Coverage Optimization in Directional Sensor Networks Using Multi-Demand Target Approach

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Abstract:- Coverage is the important and main challenging issue in the Wireless sensor networks. For a directional sensor network the sensor direction is fixed in a particular direction to cover the target. Many related studies have been exploited to improve the coverage quality and minimize the movement of sensors, which consumes more energy of sensors and thus shortens the network lifetime significantly. To solve the problem proposed work addresses the mobile sensor deployment problem and how to deploy the mobile sensors with minimum movement to form a WSN network and to provide a good coverage quality. For a case of target coverage problem in the direction sensor network voronoi based TV-Greedy algorithm is proposed.

Key Words: Coverage, minimizing movement, network lifetime, WSN

I. INTRODUCTION

Wireless sensor networks are used for target tracking and environmental monitoring. Target coverage is the important issue in the WSN. Decision making complexity can be reduced by the voronoi diagram characteristics and it can maximize the target coverage [2]. Target coverage aims to cover a set of target by the deployment of static sensor. The target coverage is based on the region of interest and priority of the target. Different types of applications need different types of coverage.

In recent days give mobility to the mobile sensors to improve the coverage quality. The movement of mobile sensor is nothing but relocating the mobile sensor to its new position to enhance the coverage quality. Most of the monitoring area Consist of multiple and different region of interest with different non uniform requirements. One such real time example for ROI and non uniform requirement is landslide monitoring. Distributed based on the risky level of the region. More risk level region having more ROI than low risk level region. For the general case target coverage problem two algorithms are proposed. Basic algorithm based on the clique partition and TV- greedy algorithm based on the voronoi partition diagram of target points. Basic algorithm reduces the total movement by reducing the number of sensors to be moved. [3]

II. RELATED STUDIES

Mohd Norsyarizad Razali, Shaharuddin Salleh, Hosein Mohamadi "Solving Priority-Based Target Coverage Problem in Directional Sensor Networks with Adjustable Sensing Ranges" (2016) resolve the issue of Priority Based Target Coverage with Adjustable Sensing Range(PTCASR) with the proposal of two scheduling algorithms i.e. greedy-based and learning automata-based algorithms. These proposed algorithms were assessed for their performance via a number of experiments. Additionally, the effect of each algorithm on maximizing network lifetime was also investigated via a comparative study. Both algorithms were successful in solving the problem. However, the learning automata-based scheduling algorithm proved relatively superior to the greedy-based algorithm when it came to extending network lifetime. Zhuofan Liao, Jianxin Wang, Shigeng Zhang, Jiannong Cao, Geyong Min "Minimizing Movement for Target Coverage and Network Connectivity in Mobile Sensor Networks"(2014) address a practically important problem of minimizing sensors movement to achieve both target coverage and network connectivity in mobile sensor network. This paper formulates the mobile sensor deployment problem with the aim of deploying mobile sensor to provide target coverage and network connectivity with minimum movement. To improve target coverage they proposed two algorithms i.e. clique partition algorithm and target based voronoi greedy algorithm. The movement of sensors should be minimized to prolong the network lifetime because the sensor movement consumes much more energy than the sensing and communication so the sensor which is nearest to the target should move and covered.

D.Arivudainambi, D.Rekha, S.Balaji "Improved Memetic algorithm for Energy Efficient Target Coverage in Wireless Sensor Networks" (2014) resolves the network lifetime problem and to identify the sensor covers to monitor the entire target and to find the techniques to maximize the total number of covers. An improved memetic algorithm is proposed to solve disjoint set cover. In this algorithm, a matrix with bit streams is used to represent the sensors which monitor the target. The sensors can be scheduled to alternate between active and sleep modes so that they can cover all targets with minimum energy.

It can be done by partitioning the set of all sensors into disjoint subsets or sensor covers. Only one sensor cover need to be activated to monitor the target at a specific time and other sensor covers can be set at low energy.

Chia-pang Chen, Subhas Chandra mukhopadhyay, Cheng-long Chuang, Tzu-shiang lin, Min-sheng Liao, Yung-chung Wang, Joe-air jiang "A Hybrid Memetic Framework for coverage optimization in Wireless Sensor Networks" (2015) the purpose of this paper is to deal with both the disjoint set covers and dynamic coverage maintenance problem at the same time in order to maximize the lifetime of Wireless Sensor Network. In this paper they proposed the a centralized memetic algorithm based scheduling strategy to select a minimum number of sensor nodes and arrange them into a maximum number of disjoint sets which will then be activated by turns i.e. to solve the disjoint set cover problem because the centralized scheduling method is able to generate the near optimal outcome better than that resulted by the distributed method.

