SCHEDULING OF WIRELESS SENSOR NETWORK FOR THE MAXIMUM COVERAGE

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Abstract - Wireless Sensor Networks (WSN) consist of a great number of low powered battery devices, which are widely used for monitoring purpose. In WSN coverage is basic problem because node has limited power. The classical algorithm assumes that coverage is known and covers the target area by one sensor. If sensor dies or battery rain out of energy, then there is coverage hole. In this work formulated a set k-cover problem for we propose a random scheduling method, where sensors are divided into subgroups. The groups are operated in ON and OFF pattern to maximize the coverage and reduce the energy conservation of sensor.

Keywords - Wireless sensor network, target monitoring, k-Coverage, Scheduling

I. INTRODUCTION

Wireless sensor network (WSNs) has been widely used for monitoring and tracking of the applications such as industry, health care, surveillance, traffic monitoring, environment monitoring, etc. Each sensor hasa certain range of coverage and sensor are deployed in a group to cover the target range. The sensor coverage and lifetime are important parameters for the performance of wireless sensor network. If we increase the sensor coverage, then sensors have a very short lifetime. For wireless sensor network, it is necessary that sensors are placed in such a way that they provide the maximum coverage with minimum energy consumption [1-3].

WSN is deployed in three different ways: static, mobile and hybrid. In static sensor deployment they sensor are do not change their position after their deployment[4]. In mobile sensor network, deployment sensor can change their position according to certain defined rules. In a hybrid sensor network, both fixed and mobile sensors are deployed. The mobile sensor covers those which are not covered by a fixed sensor or those areas where fixed sensor energy is depleted[5]. In this work, we only consider fixed sensor deployment.

II. COVERAGE PROBLEM IN WSN

Coverage of sensors is another key design of constraint of wireless sensor network. Sensing range, position and battery power are used input for wireless sensor network coverage [6]. However, sensors are battery powered, extending the lifetime of the sensors with full coverage is required. The sensor coverage can classify as target coverage, area coverage, barrier coverage[4]. Target coverage of sensor network includes some point where a target is detected and tracked. Area coverage include application like military surveillance and barrier coverage application includes coverage of sensors in some sub-regions defined by the certain boundary line.

The wireless sensor can be deployed in three ways: (i) forced deployment (ii) grid base deployment and (iii) computational geometry base deployment[7]. In fore deployment sensor are moving toward or away from each other using virtual attractive or repulsive force so full coverage is obtained. In grid based deployment sampling method is used, where coverage is evaluated only on the base of the set of points in the region of interest. Voronoi diagram and Delaunay diagram are commonly used for computational geometry based deployment. In next section, we will discuss the set K-cover problem for WSNs.

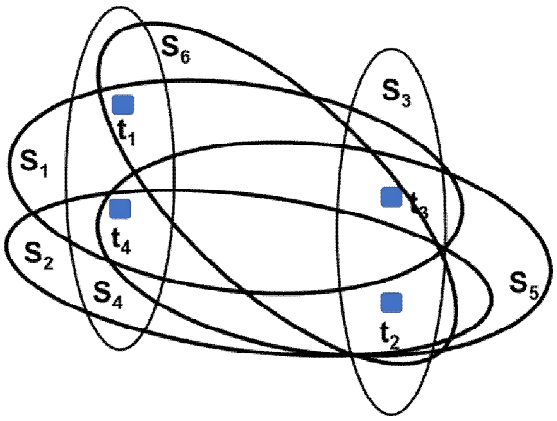


Fig.1 Wireless Sensor Network Coverage.

III. SET K-COVER PROBLEM

In classical target problem, it is assumed that is known and algorithm finds the optimal sensor that covers the area with maximum battery lifetime [8]. In these methods, only one sensor covers a particular area and a sensor died or energy is drained out then another sensor is required to cover that area. One approach to extend the battery life of sensors is the target coverage area is portioned in several areas

covers all targets and active the sensor one by one [9, 10]. By this approach, the sensor lifetime ideally increased by k time. The set k-cover problem is solved by scheduling the nodes activity by maximizing the battery lifetime. In this problem, the sensors are portioned in groups and cover is defined as the area covered by more than one sensor as shown in Fig. 1. The set k-coverage problem is proven to be Np-Complete [9].

There are many solutions proposed by research to solve this problem. Authors in [9], uses an integer coded genetic algorithm and local search, proposed a novel memetic algorithm. Hu et al. [11], proposed a genetic algorithm based approach to maximize the number of disjoint subset of nodes while furnishing the complete coverage in the targeted area. Xia [12], utilized particle swarm optimization approach to perform a quick search, to fix the position of sensor in order to reduce the overlay regions and blind areas.In this work, we use random scheduling technique to maximize the sensor coverage.

