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A Progressive Approach to Enhance Lifetime for Barrier Coverage in Wireless Sensor Network

C N Abhilash[1], A S Chandan[2], S H Manjula[3], K R Venugopal[4], L M Patnaik[5]

Department of CSE, UVCE, Bangalore University, Bengaluru, India[1,2,3]

Principal, Department of CSE, UVCE, Bangalore University, Bengaluru, India[4]

Professor & Chairman, Indian Institute of Science, Bengaluru, India[5]

ABSTRACT: Wireless sensor networks have their applications deployed in all the fields of area of research beyond the visualization of smart sensors. The sensors installed may experience many coverage related faults e.g., Barrier coverage problem. This problem affects the random deployment in sensor network to conserve energy and therefore has to be rectified, confined and approved. The protocol CSP and VSP defined extends the advantage of reducing the energy consumption and increases the lifetime of sensor nodes with the intrusion detection model over heterogeneous deployment. Inspite of low connectivity and multihop signal paths, the protocols is entirely scalable in terms of computational control and communication bandwidth. Two diverse cases are employed between the nodes with the protocols: position to position connectivity and load balancing. The former produces better results with a linear increase in network lifetime whereas through latter achieves 40 percent of energy utilization. Simulation results are provided to display the efficiency of the protocol designed.

KEYWORDS: Barrier Coverage, Intrusion Detection, Energy Conservation, Wireless Sensor Networks

I. INTRODUCTION

A wireless sensor network (WSN) is a group of spatially scattered sensor nodes over a certain region, to observe a definite task or set of tasks. These nodes are individual devices lacking contact to a regular power source and are positioned near to the target they are monitoring. The sensors correspond with one or more central positions, normally called base station or a sink. A distinct sensor node contains a logic unit, a process unit to execute computations, a radio unit to unite nodes to the system and a battery power unit [1]. Coverage is one of the most important challenges in the vicinity of sensor networks. Since the energy of sensors are limited, it is essential to cover the region with less number of sensors. Generally, coverage in sensor networks is divided into area coverage, position coverage, and barrier coverage. The barrier coverage problem for heterogeneous lifetime is overcome by the use of geometrical model to monitor the intrusion movements in the network. Recent researches show that significant energy reduction can be achieved by planning node duty cycles in high compactness sensor networks.

II. RELATED WORK

In this segment, the previous research work on Intrusion detection and barrier coverage measures and other related issues has been discussed. Many approaches have been discussed and the major objective is to sense the intruder activities in the sensor network efficiently. Poonam G et al. [4], proposes work on the issues in heterogeneous sensor networks models and also estimating different approaches for finding node location. Detecting intrusion in WSN will focus on practical implementations. In many applications used for detecting intrusion in smart offices and recent network resources. Amandeep et al. [5], explains the how the sensor nodes are deployed in the coverage problem. Genetic algorithm (GA) is used to tackle the heterogeneous and the coverage problem i.e. nodes having different range are used to cover the area. It places the sensing nodes on their best positions removes intersection and covers maximum area and it is an efficient algorithm for this problem. Jun Liu et al. [6], discuss deployment of barrier for dynamic area

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is mobility and unsure. It is an important issue that sensors form an effective barrier and describes the problem of barrier deployment for dynamic region developing a Barrier Deployment Algorithm based on swarm Intelligence of artificial fish swarm algorithm. It is efficient to form a barrier on dynamic area with less time and less cost of energy. The maximum lifetime scheduling for strong k- barrier coverage based on detection coverage model has been explored in [1]. A coordinated detection coverage model is formalized by a general function and analyses the factors of barrier coverage lifetime leading to optimization problem. Based on Divide-and-Conquer concept, localized maximal lifetime algorithm is proposed for strong k-barrier with coordinated sensors outperforming Randomized Independent Sleeping (RIS) and Local Barrier Coverage Protocol (LBCP) by 5 time units. Jie Chen and Xenofon Koutsoukos, [2] consider the coverage problem when combined with connectivity and energy efficiency with recent five research scheme on coverage of sensor networks. Comparison of design objectives of distributed and localized algorithm outperforms centralized algorithm in energy conservation due to less message transmissions. Yun Wang et al. [8], discuss wireless sensor networks by two sorts of nodes to facilitate the difference in their abilities, and focus the property of broadcast range on the coverage network, reachability of broadcast and heterogeneity of detection. They also explain the preface of a small amount of nodes through better abilities can condense the number of entire sensors required sacrificing without the coverage and the reachability of broadcast. It serves as a rule for manipulation of sensor networks in large-scale with cost-effective way.

