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Review Paper on Optimization Techniques in Wireless Sensor Network

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Abstract: Wireless sensor network have important applications in target coverage and monitoring. Now a day the development in wireless communication system led to low power and low cost wireless sensor network. The key requirement to design a network protocol is to maximize network lifetime and low power consumption. Wireless sensor network comprise of tiny sensor nodes. The nodes are sense the information, compute it and communicate to the neighbour nodes. To improve the performance of the network many optimization techniques are present. In this paper we discus different optimization techniques like PSO, ABC, GA, and ACO, AS.

Keywords: WSN, ACO, routing, ABC

I. INTRODUCTION

In recent year the popularity of wireless sensor network increases day by day due to the low power and versatile network in field of information technology and electronics field. Wireless sensor network are used in many different applications such as targeting, forest fire detection, patient monitoring and structural health monitoring. Wireless sensor network have large quantity of sensor nodes with one base station. The sensor nodes are consists of tiny device; it has four basic components i.e. sensing, processing, wireless communication and energy supply subsystem. The sensor nodes have deficient power, memory and communication range [1]. The conventional networks focus on better quality of service where as sensor network are focused on energy efficient and network lifetime. Numerous recourses constraints (limited range, speed, storage and bandwidth) are affect the performance of the network. These issues are associated to the optimization problem. The best solution is to design routing protocols such that it uses less amount of energy between nodes and perform efficiently.

II. ROUTING CHALLENGES AND DESIGN ISSUE

Some factors are given below which affect the performance of WSN [2].

Node deployment: It has two types deterministic or random. Modes are placed manually in deterministic node deployment and data routed by pre define path. Where as in random node deployment scheme sensor nodes are deploy randomly with an ad-hoc manner

Energy uses without losing accuracy: in computation and transmission of information through sensor node, network utilizes their finite supply of energy.

Data reporting model: is classified as time-driven (continuous), hybrid, query-driven and event-driven. The Acceptable model is time-driven whereas in query-driven and event-driven models node are suddenly changes their sensed credit due to an evidently event by the BS.

Node/Link Heterogeneity: we assume that all sensor nodes become homogeneous if they have equal capacity of computation, power and communication [3].

Fault Tolerance: After some particular amount of time sensor node becomes dead, blocked or fail to do any communication between nodes in given field. The node failure may occur due to less power, software problems, interference and physical damage. Due to failure of a sensor nodes network disconnect it from the path.

Scalability: The numbers of hundred and in range of thousands in sensing area sensor nodes are deploy.

Network Dynamics: in many applications sometimes assume that sensor nodes are stationary and movable. Route stability is an important issue to routing the massage from or to dynamic nodes.

Transmission Media: the communicating nodes in multi-hope sensor network are connected with each other in wireless fashion. High error rate and fading can affect the performance of the network.

Connectivity: Sensor network cannot be isolated from each other due to high node densities.

Coverage: is a measure of the quality of service of a sensor network. It has two types first Area coverage and second is target coverage [4]. The area coverage problems focus to monitor the entire region of attention whereas target coverage problem are concern to monitor only some specific points in a specified region.

Data Aggregation: data aggregated from different sources based on minima, maxima, duplicate suppression and average. The transmission rate can reduce if similar packets are received from different sources.

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Quality of Service (QoS): In many applications of wireless sensor network, the lifetime of network is directly related to conservation of energy that shows the quality of transmitted data. As the energy gets reduces, it decreases the energy of the node, quality of result and shortens the network lifetime.

III. OPTIMIZATION TECHNIQUES

Based on nature inspired many optimization techniques have been developed. There are two category of nature inspired algorithm i.e. Evolution algorithm and swarm optimization algorithm.

Genetic algorithm and differential algorithm are the example of evolutionary algorithm in which each group search for payee transformation in ever changing domain [5].

3.1 Ant-System

It is used in many applications like to find the shorted path among the different path form source node to destination node. The Ant System algorithm is categories in three ways of pheromone trails i.e. ant-density, ant cycle and ant quantity. To build a solution ant density and ant quantity will used, where as ant cycle is deposit its pheromones after completion of tour.

