Optimized Coverage and Efficient Load Balancing Algorithm for WSNs-A Survey

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***Abstract*— *Major challenge in field of wireless sensor networks (WSN) is to provide full coverage of a sensing field and connectivity of relaying nodes. Many applications—such as object tracking, healthcare, natural environment protection and battlefield intrusion detection —requires the full coverage at any time. Load balancing aims to optimize resource use, maximize throughput, minimize response time, and avoid overload of any single resource. In this paper we are over viewing techniques which are used in WSN for load balancing. The maximum cover tree (MCT) difficulty is to construct several connected cover trees and difficult in Nondeterministic Polynomial (NP)-Complete problem, Ant colony based scheduling Algorithm (ACB-SA) can used to solve the efficient coverage problem but it has time delay as drawback, And Temperature aware Algorithms that seek to save energy but the implementation is complex. In order to mitigate limitations above, Novel maximum connected load-balancing cover tree (MCLCT) algorithm is proposed and it is composed by two sub strategies: a coverage-optimizing recursive (COR) heuristic and a probabilistic load-balancing (PLB) method. This Algorithm provides the better coverage and connectivity among others which is presented as a result of this survey. Simulation results show the output in terms of energy efficiency and connectivity maintenance.*

Keywords*— *wireless sensor networks, Coverage / connectivity preservation, scheduling, lifetime maximization.

I. INTRODUCTION

Data gathering is a fast growing and demanding field in today's world of computing. Sensors give a cheap and easy solution to these applications particularly in the inhospitable and low-maintenance areas where conservative approaches prove to be very expensive. Sensors are tiny devices that are able of gathering physical data like heat, light or motion of an object or surroundings. Sensors are deploying in an ad-hoc way in the area of interest to monitor events and gather data about the environment. Networking of these unattended sensors is expected to have significant impact on the effectiveness of many military and civil applications, such as combat field observation, security and disaster management. Sensors in such systems are typically disposable and predictable to last until their energy drains. Therefore, power is a very scarce reserve for such sensor systems and has to be managed shrewdly in order to extend the life of the sensors for the duration of a particular assignment. Typically sensor networks follow the model of a base station or command node, where sensors relay streams of data to the control node either periodically or based on events. The command node can be statically located in the vicinity of the sensors or it can be mobile so that it can move around the sensors and gather data. In either case, the command node cannot be reached efficiently by all the sensors in the scheme. The nodes that are positioned far away from the command node will consume more energy to broadcast data then other nodes and therefore will die sooner.

A wireless sensor network is characteristically consisting of a potentially big number of resource forced sensor nodes and few relatively powerful manage nodes. Each sensor node has a battery and a low-end processor, a limited amount of memory, and a low power communication module capable of short range wireless communication. As sensor nodes have very restricted battery power and they are randomly deployed it is not possible to recharge the dead battery. So the battery power in WSN is considered as scarce resource and should be efficiently used. Sensor node consumes battery in sensing data, receiving data, sending data and processing data. Generally a sensor node does not have enough power to send the data or communication directly to the base station. Hence, along with sensing the data the sensor node act as a router to broadcast the data of its neighbour. In large sensor network, the sensor nodes can be split into small clusters. Each cluster has a cluster head to organize the nodes in the cluster. Cluster arrangement can prolong the lifetime of the sensor network by creation the cluster head collective data from the nodes in the cluster and send it to the base station.

The cluster heads should also be chosen. There are two approaches used in this process the leader first and the cluster first approach. In the leader first approach the cluster head is selected first and then cluster is formed. In the cluster first move toward the cluster is formed first and then the cluster head is chosen. The schematic diagram of cluster architecture is shown in fig 1.