IV. RANDOM SCHEDULING BASED COVERAGE

The sensors are deployed in the targeted coverage area by two methods: (i) deterministic method and (ii) random method. For a sensor to operate successfully, the active node must remain connected and maintain the coverage. In random deployment case sensor scheduling is one of the best approaches to maximize the battery lifetime and coverage of sensor. The sensors have to state active and sleep state. During active state, node consumes maximum power to cover the target area while during the sleep state node consumes minimum power. The sensor can switch on between two states. If a mutually exclusive subset of sensor covers the target area, the remaining nodes are forced to transit to sleep state.

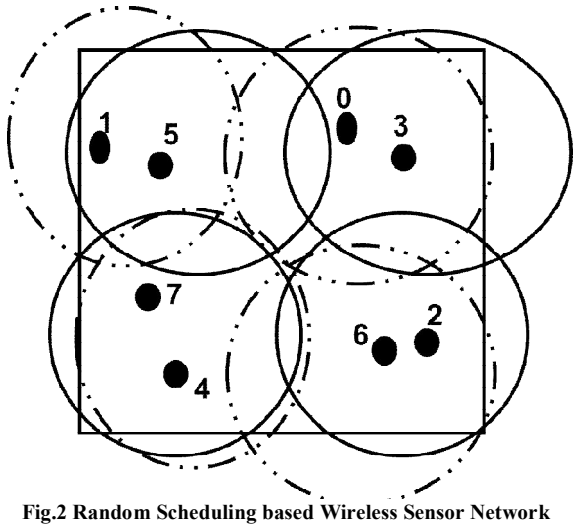


Fig.2 Random Scheduling based Wireless Sensor Network Coverage

Fig.2 shows an example [13]. Eight sensors are randomly deployed into a rectangular area. Assume that there are two disjoint subsets S_0 and S_1assigned to eight sensors. Each sensor selects a subset and then join that subset. Assume that sensors3, 4, 5, 6 select S_0, while sensors 0, 1, 2, 7 select S_1. After formation of subgroups, we select each subgroup ne by one and schedule their sensor coverage randomly. The process is repeated. The sensors work alternately ON and OFF. The sensing range for active sensors is shown by solid line (sensors 3, 4, 5, 6) and sensing range denoted dotted line (0, 1, 2, 7) fall asleep and vice versa.

CONCLUSION

Wireless sensors network has been widely used in the civil and military application for collecting, dissemination and processing of environmental data. The sensor coverage is one of the major problems because of limited power. In this paper, we proposed a random scheduling based coverage enhancement technique for set k-Cover problem. By efficient subgrouping and scheduling, the sensor coverage is maximized at minimum energy cost.

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REFERENCES

[1] Elhoseny, M., et al., K-coverage model based on genetic algorithm to extend wsn lifetime. IEEE sensors letters, 2017. 1(4): p. 1-4.
[2] Akyildiz, I.F., et al., Wireless sensor networks: a survey. Computer networks, 2002. 38(4): p. 393-422.
[3] Akyildiz, I.F., T. Melodia, and K.R. Chowdhury, A survey on wireless multimedia sensor networks. Computer networks, 2007. 51(4): p. 921-960.
[4] Wang, B., Coverage problems in sensor networks: A survey. ACM Computing Surveys (CSUR), 2011. 43(4): p. 32.
[5] Bhattacharjee, M. and S. Gupta. Determining redundant nodes in a location unaware wireless sensor network. in Advanced Communication Control and Computing Technologies (ICACCCT), 2014 International Conference on. 2014. IEEE.
[6] Wang, J., R.K. Ghosh, and S.K. Das, A survey on sensor localization. Journal of Control Theory and Applications, 2010. 8(1): p. 2-11.
[7] Aziz, N.A.A., K.A. Aziz, and W.Z.W. Ismail, Coverage strategies for wireless sensor networks. World academy of science, Engineering and technology, 2009. 50: p. 145-150.
[8] Moh'd Alia, O., Dynamic relocation of mobile base station in wireless sensor networks using a cluster-based harmony search algorithm. Information Sciences, 2017. 385: p. 76-95.
[9] Liao, C.-C. and C.-K. Ting, A Novel Integer-Coded Memetic Algorithm for the Set k-Cover Problem in Wireless Sensor Networks. IEEE Transactions on Cybernetics, 2017.
[10] Raghunathan, V., et al., Energy-aware wireless microsensor networks. IEEE Signal processing magazine, 2002. 19(2): p. 40-50.
[11] Hu, X.-M., et al., Hybrid genetic algorithm using a forward encoding scheme for lifetime maximization of wireless sensor networks. IEEE transactions on evolutionary computation, 2010. 14(5): p. 766-781.
[12] Xia, J. Coverage Optimization Strategy of Wireless Sensor Network Based on Swarm Intelligence Algorithm. in Smart City and Systems Engineering (ICSCSE), International Conference on. 2016. IEEE.
[13] Liu, C., et al., Random coverage with guaranteed connectivity: joint scheduling for wireless sensor networks. IEEE Transactions on Parallel and Distributed Systems, 2006. 17(6): p. 562-575.