III. **PROPOSED ALGORITHM**

A. *Design Considerations:*

- The topology of the network changes typically results in the sequential loss of network connectivity
- An asynchronous and distributed solution to the problem of minimum-node barrier coverage is proposed for protected areas of any size, shape, and sensor deployment methods in WSNs.
- A node only needs to exchange information with its neighbours without any location information.
- The intrusion probability for Uni-sensor and k-sensors recognition model has to be developed in homogeneous and heterogeneous scenarios.

B. *Description of the Proposed Models:*

Aim of the proposed model is toreduce the number of nodes active in order to maximize the network lifetime and in the same time ensure the required quality of service such as coverage and connectivity. The proposed model in homogeneous sensor network consists of following steps.In the Uni-sensing recognition model, the unknown target can be identified on one occasion as it travels into the coverage sensing disk of any sensor from any position of the network periphery or a position randomly in the network area. The corresponding intrusion recognition area I_R is similar to quadrilateral area with length-wise R and breadth 2rg and a half disk with radius rg attached to it. It has

$$\mathbf{I_R = 2 * R * rg + \pi r^2 g/2} \qquad \textbf{(1)}$$

In the k-sensor recognition model, an unknown target has to be sensed with minimum of k sensors for intrusion recognition in a sensor network. For example, minimal of three sensors information sensing is necessary to determine the position of the unknown target. Initially, think about the recognition probability that the un-known target can be detect immediately as it crosses the net-work area. In otherwords, if it has an intrusion distance R = 0. The corresponding intrusion recognition area is

$$\mathbf{I_0 = \pi r^2 g/2.} \qquad \textbf{(2)}$$

In a heterogeneous sensor network model, any position in the network area is said to be enclosed if the position is in the sensing range of any sensors (FormI, FormII, or both). A FormI sensor has the sensing range Sg1, and the sensing coverage with disk area of $S1 = \pi r^2 g1$. A FormII sensor has the sensing coverage of $S2 = \pi r^2 g2$ with the sensing range of Sg2. In this segment the analysis of intrusion recognition probability of a heterogeneous sensor network is demonstrated in Uni-sensing recognition and multiple-sensing recognition models. The intrusion distance in the given heterogeneous WSN is represented by Rh. Again, an unknown target may be identified by the WSN once it comes close to the network periphery, and the corresponding intrusion distance is Rh = 0. According to the Uni-sensing recognition model, the unknown target is identified only if one of the following criteria is satisfied:
(i)The unknown target gets into the sensing coverage area of any FormI sensor(s).
(ii)The unknown target gets into the sensing coverage area of any FormII sensor(s).

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IV. PSEUDO CODE

To Construct Barrier Coverage Divide-and-Conquer Algorithm is used.

1. Divide the given (curly) strip into small segments interleaved by thin perpendicular strips. The length of each perpendicular strip is w(n), the width of the original strip. The width of each perpendicular strip is chosen to be of the order log w(n) such that there exist $\Theta(\log w(n))$ disjoint barriers crossing the perpendicular strip.
2. In each perpendicular strip, sensor nodes use Compute Barriers to find all of the disjoint perpendicular barriers and the horizontal barriers that connect the perpendicular barriers together.
3. For each strip segment, use Compute Barriers to find disjoint horizontal barriers intersecting the perpendicular barriers on both ends of the segment.
4. Each perpendicular strip finds its horizontal and perpendicular barriers. Each segment finds the local horizontal barriers intersecting the perpendicular barriers on both ends. These local horizontal barriers are connected by perpendicular barriers so continuous barrier coverage across the entire strip is ensured. Each dot represents the location of a sensor.