3.2 Ant Colony Optimization

Ant colony optimization (ACO) is the probabilistic technique. It is used to find the shortest path among all possible paths from source node to destination node depends on the pheromones centring value. This technique is based on swarm intelligence which is mostly used in network routing [6].

Pheromone is the chemical substance which release by ants along the path between sources to destination. Ants never do direct communication for the solution instead of use indirect communication by stigma. This approach not only finds the optimal path between sensor nodes but also balances WSN node power consumption, count node energy and enhance the network lifetime.

3.3 Artificial Bee Colony optimization

This algorithm is inspired by intelligence behaviour of honey bee swarm. The bee's colony consists of three groups i.e. employed bee, scouts and onlooker. The employ bee collector the nectar from the source and then unloaded this nectar to the hive.

After this process bee perform a special type of dance which is known as wangle dance. This bee's dance represents the direction, quality and quantity of the food [7]. Onlooker bee sees the all dances of bees and then chooses the best one qualitative source. The scout bee does the random search. ABC algorithm has high coverage speed as well as it can be used with other algorithms.

3.4 Particle Swarm Optimization

This is made of interacting agent assemble in small groups is called swarm. PSO algorithm is based on the search of the possible solution by the collection of birds, fish pedagogy and animals etc. It exhibits an attribute to react with environmental conditions and resolution capability. Each agent changes their position with time. Local and global method is used by PSO [8]. The agent search possible solution in multidimensional space. This algorithm needs only few parameters to change. PSO has fast coverage and gives best quality of solution.

3.5 Genetic Algorithm

Genetic algorithm is also called global heuristic algorithm. It appraises an optimum solution by producing unlike individuals. GA is based on the Darwinian principle of biological evolution and replication. Chromosome is the assembly of strings which is in the form of binary and real numbers. It don not have local minima and it find the optimum solution. There are only few parameter are required to adjust.

IV. LITERATURE REVIEW

Selcul Okdem et al. in [9] for effective and easy routing task they develop a routing scheme using ant colony optimization. They implement a small sized hardware component which can be easily handled and work as a router chip. The performance of implemented chip is tested by proteus simulation program.
Yingshu Li. Shan Gao at al. in [10] presents that the network life time increased by sensor scheduling for k-coverage problem. In this paper they worked on area coverage. The scheduling are done by two heuristic algorithm. Sensor deployment at optimal place can save the energy as well as reducing NP-hard problem.

K.Syed Ali Fathima et al. in [11] presented WSN consist of many nodes which has limited power in which it has to receive useful information from the given field. The main problem is limited power supply. In this paper they used ACO based on Bio-Inspired mechanism for routing. Ant colony optimization is a reliable and dynamic protocol. In this paper they define implementation of wireless sensor network and comparison of its performance parameter.

Anil Kumar N V, Anil Thomas et al. in [12] presented network lifetime is the essential requirement of wireless sensor network which can be improved by mobile sink. The mobile sink has specific speed and particular time to collect the data form sensor nodes and deployed it uncertainly. This novel technique Maximum Amount Shortest Path provides maximum throughput and reducing the power consumption. Zone based partition is done to implement this scheme. Joon-Woo Lee, Byoung-Suk Choi, Ju-Jang Lee et al. in [13] presented in implementation of WSN the Efficient –Energy Coverage problem occur due to the use of minimum energy. This problem is resolve by

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using Three Pheromones ACO (TPACO) technique. Here it uses the three pheromone to find the optimum solution, one of them is local pheromone and other two is pheromone are called global pheromone. Local pheromone helps to set its coverage with some sensor nodes whereas in global pheromone one is used to find the required effective number of active sensors per Point of Interest and second is used to former pheromone to select the active number of sensors.

Jian-Feng Yan et al. in [14] presented a heuristic technique to decrease energy consumption. They present three Ant Colony Optimization techniques i.e. the Ant colony system, Ant System and improved Ant System (AS) as well as their applications in WSN routing process. The obtained result after simulation shows that using ACO technique energy consumption of the nodes decreases and it enhanced network lifetime.