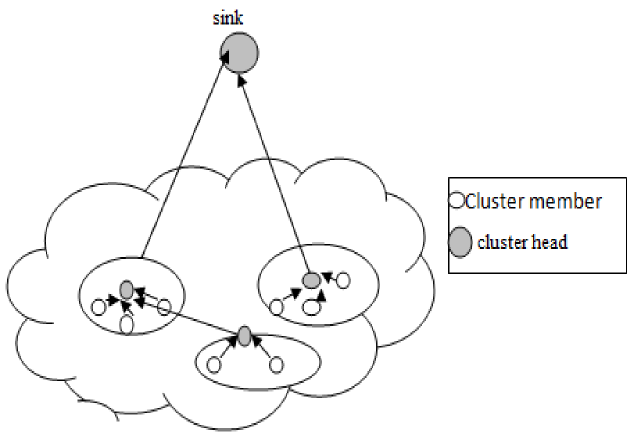

FIG. 1. THE CLUSTER ARCHITECTURE

II. LITERATURE SURVEY

2.1 Ant-colony-based scheduling Algorithm for Energy Efficient coverage of WSNs.

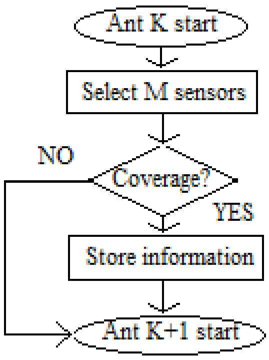

FIG 2. CONSTRUCTION GRAPH OF CONVENTIONAL ACO ALGORITHM

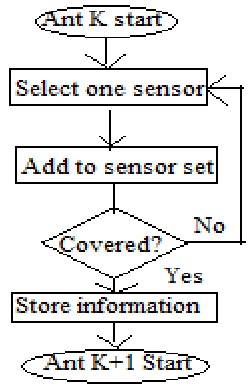

FIG 3.CONSTRUCTION GRAPH OF ACB-SA

The ACO algorithm is based on swarm intelligence, which states that complex collective behavior emerges from the behavior of many simple agents, like ants. The performance of the ACO algorithm is determined by how it initializes a pheromone field and how it makes a construction graph. When most ACO algorithms are applied to different problems, the algorithm is modified to reflect the characteristics of the problem. As a result, the ACO algorithm can get better performance. To improve the performance (which focused on lifetime improvements) of the ACB-SA, we applied a new initialization method, which was unlike the conventional ACO algorithm, for the pheromone field and the modified construction graph.

A novel ACO algorithm is optimized to solve the EEC problem. The ACB-SA has new characteristics that are different from conventional ACO algorithms. The traditional scheduling algorithms that use the ACO algorithm simply follow the lead of the solutions, and they are not optimized to solve the EEC problem. ACB-SA, unlike conventional ACO algorithms, does not consider what values are needed for the user parameters α and ß. The result of the first simulation verifies the effectiveness of the ACB-SA over other algorithms. The limitation is time delay and ACB-SA is the least complex among stochastic algorithms. The simulation was run ten times and the average network lifetime was found to be 58.8 cycles.

2.2 Jenga- inspired optimization algorithm for Energy- Efficient coverage of unstructured WSNs.

A new stochastic optimization algorithm, called the JOA, which overcomes some of the weaknesses of other optimization algorithms for solve the EEC difficulty. The JOA was inspired by Jenga which is a well-known board game. Also introduce the probabilistic sensor detection model, which leads to a more realistic approach to solving the EEC problem. The structure of the JOA is based on a greedy technique for fast meeting and employs a stochastic method for the ability to conduct random exploration. These features of the JOA made a better presentation than that of conventional approaches possible.

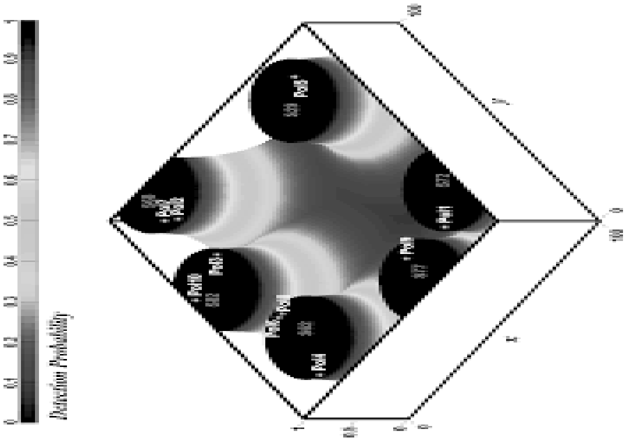

FIG 4. OPTIMAL COVER SET FOUND BY JOA

For the network lifetimes obtained by each algorithm, the case of the ACO and PSO algorithms occasionally is worse performance than the greedy-based approximation algorithm because of the stochastic uncertainty. The TPACO algorithm and JOA, on the other hand, have consistently longer lifetime than the other algorithms. However, in addition to considering the computation time for the solution, the JOA has better performance than the TPACO algorithm because it determines a better solution for prolonging network lifetimes by shortening computation times. The JOA required much more computation than the greedy-based approximation algorithm which was based on the mathematical calculation method. To reduce the computation time, however, is less important than to prolong the network lifetime in solving the EEC problem. The reason is that the EEC problem is not the optimization problem demanding the solution in real time. Therefore, the simulation results demonstrate that the JOA outperforms the other algorithms.

2.3 Efficient Coverage and Connectivity Preservation with Load Balance for Wireless Sensor Networks.

Among the previous algorithms, we investigated a new maximum connected load-balancing cover tree (MCLCT) algorithm to attain full coverage as well as BS-connectivity of each sensing node by dynamically forming load-balanced routing cover trees.

