ISSN (Online) : 2278-1021
ISSN (Print) : 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering
Vol. 3, Issue 2, February 2014

REDUCED COST SENSOR PLANNING MECHANISM FOR EXTENDED NETWORK LIFETIME IN SURVEILLANCE SENSOR NETWORKS

B.Narasimhan[1], T.Girija[2]

Assistant Professor, Department of Computer Technology, Dr.N.G.P.Arts and Science College, Coimbatore, India[1,2]

Abstract: In surveillance networks, sensor nodes are powered by batteries that have limited power. There have been different methods proposed in the literatures, for maximizing the network lifetime. A surveillance network is used to view the items and the network lifetime is expected to be present until the duration of the items in the location. In this research work the objective is to minimize the network cost which results in resulting extended network lifetime. For minimizing the network cost, the optimum number of sensor nodes is placed by which all the available targets will be monitored. Also the sensed data can be forwarded to a given base station. This research work projects that this problem is NP-hard and derive a lower bound on the minimum number of sensors required. Extended simulation has been conducted and the results show that the proposed work yields better solution.

I. INTRODUCTION

Target surveillance is a promising application of wireless sensor networks [1]. In a sensor-target surveillance network, the sensor nodes are used to monitor some targets, collect the sensed data, and transmit the sensed data to a base station. These operations involve energy usage but sensors are typically powered by batteries with limited energy. Hence, it is becoming important to effectively manage the usage of energy. In the literature, several methods have been proposed to maximize the lifetime of sensor-target surveillance networks [1], [7], [10], where the lifetime is the duration that the surveillance network can properly operate. The review of the existing methods is dealt in the next section.

1.1 Problem Statement

Given the locations of the targets and the base station, the problem is to place the smallest number of sensors for monitoring all the targets and forwarding the sensed data to base station, such that the resulting surveillance network has a lifetime of at least L where L is a given lifetime requirement. In this manner, the network cost is minimized while fulfilling a given lifetime requirement.

II. REVIEW OF LITERATURE

In [22], the on/off modes of sensors were determined such that the necessary data can be delivered to the base station and the lifetime of the network is maximized. Liu et al. [7], [13] investigated an integrated solution that combines energy efficient routing and on/off scheduling and designed optimal algorithms for maximizing the lifetime. Wettergren and Costa [11] studied sensor placement for surveillance of moving targets. Given the number of sensors, the problem in [11] is to determine the statistical distribution of the sensors' locations (rather than the exact locations of individual sensors), such that the probability of successful search of the moving targets is maximized. In [4], the lifetime performance of sensor networks was evaluated for wo basic placement schemes: square-grid and hex-grid. Lifetime of each individual sensor was modeled as a random variable and the network lifetime was analyzed based on the probability density functions. Relay node placement. Some studies employed relay nodes which are more powerful than sensors (e.g., relay nodes have more energy, larger communication range, or higher computing power). The objective of energy management is to prolong or maximize the lifetime of wireless sensor networks. There are three major techniques of energy management [13]: 1) energy efficient routing, 2) on/off scheduling for sensors, and 3) integrated routing and on/ off scheduling. Several energy efficient routing protocols have been proposed in the literature, such as Directed Diffusion [6] and PEGASIS [3]. Wu et al. [9] studied how to construct a data gathering tree to maximize the lifetime of sensor networks. In [12], a minimal-Steiner-tree-based algorithm and a randomized algorithm were proposed for constructing data gathering trees on grid graphs and general graphs, respectively. Carle and Simplot-Ryl [8] suggested that the best method for conserving energy is to turn off as many sensors as possible while keeping the system functioning.

Li et al. [2] proposed a 6-approximation algorithm to place a minimum number of relay nodes to establish directed paths from any sensor to a base station. Computational geometry is a very useful tool to various sensor coverage problems. A subproblem of this work is related to a typical computational geometry problem. Biagioni and Sasaki [1] investigated how to place a set of sensors to cover an area of interest such that the network is resilient to single node failure and the number of sensors is minimized. They proposed a line placement scheme for 1D region, and square, triangle, and hexagon placement schemes for 2D region.

