm Optimization and Genetic algorithm.*

Key Words*: *Wireless Sensor Networks, Ant Colony Optimization, Particle Swarm Optimization and Genetic algorithm

1. INTRODUCTION

The Sensors are mainly used to sense the environment and to gather the data to a centralized location. Advent of processing devices and networks makes it as "Wireless Sensor Network" [1]. Development in Semi-conductor technology and Networking methods have stimulated the use of sensor networks for observing and information collection. In Wireless sensor network, information collected by sensors is gathered at a distant location for analyzing and computation purpose via wireless links. Some applications of wireless sensor network include medical, environmental, transportation, military, entertainment, homeland, defense, and crisis management etc. Alike to other communication systems, wireless sensor network systems development has a diversity of origins. The history of development can be briefly alienated into four phases [2]:

Phase 1: During the cold war period, there was a need to monitor and detect the positions of enemies which gave birth to number of projects such as Sound Surveillance System and radar networks developed by United States.
Phase 2: DARPA (Defense Advanced Research Projects Agency) of United States Department of Defense initiated the research programs in the early 1980s that were basically focused on advance developments on new technologies and protocols of wireless sensor networks.
Phase 3: Projects undertaken by DARPA laid the foundation for military applications developments based on wireless sensor networks. Huge amount of money spent on newer technologies made the development faster in early 1990s.
Phase 4: Recent advancements in semi-conductor technologies and networking techniques directed an innovative stage in the growth of sensor network technology. In 2000's IEEE released the first version of IEEE Standard i.e. 802.15.4 standard "Low Rate Wireless Personal Area Networks" which is the base for recently introduced standards such ZIGBEE [3].

From last few decades researchers are making exertions for Wireless Sensor Network (WSN) routing technology with more power efficient protocols. Diverse government and research agencies are trying to put different proposals for Wireless Sensor Technology advancements.

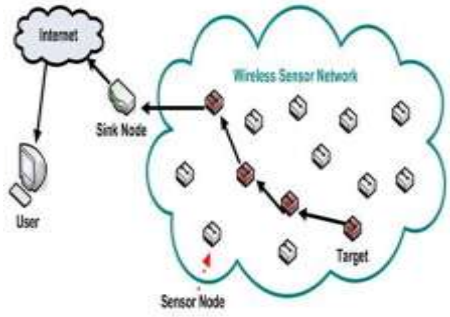


Figure-1. Diagram of WSN

Wireless sensor network contains battery functioned small nodes which are positioned over a wide geographical area to monitor the events and to accumulate the collected data to a distant centralized location called as base station as shown in Figure 1.1. Nodes are deployed in such a way that the entire area is in the coverage of wireless nodes The deployed nodes sense the data from its neighborhood and transmit the collected data for further processing. The main distinction between ad hoc networks and Wireless Sensor Networks is their applications area. Ad-hoc networks primarily focus on communications aspects whereas wireless area networks focuses more on monitoring and information collection. Wireless nodes are bound by several resource restrictions such as the memory availability, battery power, bandwidth requirement and the data rate. These tiny nodes may work for a longer duration of time from few months to many years depending upon the application requirements, so the battery power needs to be employed proficiently so as to extend the network life time. Sleep Mode operation of nodes is efficient way to increase the life time. Nodes wakes-up only when

there is a need to sense the environment. In order to save the maximum battery life, the sensor node should communicate by using a special routing technique

1.1 Transmission Between Node and Sink

In single-hop transmission, every sensor hub/node can send information to the sink through a solitary jump i.e. by long separation transmission. In any case, the confinement of this transmission is that it isn't ideal regarding energy utilization. So as to beat this downside, we have to diminish the separation in this way can expand energy effectiveness and draw out the system lifetime and this can be accomplished by Multi-hop. In multi-hop transmission every hub courses it information through different hubs and these hubs send the information to sink, in this way it diminishes the transmission separation and energy utilization when other hub go about as switches. Restriction of this technique is that the energy of hub situated close to the sink will drop rapidly. So as to beat the impediment found in Multi-hop transmission, another answer for decline energy utilization is clustering technique.

