A Study on Varied Problems Related to Coverage Space in Wireless Sensor Network

Snehal Sarangi[1] Geetanjali Sharma[2]
[1,2]Assistant Professor
[1,2]Department of Information Technology Engineering
[1,2]DYPCOE, Akurdi, Pune, Maharashtra

Abstract— Wireless sensor networks area unit speedily growing for analysis and industrial development that is employed for monitor a given field of interest to alter the surroundings wireless sensor network loosely employed in health care, national security, police work, and military. We tend to survey the present work on the coverage drawback in wireless sensor network. There are 2 kinds of coverage. One is space coverage and another is target coverage. The quality of service in wireless sensor network is directly proportional to the area of sensor coverage. Coverage in wireless sensor network is sometimes as a measure of how well and for how long the sensor nodes are able to observe the physical. In this paper we are dealing with these coverage problems in wireless sensor network.

Key words: Wireless sensor network, coverage, network lifetime

I. Introduction

In recent year wireless sensing element network has been increasing interest during this field. The wireless sensing element includes several sensors that is applicable in supervision and security environment. They incorporate sensing element node deployed over a geographic region for watching physical phenomena like temperature, humidity, vibration etc. A wireless sensor element network consists of sensor nodes. The sensing element or sensor node consist of 5 major elements i.e Sensor, Memory, Radio, Processor and Power supply. The power source of sensor node is not able to recharge or replace batteries due to number of factors like a large number of sensor nodes, distribution of node in remote access, desert or hostile places, in this the radio absorbs more power than other components in sensor network. Coverage and connectivity are two major problems for Quality of Service within the wireless sensor network. QoS of the network may be measured through the energy consumption to execute the service. The most necessary issue for developing wireless sensor network is to contemplate the coverage drawback and decreasing the energy use of the device. Coverage is important for a sensor network to maintain connectivity. Connectivity can be defined as the capacity of the sensing element to reach data link. Each node has a communication range which has defined the area in which another node can be located in order to receive data. The device in an exceedingly network will gather data from a region of observation and transmit this collected data to the end station. There are 2 ways of sending data 1. event-driven, 2. On- demand. In event driven data are sent to the base station when one or more sensor detects an event. In On – demand, data sent from the sensor to the base station on request.

This paper is organized as following sections: Coverage and connectivity issue in wireless sensor network, Coverage Strategies and Conclusion.

II. Coverage and Connectivity Issues

The area of coverage and connectivity are closely associated with one another. Both connectivity and coverage are combined in a single algorithm. It is to be consider that if the communication range of sensor is twice of sensing range then the coverage area adds connectivity. The most important requirement in wireless sensor network are Optimal resource management and assuring reliable QoS. It is necessary to design an effective development strategy that would reduce computation which will minimize cost and also node to node communication cost It is necessary to define a precise measure of efficient coverage that will input overall system performance.

There are 3 different types of coverage

A. Blanket/Area Coverage:

Sensor node that maximizes the detection rate of the target. Blanket coverage implies that at least a single node should be within the sensor area.

B. Barrier Coverage:

Sensor node that minimizes the probability of undetected penetration through the barrier.

C. Point Coverage:

The objective is to hide a collection of point with best/known location that require to be monitored. The point coverage theme focuses on determinative detector nodes' actual positions, that guarantee efficient coverage application for a limited range of target nodes.

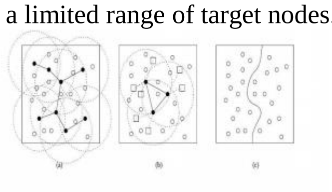

Fig. 1: (a) Area coverage, (b) point coverage, and (c) barrier coverage.

We state the coverage configuration protocol. The protocol perceives to maximize the quantity of nodes that place into sleep mode. They use a Voronoi diagram to prove that Coverage implies property once $Rc \geq 2R$ s ,they additionally verified the convex region, the property is 2kj if $Rc \geq 2Rs$, to prove the coverage the author specialize in the boundary of the sensing element. The node in CCP (Coverage Configuration Protocol) may be in one of the among 3 states. ACTIVE, LISTEN, SLEEP. every node can send periodically HELLO packets with its location and static. The node then can compile status its neighbor once it's in LISTEN state. It coated sensing space if neighbors then it'll transaction in to SLEEP mode. The CCP protocol doesn't guarantee property once $Rc \geq 2Rs$.

Optional Geographical Density Control (OGDC) is another protocol that decides coverage and property of sensor network. CCP (Coverage Configuration Protocol) coverage implies property once $Rc \geq 2Rs$ .The node in ODGC can be of 3 states. ON, OFF, UNDECIDED. The nodes starts out an UNDECIDED and then transit to either ON or OFF for steady phase. The OGDC protocol compares their work with CCP, their protocol extends the nodes lifetimes far better than the CCP. Both the protocols are useful for dense sensor network. If the redundancy is not of high degree then the overhead of implementing these protocols would not be beneficial.

These protocols approach the matter connected to the coverage of sensor network with varying sensing ranges.

Helly Theorem is another theorem to determine coverage space. They outlined the sensing states as READY, WAITING and RUNNING. Once a sensing element is in READY state. then the sensor nodes which are waiting to be woken up by "awake message" they form a running node which will be able to communicate and sense. This theorem can be implemented in both centralized, distributed connected K-coverage protocol.

III. Coverage Strategies

Coverage strategies are used for solving problems related to coverage in wireless sensor network. The strategies are divided into three categories force based, Grid based, Computational geometry based.

