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Node Deployment in Homogeneous and Heterogeneous Wireless Sensor Network

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ABSTRACT

Optimal sensor deployment is necessary condition in homogeneous and heterogeneous wireless sensor network. Effective deployment of sensor nodes is a major point of concern as performance and lifetime of any WSN. Proposed sensor deployment in WSN explore every sensor node sends its data to the nearest sink node of the WSN. In addition to that system proposes a hexagonal cell based sensor deployment which leads to optimal sensor deployment for both homogeneous and heterogeneous sensor deployment. Wireless sensor networks are receiving significant concentration due to their potential applications ranging from surveillance to tracking domains. In limited communication range, a WSN is divided into several disconnected sub-graphs under certain conditions. We deploy sensor nodes at random locations so that it improves performance of the network.This paper aims to study, discuss and analyze various node deployment strategies and coverage problems for Homogeneous and Heterogeneous WSN.

KEYWORDS: *Sensor Deployment, Homogeneous, Heterogeneous, Energy Hole Problem, Area Coverage.*

I. Introduction

Wireless sensor networks (WSNs) collect data from the physical world and communicate it with the virtual information world, such as computers. Sensor nodes are battery powered devices it has limited power so we need to use it efficiently. Proper sensor deployment improves monitoring and controlling of physical environment. Proposed system is used to sensing in the target area. Communication between sensor nodes is utilized to collect physical information such as temperature but collected data is waste of sense if it is not transmitted by access point. The nodes close to the sink should forward the data packets faster than other nodes, they exhaust their energy quickly, leading to an energy hole around the sink.

Each sensor in the wireless sensor network has limited communication range, which affect connectivity of network. Therefore to mitigate drawback of current network is to distribute sensor node and minimize network break down. Dynamic node deployment is used for distribution of sensor nodes at random locations. We develop a model which provides minimum distortion with Maximum Coverage.

In future network, mobility of a node going to be critical factor for deployment and lifetime improvement of network. Many algorithms are proposed for handling the data processing and routing in mobile environments[1]. Section II describe in detail about the various current techniques available for deployment of the node. Section III discusses the proposed mechanism for efficient deployment of the nodes for future applications.

II. Literature Survey

A sensor node normally encapsulates one or more sensor units, a power supply unit, a data processing unit, data storage, and a data transmission unit. A sensor networkconsists of sensor nodes that are deployed in different geographical locations within asensor field to collectively monitor physical phenomena. A sensor network also includesone or more sinks which collect data from sensor nodes. A sink can be regarded as aninterface between a sensor network and the people operating the sensor network.Applications of sensor networks are in a wide range, including battlefield surveillance, environmental monitoring etc. A brief survey of different node deployment strategies is described below.

2.1 Sensor Deployment with Limited Communication Range in Homogeneous and Heterogeneous Wireless Sensor Networks

It models the sensor deployment problem as a source coding problem with distortion reflecting sensingaccuracy. When the communication range is limited, a WSN is divided into several disconnected sub-graphs under certain conditions. The necessary condition implies that every sensor node location should coincide with centroid of its own optimal sensing region. In this a backbone network is designed for communication between sensor nodes and cluster node. Every sensor in the backbone network calculates its own approximate desired region and moves to a critical location with maximum local performance. It proposes a method which depends only on local information to keep connectivity in WSNs. It uses a RL (Restraint Lloyd) algorithm in which sensor nodes move to the centroid and partitioning is done by assigning the optimal partitions [2].

2.2 A Location-wise Predetermined Deployment for Optimizing Lifetime in Visual Sensor Networks

In this we analyze the optimization of network lifetime by balancing the energy consumption among different SNs. From analysis it is revealed that the number of SNs and relay nodes, and their locations has significant influence on limiting the energy hole problem and optimization of network lifetime. In this all SNs are distributed in a two dimensional plane covered by a set of Regular Hexagonal Cells (RHC). In this SNs are deployed at the specific vertices on each RHC and relay nodes are distributed at the centre of each cell. A camera based visual sensing node (VN) that captures images from the environment, generates imagery data and periodically transmits those data to a neighbouring RN. A RN forwards the data received from both the neighbouring VNs and neighbouring RNs which are farther away from the sink. The effect of placement errors on the performance and robustness of the scheme is also explored [3].