III. PROPOSED WORK

The surveillance network consists of a base station and some sensors, where the base station is located at a given

ISSN (Online) : 2278-1021
ISSN (Print) : 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering
Vol. 3, Issue 2, February 2014

position while the number and locations of sensors are to be optimized. The sensors are used to:

1) Monitor the given targets located at fixed positions (e.g., the targets are the precious items located at fixed positions in an exhibition),
2) Collect the sensed data, and
3) Transmit this data to the base station.

Each sensor is powered by battery with an initial energy reserve of E. We assume that the sensing range of each sensor is Rs and the sensor can monitor all the targets which are within a euclidean distance of Rs from itself. To handle the non uniform sensing performance, we place a sensor close to a target to guarantee the requirement of the surveillance quality. Specifically, given a requirement of the surveillance quality, we can determine an appropriate sensing range Rs, such that sensing targets within Rs can fulfil the requirement. When a sensor monitors a target, it generates data at a rate of r. If it monitors n targets simultaneously, then it will generate data at a rate of nr. It forwards the data to the base station along a route using a collision-free MAC protocol. The energy usage model used for this research is [14].

The initial energy reserve E of each sensor is equal to $Lmr(e_s + e_T + \beta(d_{\max} + Rs)^{\alpha}$ where $d_{\max} \equiv \max\{d(t_i, B) \mid t_i \in T\}$ is the maximum distance between the target and the base station. The above said issue is more or less equal to covering with disks problem. Considering the case with only one target denoted as t. The problem is to place the smallest number of sensors to monitor target t and forward the sensed data to the base station, such that the resulting surveillance network has a lifetime of at least L. To minimize the energy usage, we place sensor s_1 for watching target t by which the distance between sensor s_1 and target t is equal to the maximum sensing range R_s and Target t, sensor s_1 and the base station are placed along a straight line Additional sensors will be placed a_l sensors so that these sensors can relay the sensed data from sensor s1 to the base station. With m given targets and a given lifetime requirement L, contains lower bound and upper bound. The lower bound can be used as a benchmark to evaluate the performance of any approximation algorithm for the research problem. Since the research problem is NP-hard, an adaptive approximation algorithm is used in order to find close-to-optimal solutions to this research problem.

Begin

$$H = \max\left\{\left(\frac{E/L_r - e_s - e_r}{\beta}\right)^{\frac{1}{\alpha}}, 0\right\};$$

$$T_1 = \Omega(H);$$

$$T_2 = \Omega(H + R_s) - \Omega(H);$$

$$T_3 = T - T_1 - T_2;$$

$$Execute\ SensorPlacementA\lg orithm\ for\ T_1 \cup T_2;$$

$$Execute\ SensorPlacementA\lg orithm\ for\ T_3;$$

End

Algorithm for Minimum Sensor Placement

The placement algorithm for T_1 operates in an iterative manner. In each round, we compute the smallest number of sensing disks of radius Rs to cover all the targets in T_1. Let S be the set of sensors of these sensing disks and $T(s_i)$ be the set of targets which are covered by s_i. For each sensor s_i, one target is selected randomly a sensor node s_i to watch the specified target. If sensor s_i has enough energy to watch this target for the necessary duration, this target is removed and the remaining energy of sensor s_i is updated accordingly. Otherwise, the sensor watches this target for the longest possible duration using its remaining energy and we record the remaining duration that this target should be watched. The above steps are repeated until sensor si uses up its energy. After all the sensors in S use up their energy, a new round gets started. The above process is continued until sensors have been assigned to watch all targets in T_1 for duration of L.

Simulation Settings and Performance Metrics

Parameter	Value
Terrain Size	500m X 500m
No. of Nodes	20 – 100
Range	10m – 50m
Energy	593J
Duration	200hrs – 750 hrs
Data Rate	8.7 kbps
E_s, e_r, e_g	50nj/bit

Results and Discussions

Fig. 1shows the number of sensors required versus the sensing range. It can be seen that the number of sensors decreases with the increase of sensing range. It is because that a sensor with larger sensing range can cover more targets and hence there is larger flexibility for efficient sensor placement. Another reason is that the distance for transmitting the sensed data to the base station becomes shorter.

VI. CONCLUSIONS

This research work focussed on minimizing the network cost. Due to reduction of cost the network lifetime will be extended. For minimizing the network cost, the optimum number of sensor nodes is placed by which all the available targets will be monitored. Also the sensed data can be forwarded to a given base station. This research work projects that this problem is NP-hard and derive a lower bound on the minimum number of sensors required. From the simulation results it is shown that the proposed work performs better.