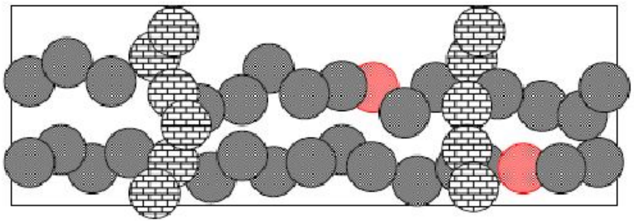

Fig.1. Improved Robustness for the Barrier Coverage

In the above barrier construction process, each segment and perpendicular strip independently computes the horizontal barriers. These horizontal barriers are connected by perpendicular barriers in the neighboring perpendicular strips to provide global barrier coverage. This ensures that there is no gap between the horizontal barriers; so continuous barrier coverage across the entire strip is provided. The Compute Barriers algorithm ends all barriers in each strip segment and each perpendicular strip. If only k disjoint barriers are required, we can activate k horizontal barriers in each segment and in each perpendicular strip and rotate the active-duty barriers among all available barriers. Also, we can move the perpendicular strips as sliding windows to avoid the overuse of the same perpendicular barriers. The barrier rotation process and sliding perpendicular barrier scheme will balance the power consumption among sensors and hence extend the network lifetime.

V. SIMULATION RESULTS

The simulation study shows that the network topology with 500 nodes in a 100x100 rectangular region. The proposed model is implemented in C# & .Net packages. The packets are transferred through the nodes deployed randomly with different initial energylevels and residual energy. The proposed model is analyzed between two metrics Transmission Energy and Maximum Number of Nodes on the basis of total number of packets transmitted, network lifetime and energy consumed by each node. The network lifetime is calculated by the residual energy and initial energy levels remaining with the deployed nodes. As the number of nodes increases the complexity will raise. In figure 2, the proposed model Variable State Protocol (VSP) performs better with minimal nodes being active than latter model with the variation of initial energy levels and residual energy in the nodes for intrusion detection. In figure 3, the number of the proposed model achieves better rate over the existing model as the nodes is gradually increased with respect to the energy levels of the nodes deployed thereby enhancing the network lifetime.

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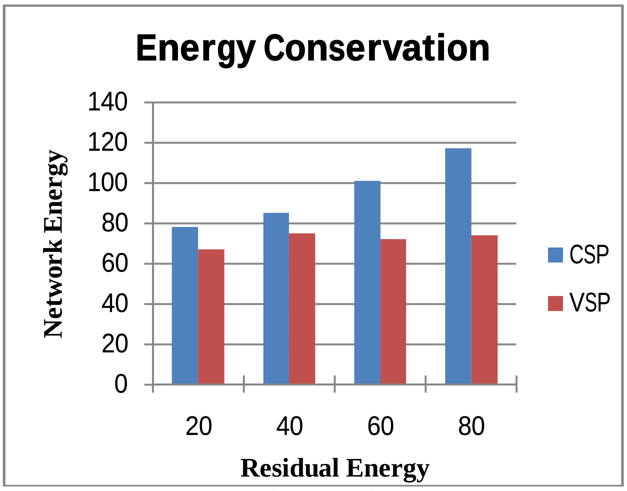

