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Review: Improved Differential Evolution Algorithm for Wireless Sensor Network Coverage Optimization

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***Abstract*— Particle swarm improvement (PSO) consists of a swarm of particles, wherever particle represent a best answer. Particle can move through a flat search area to search out the simplest position in this area wherever the simplest position might doable to the most or minimum values. Particle Swarm improvement (PSO), the coverage drawback gets improved by finding the best coverage counting on best placement of nodes that improve the general output. to induce the foremost best position PSO unceasingly update its rate that is predicated on speed and distance of the node. A changed version of formula is projected that's referred to as VORONOI_PSO. during this work to Implementation of VORONOI diagram and PSO_VORONOI(PSO_VORONOI DIAGRAM)and the Performance analysis of VORONOI DIAGRAM and PSO_VORONOI(PS O_VORONOI DIAGRAM) in terms of average coverage, variance and dead node.**

***Index Terms*— PSO, Network ,Sensor , node etc.**

I. INTRODUCTION

Due to a recent development in the technology, there is a growth in wireless sensor network which is composed of large figure of homogeneous & heterogeneous sensor nodes which operates in wireless fashion to achieve common objective. A wireless sensor network in its simplest form can be defined as a network of (possibly low-size and low-complex) devices denoted as nodes that can sense the environment and communicate the information gathered from the monitored field through wireless links; the data is forwarded, possibly via multiple hops relaying, to a sink that can use it locally, or is connected to other networks (e.g., the Internet) through a gateway.

- The nodes can be stationary or moving.
- They can be aware of their location or not.
- They can be homogeneous or heterogeneous.

In general a WSN consists of one or more base Stations(or sinks) and a large number of sensor nodes that organize themselves into a wireless network and work together to sense the environment, perform simple data processing and communicate.

➢ WIRELESS SENSOR NETWORK (WSN)

Figure 1 shows the communication in WSN

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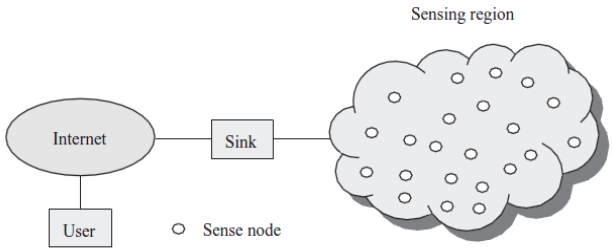

Figure 1.1: Communication in Wireless Sensor Network

Sensor: Sensor is a transducer. It converts physical phenomenon e.g. light, heat, vibration, motion, and sound into electrical signals.
Sensor Network: Sensor network consists of a large number of sensor nodes and nodes deployed either inside or very close to the sensed phenomenon.
Sensor Nodes (motes): Sensor nodes are battery operated nodes with limited computing and processing capabilities.
Sensor nodes with limited energy can sense their own residual energy and have the same architecture; Sensor nodes works together to form a network for monitoring the target region. Through the co-operation of sensor nodes, the Wireless Sensor Networks collect and send various kinds of message about the monitored environment (e.g. temperature, humidity, etc.) to the sink (base) node, which processes the information and reports it to the user
Base Station (BS): Base station is a node with high computing capabilities. Base Station without energy restriction is far away from the area of sensor nodes. All above given terminologies works together as all sensor nodes are immobile in nature. They use the direct transmission or multi-hop transmission to communicate with the Base Station. Sensor nodes sense environment at a fixed rate and always have data to send to the Base Station.
Characteristics of Wireless Sensor Network

The important characteristics of WSNs are:

- Less power consumption
- Ability to cope with node failures
- Mobility of nodes
- Communication failures
- Heterogeneity of nodes
- Usability in large scale
- Withstand in unfavorable environmental conditions
- Ease of use

Type of wireless Sensor network
1. *Structured Network*: In structured WSN sensor nodes are arranged in a pre-planned manner. Here we need only fewer nodes to spread that minimize network maintenance and management cost.
2. *Unstructured Network*: In unstructured WSN sensor nodes are scatters over the network as a dense collection or arranged

in an ad hoc manner. It is difficult to perform monitoring, network maintenance such as managing connectivity or detecting failures and reporting function in unstructured WSN. Ad hoc network is preferred over pre-planned network, when network is composed of hundreds to thousands of nodes. To remove the constraints of WSN, we need to introduce new design concepts, improving existing protocols and developing new algorithms.