2. Clustering

In clustering, groups are formed and each gathering has one pioneer called Cluster Head (CH).Group individuals or we can say group individuals sends their information to CH and afterward CH sends that information to BS. Different calculations were proposed to decrease energy utilization of sensor.

2.1 Clustering Objectives

Different goals have now been sought after by different writings in creating clustering structure for WSN. Numerous targets are set to meet the application limitations. This part give three primary targets that are emphatically related the concentration.

2.1.1 Clustering Objectives

- Maximizing network Life-time
- Fault-tolerance
- Fill handling

2.2 Cluster Head Variety Standards

I. **Original energy** To select the initial energy group head is a significant parameter. When any algorithm begins it usually thinks the initial energy.
II. **Recurring energy** after a number of the times are done, the group head collection must be on the basis of the energy left out in the sensors.
III. **Average energy of the network**: This energy is used whilst the guide energy for every node. It's the ideal energy that all node must possess in current circular to help keep the network alive.

3. Mobile Sink (MS)

To enhance energy effectiveness or decline to diminish energy utilization another idea called Mobile Sink has been presented[4,5,6]. Sink development might be controlled or un-controlled. In controlled MS, the MS direction is predefined while in uncontrolled MS, the sink moves arbitrarily in a pre-decided condition

4. Optimization Techniques

This section introduces several SI-based algorithms, highlighting their notable variants, their merits and demerits. These algorithms include Genetic Algorithms (GA), Ant Colony Optimization (ACO), Particle Swarm Optimization (PSO)[7,8,9].

4.1 Genetic Algorithm (GA)

GA is versatile heuristic pursuit calculation dependent on developmental thoughts of common determination and hereditary qualities. GA recreates the survival of the fittest among people over continuous age for tackling an issue. Every age comprise of a populace of character strings that are closely resembling the chromosome that we find in our DNA. Every individual speaks to a point in a hunt space and a conceivable arrangement. The person in the populace are then mode to experience the procedure of development. GA depend on hereditary structure and conduct of chromosomes.

Algorithm:

At first, the underlying populace is haphazardly created. New populace s are made in consequent age using four crucial systems

Selection: chooses individual for cross over and mutation

Cross-over: technique that causes the exchange of genetic materials between parents to produce off springs

Mutation: In corporate new genetic trails

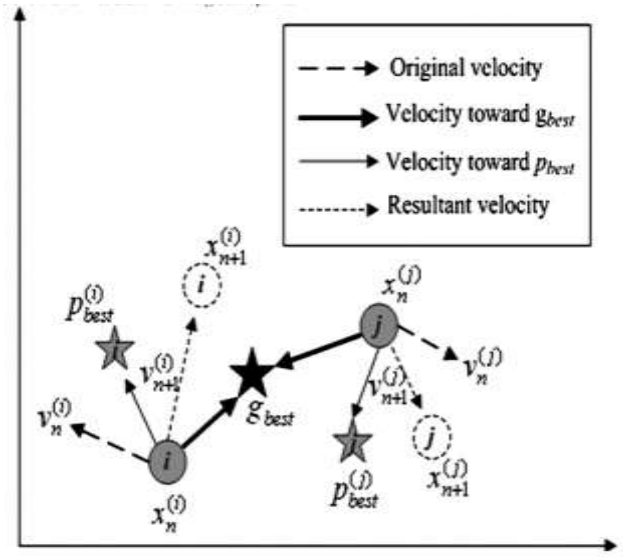
GA keeps up this populace and over and again alters to create another age of chromosomes. This procedure is rehashed until most extreme quantities of age are accomplished.