Selcuk Okdem et al. in [15] presented the WSN consists of sensor nodes with finite power. Sensor nodes gather the useful data from the region of interest. Here they use novel routing algorithm based on ACO in which nodes are in stable condition. They proposed a small sized hardware component which acts as a router chip.

R K Jena et al. in [16] presented in WSN the placement of nodes in sensing area is an important task. They must be able to provide long network lifetime with maximum coverage. All these thinks can be achieved by using Artificial Bee Colony Multi objective algorithm. This technique modifies the performance of sensor nodes.

Ying Lin, Jun Zhang, Henry Shu- Hung Chung et al. in [17] presented the network lifetime of heterogeneous wireless sensor network can be improved by indentify the non connected covers. Using this methodology they can get maximum sensing coverage with large network connectivity. This can be achieved by taken the information from pheromone. Ants select the optimum path on the construction graph. The connections between covers can be done by pheromone which acts as a metaphor. The device assignments are reflected by heuristic information.

Xuxun Liu et al. in [18] presented in WSN for Maximum possible energy efficiency (MPEE) and Maximum Possible energy Balancing (MPEB) strategy are used to achieve effective transmission as well as longer network lifetime. These proposed schemes are based on ACO algorithm. Here each and every ants need to move one step to complete the target since no heuristic knowledge of the ant transition.

Xuxun Liu et al. in [19] presented that in WSNs some problems are generated i.e. minimum cost and Connectivity Guaranteed Grid Coverage (MCGC). So they proposed a novel technique that is based on an ant colony optimization with three classes of ant transition i.e. ACO-TCAT. It reduces the inferior solutions and limits the search.

Tu-Liang Lin et al. in [20] presented the packet delivery ratio compare with other routing schemes. In ACO algorithm the arrival time of first packet and the end-to-end delay compare with three different routing protocols i.e. MANET, AODV, DSDV and DSR. They found that the ant colony optimization is not only energy efficient as well as it has greatest performance in both the first packet arrival time and packet ratio compare to other routing algorithms.

Songzhu Xia, Su Wu, Jun Ni et al. in [21] presented that the sensor node having limited availability of energy in wireless sensor network, so to design an energy efficient routing scheme is the challenging issue. They propose an energy efficient multi path routing scheme which is based on ant colony system. The proposed algorithm has three improved rules: ant marginalization, state transition and global pheromone update rule. These rules solve the local convergence problem local optimize as well as find multiple path for data transmission.

Pang Yi et al. in [22] presented that the energy consumption is the major issue of WSN. They consider a non uniform network with new scheme of power control; this scheme is based on the PACA (parallel ant colony algorithm). This algorithm provides less energy consumption by the sensor nodes. This approach searches the solution space as well as optimizes the route of data transmission. Here three different nodes distributed in network and adopted the new mechanism. This provides uniform energy consumption and improves the network lifetime.

Table 1: Comparison of various optimization techniques

Techniques/ Parameters	ACO	ABC	GA	PSO
Year	In 1992	In 2005	In 1970	In 1995
Inspired By	Ants Behaviour	Honey Bee Behaviour	Biological Reproduction	Birds flocking
Proposed By	Marco Dorigo	Karaboga	John Holland	Dr. Eberhart and Dr kennedy
Node Deployment	Solving Mobile Node Deployment	Random and deterministic	Random Deployment	Reduces area of coverage for stationary nodes
Limitations	Stuck into one path	Required Initial position of sensor nodes	Coverage toward local minima	don't find Optimum path
Strength	Discover best solution	flexible and robust	Solve multidimensional problem	Ability to break local minima
Coverage speed	quick	fast	less	Quick
Data Aggregation	Better	High	Minimum	Quite Suitable
Applications	Used in dynamic applications	Deployment Location	Vehicle Routing	Image Recognition

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IV. CONCLUSION

In this paper we discuss the overview of different optimization techniques like PSO, ABC, ACO and GA. Optimization techniques are used to improve the performance like longer network lifetime, low power consumption, optimal path, and target coverage in wireless sensor network. Ant colony optimization and Artificial Bee Colony algorithm provides high success rate and longer network lifetime for systemic network but for dense network it does not perform well.

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