➢ SWARM INTELLIGENCE

A swarm is a large number of homogenous, simple agents interacting locally among themselves, and their environment with no central control to allow a global interesting behavior to emerge. Swarm-based algorithms have recently emerged as a family of nature-inspired, population-based algorithms that are capable of producing low cost, at fast rate, and robust solutions to several complex problems. Swarm Intelligence (SI) can therefore be defined as a relatively new branch of Artificial Intelligence that is used to model the collective behavior of social swarms in nature, such as ant colonies, honey bees, and bird flocks. Although these agents (insects or swarm individuals) are relatively unsophisticated with limited capabilities on their own, they are interacting together with certain behavioral patterns to cooperatively achieve tasks necessary for their survival. The social communications among swarm individuals can be either direct or indirect. Examples of direct interaction are through visual or audio contact, such as the air dance of honey bees. Indirect interaction takes place when one individual changes the environment and the other individuals respond to the new environment (new path), such as the pheromone trails of Ants that they deposit on their way to search for food sources. This type of indirect interaction is referred to as stigmergy technique, which means communication through the environment. The

Area of research presented in this depth paper focuses on Swarm Intelligence. This paper discusses the most popular model of swarm intelligence inspired by ants' pheromone behavior for solving travelling salesman problem.

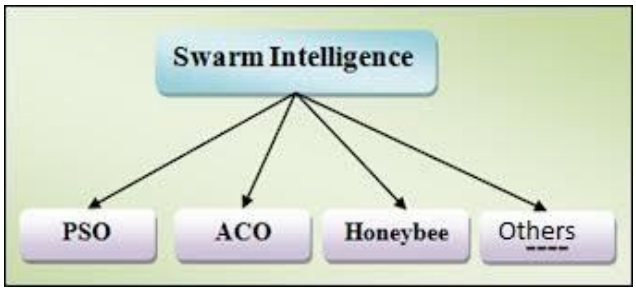

Figure 2. Types of Swarm Intelligence

➢ PARTICLE SWARM OPTIMIZATION

Particle swarm optimization is a heuristic global optimization method put forward originally by Doctor Kennedy and E Berhart in 1995. It is an algorithm developed from swarm intelligence and is based on the research of bird and fish flock movement behaviour. While search for their food, the birds are either scattered or go together before they locate the place where they can find and eat the food. While the birds are doing search for food from one place to another, there is always a bird from group of birds that can smell the food very well, i.e. the bird is aware of the place where the food can be located, having the resource information for better food. Because they are distributing the information for data, especially the good information at any time while searching the food from one place to another, conducted by the better information, the birds will eventually flock to the place where food can be found. As far as concern of particle swam optimization algorithm is concerned, solution swarm is compared to the bird swarm, the birds' roaming from one place to another is equal to the development of the solution swarm, better information is equal to the most optimist solution, and the food resource is equal to the most optimal solution during the whole course. The most optimal solution can be worked out in particle swarm optimization algorithm by the cooperation of each individual. PSO determines search path according to the velocity and current position of particle without more complex evolution operation. The particle without quality and volume serves as each individual, and the simple behavioral pattern is regulated for each particle to show the complexity of the whole particle swarm. This algorithm can be used to work out the complex optimist problems. Due to its many advantages including its simplicity and easy implementation, the algorithm can be used widely in the fields such as function optimization, the model classification, machine study, neutral network training, the signal procession, vague system control, automatic adaptation control and etc.

Each particle i in the swarm holds the following information: (i) the current position xi, which represents a solution to the problem, (ii) the current velocity vi, (iii) the best position, the one associated with the best objective function value the particle has achieved so far pbest$i$, where this objective function value is calculated using a function f(.) that evaluates the desirability of a solution, and (iv) the neighborhood best position, the one associated with the best objective function value found in the particle's neighborhood nbest$i$. The choice of nbest$i$ depends on the neighborhood topology adopted by the swarm, different neighborhood topologies have been studied in this.