III. PROBLEM DESCRIPTION

3.1 SYSTEM MODEL

Coverage Probability

In this model the distance of target is increased from the sensor the [4] coverage probability is decreased. The coverage probability denotes a chance to correctly detect an event at the point when it happens. For an example coverage probability of 0.6 means 6 out of 10 events will be correctly detected on average at this point.

Region of interest

A region in which a interesting events may arise is called a region of interest. The deployment field having different ROI which depends on its risky level. The area outside ROI does not need any sensor to monitor.

Coverage Requirements

Coverage requirements is typically depends on the risk level. The high ROI probability having more coverage requirement than the low ROI coverage requirement [5].

3.2 PROBLEM STATEMENT

3.2.1 Mobile sensor deployment problem

'm' targets with known locations and 'n' mobile sensors are randomly deployed in the field area. Minimum movement of mobile sensors having some objectives.

Each target is covered by at least one sensor.

All the moved mobile sensors are connected to form a network.

Definition 1:

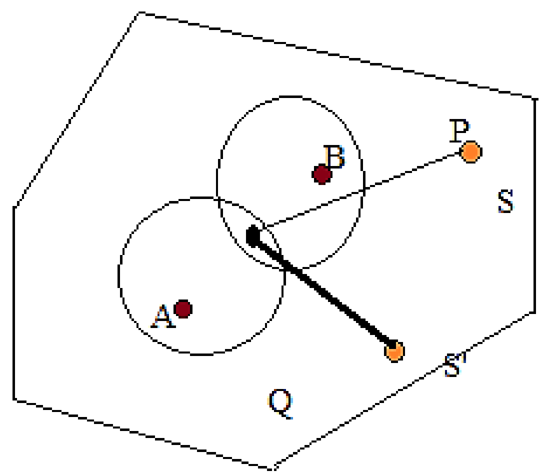
Target coverage (TCOV) problem

Given 'm' targets with known locations and 'n' mobile sensors are randomly deployed in the task area. Mobile sensors are move to the new positions. Such that all the targets are covered and movement of mobile sensor's is minimized.

Theorem 1: TCOV with free mobility model, in order to minimize the movement of mobile sensor, the number of potential positions are finite.

Proof:

For 'm' targets and 'n' sensors form a network and a single sensor exactly cover one target. Under the free mobility model sensor wants to cover more than one target it should move along the straight line connecting the mobile sensor and the target. Stop the movement of mobile sensor at the intersection of the targets coverage circle.



In the above case more than one target covered by a single sensor simultaneously, their coverage area intersects with each other. The intersection coverage area is denoted as 'I'. In the above figure targets of A and B intersect with each other. For the sensor 'S' is the closest point to 'P'. So the sensor 'S' is dispatched to cover the two targets.

IV. PROPOSED WORK

4.1 TARGET BASED VORONOI GREEDY ALGORITHM

This proposed work present a target based voronoi greedy algorithm to minimize the movement of mobile sensor to cover the targets.

4.1.1 Basic idea and definitions

TV- Greedy algorithm is used to deploy the mobile sensors and to minimize the movement of mobile sensors to cover the uncovered target. Sensors located in the voronoi structure are closer to these targets. Notations will be used in the algorithm are given below [2] Sensor located in the voronoi cell, that sensor is called as the server to that target and the target is known as the client of its servers. Group of targets server is called that target's server is called that targets Resident Server Group (RSG). The sensor in a target RSG nearest to the target is called as Clan Server of that target and other sensors are called Non-Clan Servers of the target. Two targets are neighbors if the voronoi cell shares their edges. Consider two targets A and B, the sensor A's RSG that is closest to B is called an alms server to B. Targets Pretenders Server Group (PSG) is the union of its clan server and alms servers from neighbors. For a target only sensors in its PSG will be dispatched to cover it.