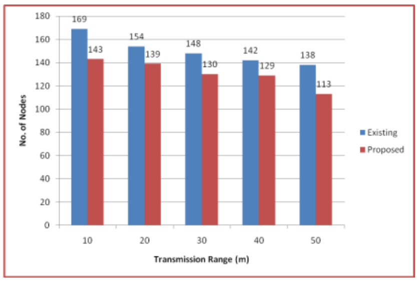

Fig.1. Comparison of Existing Vs Proposed Method

REFERENCES

[1] H. Liu, P.-J. Wan, and X. Jia, "Maximal Lifetime Scheduling for Sensor Surveillance Systems with K Sensors to 1 Target," IEEE Trans. Parallel and Distributed Systems, vol. 17, no. 12, pp. 1526-1536, Dec. 2006.

[2] S. Li, G. Chen, and W. Ding, "Relay Node Placement in Heterogeneous Wireless Sensor Networks with Basestations," Proc. WRI Int'l Conf. Comm. and Mobile Computing (CMC '09), vol. 1, pp. 573-577, 2009.

[3] S. Lindsey, C. Raghavendra, and K.M. Sivalingam, "Data Gathering Algorithms in Sensor Networks Using Energy Metrics," IEEE Trans. Parallel and Distributed System, vol. 13, no. 9, pp. 924- 935, Sept. 2002.

[4] E. Jain and Q. Liang, "Sensor Placement and Lifetime of Wireless Sensor Networks: Theory and Performance Analysis," Proc. IEEE Global Telecomm. Conf. (GlobeCom '05), 2005.

[5] E. Biagioni and G. Sasaki, "Wireless Sensor Placement for Reliable and Efficient Data Collection," Proc. Hawaii Conf. System Science, 2003.

[6] C. Intanagonwiwat, R. Govindan, and D. Estrin, "Directed Diffusion: A Scalable and Robust Communication Paradigm for Sensor Networks," Proc. ACM MobiCom, 2000.

[7] H. Liu, X. Jia, P. Wan, C.W. Yi, S.K. Makki, and N. Pissinou, "Maximizing Lifetime of Sensor Surveillance Systems," IEEE/ ACM Trans. Networking, vol. 15, no. 2, pp. 334-345, Apr. 2007.

[8] J. Carle and D. Simplot-Ryl, "Energy-Efficient Area Monitoring for Sensor Networks," IEEE Computer, vol. 37, no. 2, pp. 40-46, Feb. 2004.

[9] Y. Wu, S. Fahmy, and N.B. Shroff, "On the Construction of a Maximum-Lifetime Data Gathering Tree in Sensor Networks: NPCompleteness and Approximation Algorithm," Proc. IEEE INFOCOM, pp. 356-360, 2008.

[10] H. Liu, X. Chu, Y.W. Leung, X. Jia, and P. Wan, "General Maximal Lifetime Sensor-Target Surveillance Problem and Its Solution," IEEE Trans. Parallel and Distributed Systems, vol. 22, no. 10, pp. 1757-1765, Oct. 2011.

[11] T.A. Wettergren and R. Costa, "Optimal Placement of Distributed Sensor against Moving Targets," ACM Trans. on Sensor Networks, vol. 5, no. 3, 2009.

[12] Y. Yu, B. Krishnamachari, and V.K. Prasanna, "Data Gathering with Tunable Compression in Sensor Networks," IEEE Trans. Parallel and Distributed Systems, vol. 19, no. 2, pp. 276-287, Feb. 2008.

[13] H. Liu, X. Chu, Y.W. Leung, X. Jia, and P. Wan, "General Maximal Lifetime Sensor-Target Surveillance Problem and Its Solution," IEEE Trans. Parallel and Distributed Systems, vol. 22, no. 10, pp. 1757-1765, Oct. 2011.

[14] T. Melodia, D. Pompili, V.C. Gungor, and I.F. Akyildiz, "Communication and Coordination in Wireless Sensor and Actor Networks," IEEE Trans. Mobile Computing, vol. 6, no. 10, pp. 1116-1129, Oct. 2007.