II. LITERATURE SURVEY

AmitabhaGhosh, Sajal K. Das (2008) [3] et al. has studied that Sensing coverage and network connectivity the most fundamental problems in wireless sensor networks. By finding an optimal deployment node strategy would minimize communication overhead, reduce computation, minimize the cost, recover from node failure and also provide high degree of coverage with network connectivity which can face the challenges. Both coverage and connectivity together can be treated as measure of quality of service in a sensor network which tells that how well each point in the region of interest is covered and how accurate is the information gathered by the nodes. So it is concluded that by using resource constrained there is maximizing of coverage as well as network connectivity and also it becomes non-trivial problem(in which at least one of the value of variable is non-zero in the equation).There is also comparative study of several state-of-the-art algorithms and techniques which aim to both coverage and connectivity.

Keisuke Kameyama(2009) [4] **:** PSO is a search strategy which utilizes a set of agents that move through the search

area to find the overall minimum of an objective function.The path of each particle is determine by a simple rule which include the current particle velocity and research histories of the particle and its neighbors. PSO has attracted many experimenters due to its search efficiency even for high dimensional objective function with multiple local optima. The dynamic Particle swarm Optimization search has been examined and numerous variations for improvement have been suggested. Particle Swarm Optimization research so far, and the recent achievement for the application to large scale optimization problem has also been discussed in this paper.

Nor Azlina Bt. AbAzi,zAmmar W. Mohemmed, Mohammad Yusoff Alias(2009) [5] et al. has discussed that coverage problem in wireless sensor network is the crucial issue, where high coverage rate ensure good QOS of WSN. In this paper new algorithm is proposed by using Particle swarm optimization and Voronoi diagram to achieve the optimized sensor coverage. In this algorithm PSO is used because PSO is used to find the optimal deployment of the sensor that will provide best coverage and Voronoi diagram is used to evaluate the fitness function of the solution. The result shows the good coverage with better time efficiency. In this paper there is comparison of two techniques these are PSO_VORONOI and PSO_GRID. Both PSO_GRID and PSO_VORONOI are used for solving the coverage problem in WSN but PSO_GRID when network is small and execution time is not taken into consideration whereas in PSO_VORONOI is used where there is large size of network in greater rate of interest and where execution time is taken into consideration. But in grid quality of solution is obtained.

Qinghai Bai(2010) [6] has discussed that Particle swarm optimization(PSO) is a heuristic global optimization method and also an optimization algorithm, which is based on swarm intelligence. PSO is introduced from the social behaviour of bird and fish flock . Because of it easy implementation and adaptive nature of the particle it is widely used and developed. This paper consist comparison study of basic PSO and improved PSO. Improved PSO is examined based inertia weight, increase coverage problem, selection and blending with other intelligent optimization algorithms like Ant colony, Simulated Annealing (SA) etc. Various advantages and disadvantages of PSO have also been discussed.

W. Z. Wan Ismail and S. Abd. Manaf(2010) [7]: In this paper main idea is is to solve the coverage problem in Wireless Sensor Network (WSN) by increasing sensor nodes coverage percentages. Due to that, size of region of interest (ROI), effect of number of sensor nodes and Particle Swarm Optimization (PSO) algorithm are studied. Particle Swarm Optimization is an optimization approach that can be used for the deployment of sensor nodes to achieve higher coverage percentage.It is concluded that coverage percentage for wireless sensor network can be increased by adding more sensors or using small region of interest (ROI). However, these approches are only worthy for small observable areas such as in a room or hall. Adding more sensors nodes are costly and using small Region Of Interest is impractical for some heavy observable applications. Therefore, Particle Swarm Optimization algorithm can be utilized to work out on coverage problem for wireless sensor network without effecting number of sensor nodes and Region Of Interest.

DianPalupiRini,SitiMariyamShamsuddin,SitiSophiyatiYuhaniz(2011) [8] has studied that Particle swarm optimization(PSO) consists of a swarm of particles, where particle represent a best solution . Particle will move through a multidimensional search space to find the best position in that space where the best position may possible to the maximum or minimum values. In this paper all the basic and modified variants of PSO are listed and review of the different methods of PSO algorithm based on these variants are taken into consideration. It provide advantages and disadvantages of basic variants and also how to overcome them and it briefly describe the modified variants of PSO. The basic variants support controlling the velocity and the stable convergence. On other hands, modified variant PSO help the PSO to process other conditions that cannot be solved by the basic PSO.