The MCLCT is composed of two sub-ways: a coverage-optimizing recursive heuristic and a probabilistic load-balancing strategy. The COR heuristic aims at detect a most number of disjoint sets of nodes, which can be achieved by one of the sensor nodes (such as the sink node). The PLB approach is used to point out the suitable path from each node to the BS after the disjoint sets are initiated. For each possible broadcast path from a given node to the candidate parent nodes, the PLB strategy will assign different probabilities in order to more equally distribute the load. Maximize the system lifetime while preserving both full coverage and BS-connectivity. The network lifetime of maintaining full coverage can be professionally extended. By increasing the possible links with the neighbor nodes in the same tier, the transmission congestion caused by a relaying node can be avoided. Only essential sensing nodes will be activated during the operation in order to reduce energy waste. The network hot spot and congestion can be avoided, and longer system duration can be assured.

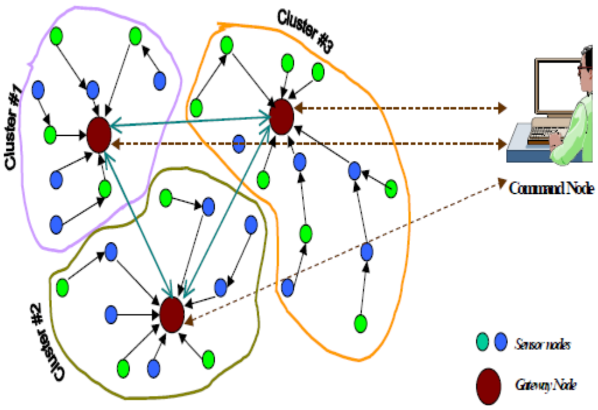

FIG 5.SYSTEM ARCHITECTURE

Maximizes the network lifetime while preserving both full coverage and BS-connectivity. The network lifetime of maintaining full coverage can be efficiently extended. By increasing the possible connections with the neighbor nodes in the same tier, the transmission congestion caused by a relaying node can be avoided. Only necessary sensing nodes will be activated during the operation in order to reduce energy waste. The network hot spot and congestion can be avoided, and a longer network lifetime can be assured.

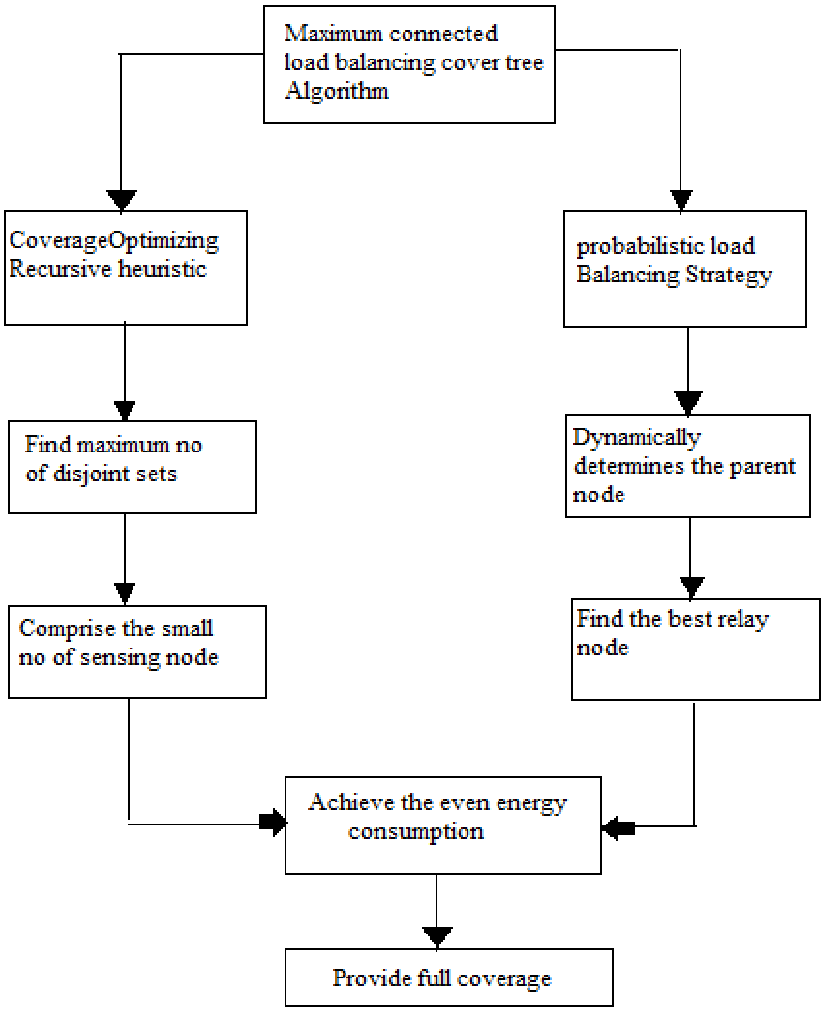

FIG 6: FLOWCHART OF MCLCT ALGORITHM.