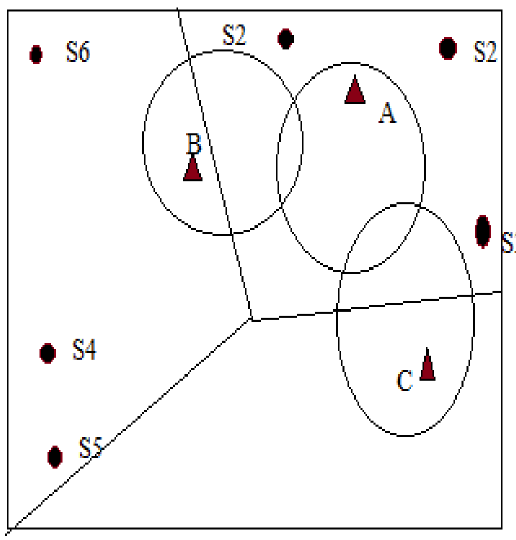


Fig.4.1 Example of servers

From figure 4.1 the resident server group of target 'B' is RSG (B) = {S4, S5, S6} in which S4 is the clan server. S6 is the alms server for 'A' and S5 is the alms server for 'C'. Pretender server group of 'B' is PSG (B) ={S4,S2}. Note that there is no sensor in target 'C' voronoi cell, so there is no alms server for 'B' from 'C'.[2]

When the static sensors are initially deployed to cover the targets. Some of the targets are not covered in the initial deployment. Then static sensors are rotated such as intra and inter adjustment to cover the remaining uncovered targets. Again some targets are not covered by a static sensor then the mobile sensors are deployed in the uncovered target region. The main aim of this proposed work is to cover the uncovered target and minimize the movement of [2] mobile sensor to improve the coverage quality. The movement of mobile sensor is based on the intersection of two targets covering range. The mobile sensor move to the intersection point of two targets, to cover the uncovered and critical targets

V. RESULTS

Static sensors and targets are randomly deployed in the voronoi region is shown in the below figure 5.1

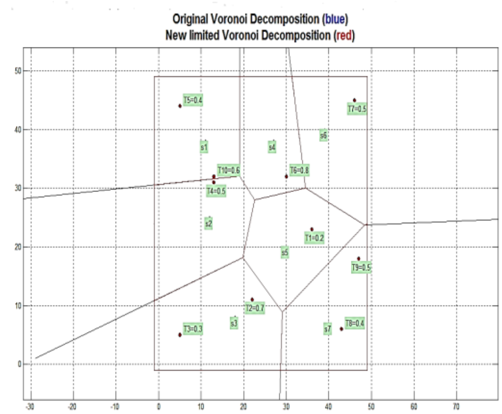


Fig.5.1 Random deployment of targets &sensors

The initial uncovered targets are covered by a intra, inter disjoint rotation of sensor and the results is shown in the below figures 5.2 and 5.3

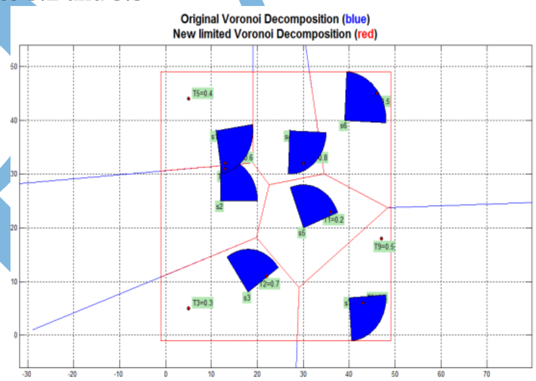


Fig.5.2 Intra disjoint rotation

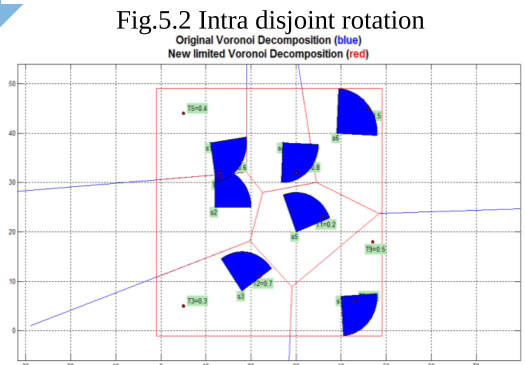


Fig. 5.3 Inter disjoint rotation

The another target coverage method is the non disjoint method. Both intra and inter rotations are shown in the below figures5.4 and 5.5