Fig.2. Energy Consumption by VSP and CSP

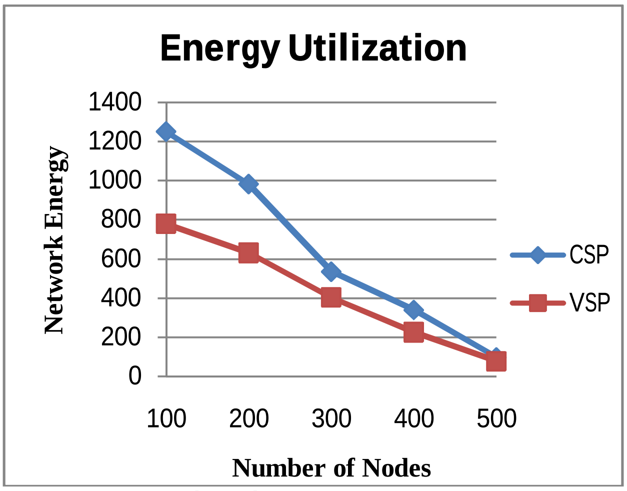

Fig. 3. Energy Consumption by Node Density

VI. CONCLUSIONS

The objective of this paper is to to minimize the number of active nodes in order to maximize the network lifetime and in the same time ensure the required quality of service such as coverage and connectivity. The simulation results showed that the proposed modelVSP performs better with the total transmission energy metric than the residual energy metric under heterogeneous sensor network. The proposed modelhelpsto reduce delay, communication overhead, and computation costs for finding disjoint barriers in a large sensor networkand the region covered is protected by strips and divides each strip into small segments interleaved by thin perpendicular strips.As the performance of the proposed model is examined between two parameters in future with variation in design considerations the performance of the proposed model can be compared with other energy efficient models. The performance of the model is analyzed under heterogeneous sensor network with high energy conservation and increased lifetime.

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BIOGRAPHY

Mr. Abhilash C Nis a is currently working as anAssociate Professor in the Department of Information Science and Engineering, SJB Institute of Technology, Bangalore, India. He obtained hisBachelor of Engineering from Dr. AI.T., Bengaluru.He received the Master of Engineering (ME) degree from UVCE, Bengaluru, India. He has 08 years of

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teaching experience. Currently he is pursuing Ph. D in the Department in theDepartment of Computer Science andEngineering, University Visvesvaraya College ofEngineering, Bangalore University, Bangalore.His research interests are Computer Networks, Wireless Sensor Networks, Adhoc Networks etc.

Dr. S H Manjulais currently working asAssociate Professor, Department of ComputerScience and Engineering, University VisvesvarayaCollege of Engineering, Bangalore University,Bangalore. She obtained her Bachelor ofEngineering, Masters of Engineering and Ph. D inComputer Science and Engineering. She haspublished a book on Wireless Sensor Networks.She has published more than 30 papers in refereedinternational journals and conferences. Her research interests are in the fieldof Wireless Sensor Networks, Semantic web and Data mining.\

Dr. Venugopal K Ris currently Special Officer,DVG Bangalore University and Principal,University Visvesvaraya College of Engineering,Bangalore University, Bangalore. He obtained hisBachelor of Engineering from UniversityVisvesvaraya College of Engineering. He receivedhis Masters degree in Computer Science andAutomation from Indian Institute of ScienceBangalore. He was awarded Ph.D. in Economicsfrom Bangalore University and Ph.D.in Computer Science from IndianInstitute of Technology, Madras. He has a distinguished academic careerand has degrees in Electronics, Economics, Law, Business Finance, PublicRelations, Communications, Industrial Relations, Computer Science andJournalism. He has authored and edited 39 books on Computer Science andEconomics, which include Petrodollar and the World Economy, CAptitude, Mastering C, Microprocessor Programming, Mastering C++ andDigital Circuits and Systems. During his three decades of service at UVCEhe has over 400 research papers to his credit. He was a Post DoctoralResearch Scholar at University of Southern California, USA. His researchinterests include Computer Networks, Wireless Sensor Networks, Paralleland Distributed Systems, Digital Signal Processing and Data Mining.

Dr. L M Patnaik is honorary Professor inDepartment of Computer Science and Automation,Indian institute of Science, Bangalore. During thepast 35 years of his service at the Institute he hasover 700 research publications in refereedInternational Journals and refereed InternationalConference Proceedings. He is a Fellow of all thefour leading Science and Engineering Academiesin India; Fellow of the IEEE and the Academy ofScience for the Developing World. He hasreceived twenty national and international awards; notable among them isthe IEEE Technical Achievement Award for his significant contributions toHigh Performance Computing and Soft Computing. He is a Ex-ViceChancellor, Defense Institute of Advanced Technology, Pune, India. Hisareas of research interest have been Parallel and Distributed Computing,Mobile Computing, CAD for VLSI circuits, Soft Computing andComputational Neuroscience.