A. *Force Based:*

It is a strategy related to sensing mobility, using virtual repulsive and attractive force. The sensor force to move away from each other so that full coverage is achieved in sensor network. Each sensor node applies an attractive or repulsive force. According to the distance between each neighboring sensor they apply these forces to reach the target distance in network. A force can be described as a vector and overall force is the result of these vector's addition. Following are the conditions of force function:

1) Inversion relation: This implies that the force is inversely proportional to the distance of nodes.
2) Upper bound: fmax is maximum force. This is set an upper bound on force.
3) Lower bound: $f(d_{ij})=0$, if $d_{ij} > Re$,this indicates that force is exerted by neighbor.

We also introduced two rules for node movement

1) *Oscillation Check*

If one node move back and forth between similar location many times, that these nodes are regarded to in oscillation states.

2) *Stability Check*

If the distance of moving node is less than the predefined threshold for many times, then this node can be considered too reached to a stable state.

B. *Grid Based:*

Grid points are used in two different ways in WSN deployment. The first method is to measure the coverage as used in VFA or determine the sensor position. In these approach sensor will redeploy according to a predefined grid. The various types of grids are : Triangular Lattice grid , Square grid or Hexagonal grid. Basically the triangular lattice is preferred above all, because it requires the smallest number of nodes in sensor network density. But in sparse network large grid size is better than all. It will avoid overlapping of sensor range therefore confirming full consumption of their sensor capabilities. The grid can be used in robotic where robotic moves according to defined rules.

C. *Computational Geometry Based*

Computational geometry is frequently used in wireless sensor network for coverage optimization. The most frequently used computational geometry approaches are a Voronoi graph and Delaunay triangulation.

In Voronoi diagraph the partition of sites are done using point inside the polygon. Voronoi graph can be used as one of the sampling methods in defining wireless sensor network act as the partition sites. Voronoi diagram and Delaunay triangulation are used to assess the worst and best coverage.

1) *Worst Case Coverage*

A path introduced can go through with the least probability of being detected, and maximum support path.

2) *Best Case Coverage*

A path with the highest coverage. The work proved that a maximum opening path must lie on the edges of Voronoi diagram.

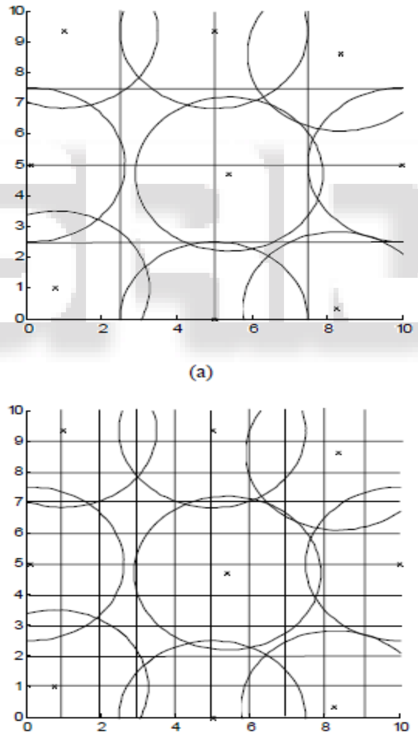

Fig. 2: Grid based coverage estimation for 9 sensors with sensing range equal to 2.5 in ROI of 10x10. (a) Grid size: 2.5x2.5; coverage estimated: 100% (b) Grid size: 1x1; coverage estimated: 95%

IV. Conclusion

Coverage in a wireless sensor network can be assumed as how well the wireless sensor network is able to observe a particular field internet. The coverage strategy work is divided into three different approaches; force based, grid based and computational geometry based. Theory and concept along with examples of algorithms proposed using these approaches were presented. The reviewed strategies commonly used to solve the WSN coverage problem each have their own advantages and costs: force based mostly, Grid based, process pure mathematics based mostly.

REFERENCES

[1] H.Zhang. "Energy –Balance Heuristic Distributed Algorithm for Target Coverage in Wireless Sensor Network with Adjustable Sensing Range", 2009 Asia – Pacific Conference on Information.
[2] Ghosh, A. and Das, S.K, "Coverage and Connectivity Issues in Wireless Sensor Network" in Shorey, R., Ananda, A.L, Chan, M.C. and Ooi, W.T "Mobile, Wireless, and Sensor Network: Technology, Application and Future Directions", John Wiley & sons(2006).
[3] Zou, Y. and Krishnedu Chakrabarty "Sensor deployment and target localization based on virtual forces" Twenty – Second Annual Joint Conference of the IEEE Computer and Communication Societies. IEEE Volume 2, 2003.
[4] Raghunathan, C. Schurgers, S. Park, and M.B. Srivastava, Energy – Aware wireless Micro Sensor Networks, IEEE Signal Processing Magazine, 2002.
[5] M. T. Thai, Y. Li, F. Wang, and D-Z,Du, Minimum Coverage Breach and Maximum Network Lifetime in Wireless Sensor Network"
[6] S. Yang, F. Dai, M. Cardei, J. Wu, and F. Patterson, "On Connected Multiple Point coverage in Wireless Sensor Networks", Journal of Network and Computer Applications, Volume 32 issue 4(July 2009).
[7] J. Chen and X.Koutsoukos. "Survey on Coverage Problem in Wireless ad hoc Sensor Networks", In IEEE communications Volume .9(Nov. 2005).
[8] Chakrabarty, K., Iyengar, S.S., Qi, H. and Cho, E. "Grid Coverage for Surveillance and Target Location in Distributed Sensor Networks" IEEE Transactions on Computer vol. 51 (2002).
[9] Wu, C.H, Lee, K.C, Yeh-Ching chung, Y.C "A Delaunay triangulation based method for wireless sensor networks deployment" 12 th International Conference On parallel and distributed Systems, volume 1, (July 2006).
[10] Y. Jennifer, M. Biswanath, and G. Dipak, "Wireless Sensor Network Survey", Computer Networks, 2008