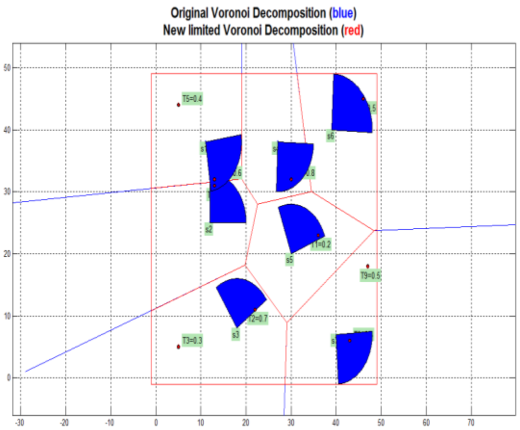


Fig. 5.4 Intra disjoint rotation

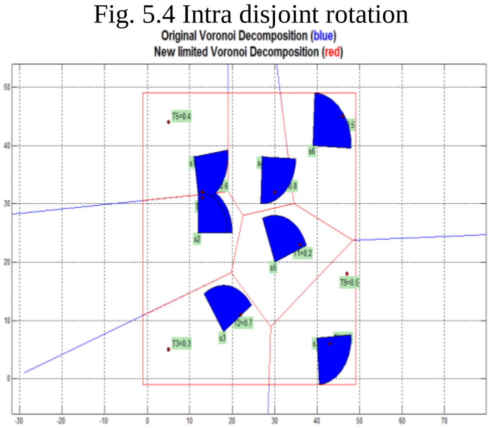


Fig. 5.5 Inter non disjoint rotation

Uncovered targets are covered by using the mobile sensor. So the mobile sensors are deployed in the voronoi region shown in fig.5.6

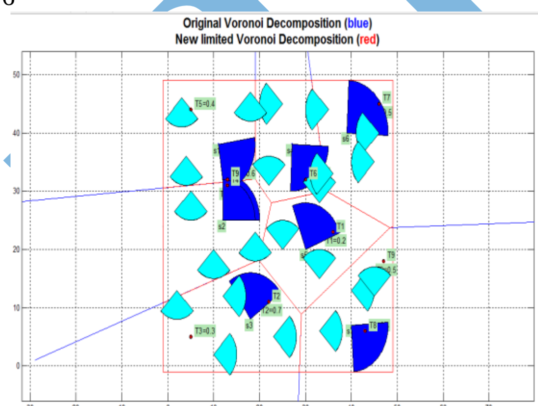


Fig. 5.6 Deployment of mobile sensors

The mobile sensors are move to cover the uncovered target is shown in the below figure. The mobile sensors are move to the intersection part of two targets to cover the critical and un covered target and the corresponding result is given below fig. 5.7

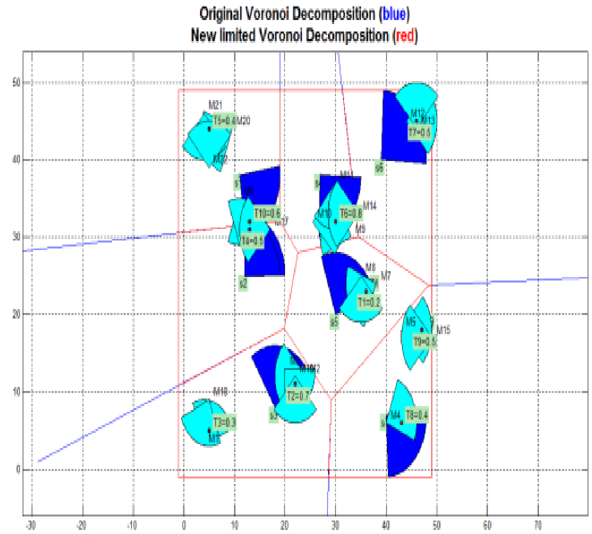


Fig. 5.7 Movement of mobile sensor

V. CONCLUSION

This study utilized the geometrical features of voronoi diagram and all the sensors were efficiently rotated and to cover all the targets. The coverage efficiency was evaluated in intra and inter coverage by disjoint and non-disjoint methods. The remaining uncovered targets are covered by a mobile sensor and the movement of mobile sensors are minimized in this proposed work. The performance of static and mobile sensors are shown in the simulated results.

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