The goal of the MCT problem is to construct several connected cover trees. By doing so, a longer network lifetime and full coverage can be acquired. The MCT problem is a complicated NP-Complete problem, so finding a suboptimal solution is a generic approach in order to decrease the time of computation. The proposed MCLCT is composed of two sub strategies: a coverage-optimizing recursive (COR) heuristic and a probabilistic load-balancing (PLB) strategy. The COR heuristic aims at finding a maximum number of disjoint sets of nodes, which can be achieved by one of the sensor nodes (such as the sink node). In each disjoint set, the nodes are able to monitor all the DPOIs together.

That is, the COR heuristic focuses on dealing with the full coverage preservation issue. Moreover, the PLB strategy is used to figure out the appropriate path from each node to the BS after the disjoint sets are initiated. For each possible transmission path from a given node to the candidate parent nodes, the PLB strategy will assign different probabilities in order to more uniformly distribute the load. Figure 6 shows the flowchart of the proposed MCLCT algorithm.

III. RESULT AND COMPARISON

In this section, presented the simulation results regarding the performance of the proposed MCLCT and compare it with previously mentioned algorithms, which include ACBSA [1], JOA [2], and TC&NC [4]. All the simulations are carried out on the MATLAB platform.

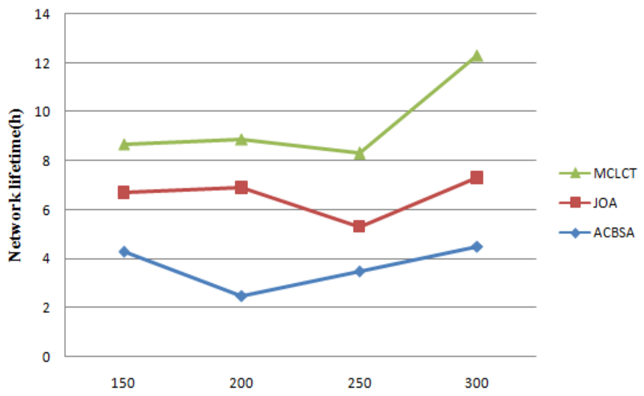

FIG 7. NETWORK LIFETIME WHEN VARIOUS NUMBER OF NODES ARE CONSIDERED.

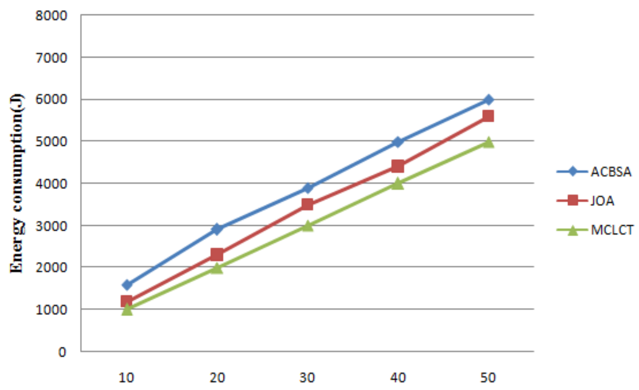

FIG 8.ENERGY CONSUMPTION FOR EVERY NODE

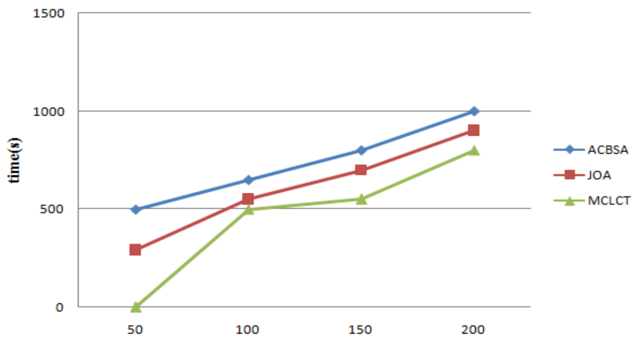

FIG 9.COMPUTATION TIME FOR EVERY NODE

IV. DISCUSSION AND ANALYSIS

The simulation results, it is obvious that network duration is efficiently prolonged since the traffic burden generated by the sensing nodes is dynamically dispatched to various relaying nodes. Furthermore, for power conservation, the analyzed outcomes demonstrate that the future MCLCT surely achieves well-arranged power utilization for nodes through the built dynamic cover tree. Meanwhile, the broadcast hot spots in WSNs bringing a large amount of power uses to nodes are also avoided.

V. CONCLUSION

In this system, an approach for load balancing in the wireless sensor network is proposed. Algorithms for cluster head selection, cluster formation, intra cluster communication and inter cluster communication in wireless sensor network are proposed. Maximum connected load-balancing cover tree (MCLCT) algorithm to attain full coverage as well as BS-connectivity of every sensing node by dynamically forming load-balanced routing cover trees.

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