D.Maruthanayagam and Dr. R.UmaRani(2011) [9]:The main focus of this paper is applying one of the rapidly growing non-deterministic optimization algorithms, ACO in Grid computing. It is rapidly increasing in the distributed heterogeneous systems for utilizing and sharing large-scale resources to solve complex scientific problems. Scheduling is the most current topic used to achieve high performance in grid environments with several conflicting objectives. In this paper, methods have been developed and applied for scheduling techniques in grid computing. Iis main objective is to find a suitable allocation of resources for each job with the comparison of Ant Colony Optimisation and proposed Ant Colony Optimisation. This paper, proposes an improved ant colony scheduling algorithm combined with the concept of Resource Aware Scheduling Algorithm. This proposed algorithm is estimated using the simulated execution times for a grid environment. The final result of this is depending upon the performance of the grid systems.

III. PROBLEM FORMULATION

Network coverage is one of the most decisive factors for determining the efficiency of a wireless sensor network. However, in dangerous or hostile environments such as battle fields or active volcano areas, we can neither deterministically or purposely deploy sensors as desired, thus the emergence of coverage holes (the unmonitored areas) is unavoidable. In addition, the introduction of new coverage holes during network operation due to sensor failures due to energy Depletion shall significantly reduce coverage efficiency. Since, the wireless sensor networks consist of a large number of sensor nodes, recharging them is often infeasible. The failure of sensor nodes caused by energy exhaustion or physical destruction may lead to the reduction of sensor areas. In wireless sensor networks, holes can be formed due to void areas in sensor nodes deployment, destruction of sensor nodes, or uneven energy consumption.

Using a technique of swarm intelligence, Particle Swarm optimization (PSO), the coverage problem gets improved by finding the optimal coverage depending on optimal placement of nodes which improve the overall output. To get the most optimal position PSO continuously update its velocity which is based on speed and distance of the node. A modified version of algorithm is proposed that is known as VORONOI_PSO.

This deals with reducing the time and energy used by nodes traverse the entire region of interest so as to decrease the

coverage hole formed by evenly placed sensors. The node which is having maximum energy and minimum distance from base station is assumed as eligible nodes. Eligible nodes are the nodes which can easily able to communicate with base station. And the nodes which could not communicate with base station are not eligible nodes and they are ignored. Then the fitness function for all the eligible nodes is calculated. Fitness function is basically the coordinates of eligible nodes or the position of the sensor node. Then finally the best solution is calculated by particle Swarm optimization which provides the optimized solution for the nodes to be placed. A suitable simulation will be performed and various parameters regarding coverage and dead node in the network will also be calculated in order to do performance analysis.

IV. METHODOLOGY

A research methodology provides us the basic concept if other has used techniques or methods similar to the ones we are proposing, which technique is best appropriate for them and what kind of drawbacks they have faced with them. Hence, we will be in better position to select a methodology that is capable of providing a valid answer to all the research questions which constitutes research methodology. At each step of our operation we are provide d with multiple choices either to take this scenario or use any other, which will let us to define and help us to achieve objective. Thus knowledge base of research paper methodology plays an important role.

RESEARCH PLAN

Research plan represents the systematic flow of all the steps or activities taken to achieve the objectives of the present research. Fig 19 represents a process flow chart to depict the sequence of activities under the methodology adopted in completing the research work. Literature survey is the first step to know the present status of present search and application of network security in various enterprises. It was observed from the literature that swarm intelligence technique's has emerged as an important part of artificial intelligence which is used to solve various wireless sensor network problems among large industries all over the world. After the identification of research gaps, the objectives of the study were formulated. This analysis yielded some useful results which are implemented to improve the existing systems. Finally the conclusions are drawn and scope for future is identified to continue the research in this field.

V. CONCLUSION

In this paper all the fundamental and changed variants of PSO square measure listed and review of the various ways of PSO algorithmic rule supported these variants square measure taken into thought. It offer blessings and drawbacks of basic variants and additionally the way to overcome them and it shortly describe the changed variants of PSO. the fundamental variants support dominant the speed and therefore the stable convergence. On different hands, changed variant PSO facilitate the PSO to method different conditions that can't be solved by the fundamental PSO and this work is enforced any with the assistance of supply and sink in MATLAB.

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