Advantages:

1. Can tackle each enhancement issue which can be depicted with the chromosomes encoding.
2. Not dependent on error surface so we can solve problems of multi dimensional, non difference, non continuous and non parametrical nature.
3. can be effectively exchanged to existing simulation and models

4.2 PSO

Particle swarm optimization is one of swarm knowledge procedure. Particle swarm optimization manages issues for finding a best arrangement and in a n-dimensional space it very well may be spoken to as a surface or point. Here every molecule finds the answer for the issue, to do as such theory are plotted in the space and chose with an underlying speed, and a correspondence channel between the particles. When an underlying speed are connected, Particles begins traveling through the arrangement space and quickens towards alternate particles which have better wellness esteems inside their correspondence gathering. The principle chief of this methodology when contrasted with other worldwide minimization procedures is that the tremendous number of individuals that make the molecule swarm cosmetics this technique strikingly adaptable to the issues of neighborhood minima. Particle swarm optimization (PSO) was first presented by Kennedy and Eberhart. It is a generally new stochastic advancement procedure that can reenact the swarm conduct of feathered creatures running. In PSO, a person in the swarm, called a molecule, speaks to a potential arrangement. Every molecule has a wellness esteem and a speed, and it takes in the encounters of the swarm to scan for the global optima



In the Particle swarm improvement conduct where every particle when chosen with some underlying speed begins traveling through the arrangement space. They quicken toward alternate particles which have better wellness esteem. When every one of the particles finds the best arrangement, in the above figure it is spoken to as P_{best}^{i} and P_{best}^{j}. Among these got arrangement the best arrangement is again determined which is spoken to in the above figure as g_{best}.

Advantages

1. Easy to implement.

2. Only few parameters need to adjust.

3. Efficient global search.

4. Good solution because of its ability to escape from local optimal.

5. Quick result

4.3 ACO

ACO is also the Member of swarm streamlining method, produced by Marco Dorigo (1991 Phd proposal). It is fundamentally a procedure to locate the shortest path among source and goal. It mirrors the conduct of characteristic ants.

Algorithm

At first ants moved arbitrarily when nourishment source is discovered ants stroll back to the state leaving markers (pheromones) that demonstrate the way has discovered when different ants gone over these markers.

They are probably going to pursue a similar way with certain likelihood. On the off chance that they do, they populate the way with their own markers as they bring the sustenance back. The way gets more grounded the same number of ants pursue a similar way, as the ants drops pheromones each time they bring their nourishment. Meanwhile a few ants are still haphazardly hunting down nearer sustenance source. A comparable methodology can be utilized to discover close ideal answer for the travelling salesman problem. When the nourishment source is exhausted the root has no longer pheromones and gradually begins rotting.

Advantages

1. Inherit parallelism

2. Used in various dynamic applications

3. Positive feedback leads to good solution.

4. React quickly

Disadvantage

1. quite slow.

Comparison Study

In the table the comparison has been done with the particle swarm optimization and ant colony optimization and genetic algorithm based on the parameter node distribution, aggregated data and efficient technique for routing as well as routing.

Problem Domain	PSO	ACO	GA
Node distribution	Centralized nature of PSO minimizes the area of coverage holes of stationary node positioning	Distributed nature of ACO is better in solving mobile node deployment issues	Good for random as well as for deterministic node deployment
Aggregated data	quite suitable	in case of large scale and dynamic WSNs it can perform better	suitable in finding the minimum number of aggregation points while routing data to the BS
Efficient technique for routing and clustering	Shows better performance in selecting the high energy node as CHs in each round thus can find optimal route effectively	performs better in terms of network lifetime and data delivery to the BS	used in the form of a pr-defined clusters which helps in reducing the overall communication distance

5. CONCLUSION

In this paper, a survey has been done among the swarm optimization techniques i.e. Ant Colony Optimization, Particle Swarm Optimization and Genetic algorithm. In Genetic algorithm, it Can tackle each enhancement issue which can be depicted with the chromosomes encoding. Whereas in ant colony optimization it is used for parallelism and quite efficient in dynamic application moreover its convergence speed is so fast and in particle swarm optimization, Good solution obtained because of its ability to escape from local optimal and it gives quick results.

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