2.3Coverage Problems in Sensor Networks: A Survey

Coverage which is one of the most important performance metrics for sensor networks reflects how well a sensor field is monitored. Individual sensor coverage models are dependent on the sensing functions of different types of sensors, while network-wide sensing coverage is a collective performance measure for geographically distributed sensor nodes. This article surveys research progress made to address various coverage problems in sensor networks. The coverage problems in sensor networks can be classified into three categories according to the subject to be covered, it includes point (or target), area coverage and barrier coverage.

It classifies design issues for coverage problems such as coverage type, deployment method, coverage degree, coverage ratio and activity scheduling. In area Coverageproblem we determine deterministic node placement and random node placement based on critical sensor density.In random independent sleeping scheduling a sensor node decides its activity states independent of other sensor nodes [4].

2.4 Lifetime and Energy Hole Evolution Analysis in Data-Gathering Wireless Sensor Networks.

It propose an analytic model to estimate the entire network lifetime from network initialization until it is completely disabled, and determine the boundary of energy hole in a data-gatheringWSN. It theoretically estimate the traffic load, energy consumption, and lifetime of sensor nodes during the entire network lifetime, based on lifetime analysis of sensor nodes it investigate the temporal and spatial evolution of energy hole from emerging to partitioning the network to avoid energy hole in WSNs. In this network lifetime is calculated under the given percentage of dead nodes and analyzed emerging time and location of energy hole. Sensor nodes periodically send the sensed data to the sink in a data period. The network lifetime is slotted into a large number of data periods. We first divide the network into a number of small regions where the nodes have similar distances to the sink. Since the energy consumption of the sensor nodes in the same region (i.e., with the similar distances to the sink) should be the same from a statistical point of view, we use the average energy consumption of this region as the nodal energy consumption of this region [5].

2.5 Autonomous Deployment of Heterogeneous Mobile Sensors

It addresses the problem of deploying heterogeneous mobile sensors over a target area. It shows how traditional approaches designed for homogeneous networks fail when adopted in the heterogeneous operative setting. Sensors may be deployed somewhat randomly from a distance and then reposition themselves to provide the required sensing coverage. In this we address two problems one is the deployment of heterogeneous sensors to achieve full coverage and deployment of sensors to achieve coverage of varying density within Area of Interest (AoI). Our sensor deployment protocol runs iteratively. In each round, the sensors broadcast their locations and construct their local Voronoi-Laguerre polygons on the basis of the information received from neighbors. Each sensor evaluates the existence of coverage holes within its polygon and makes movement decisions accordingly. Each sensor calculates its coverage as the intersection of itssensing disk with its Voronoi-Laguerre polygon, by consideringthe AoI. The movement adjustment of sensors becomes anevaluation of the increase in the coverage of the region AoI[6].

2.6 Dynamic Deployment of Wireless Nodes for Maximizing Network Lifetime in WSN

In this paper, we investigate the density in monitored area to determine the optimal deployment of nodes by taking into consideration of different requirements. By using our dynamic deployment scheme, energy balance can be achieved**.** A mathematical model is proposed to compute the desired sensor density in the monitored area. Our objective is that the sensors consume energy at the same rate, thus resulting in balanced energy consumption in the whole network. The lifetime of the network, which we define to be the period from the start of the network to the first sensor dies, can be prolonged by using this optimal deployment scheme. Sensor nodes send their messages to a sink located centrally. The density distribution optimization problem is solved by determining number of nodes in each sub-region. Given the energy constraints and data generation rate, our scheme permits sensor nodes todeplete energy at the same rate, as a result, longer lifetime is achieved [7].

2.7 Barrier Coverage of Line Based Deployed Wireless Sensor Networks

When sensors are deployed along a line (e.g., sensors are dropped from an aircraft along a given path), they would be distributed along the line with random offsets due to wind and other environmental factors. This paper establishes a tight lower-bound for the existence of barrier coverage under line-based deployments. It show that the barrier coverage of the line-based deployments significantly outperforms that of the Poisson model when the random offsets are relatively small compared to the sensor's sensing range. We then study sensor deployments along multiple lines and show how barrier coverage is affected by the distance between adjacent lines and the random offsets of sensors. We assume that sensors are deployed in a two dimensionalrectangular area of length and width where sensors do not move after theyare deployed. Deploying sensors along multiple lines may provide robustness and multiple lines of defense in the deployed region. These results demonstrate that sensor deployment strategies have direct impact on the barrier coverage of wireless sensor networks [8].

2.8 Movement-Assisted Sensor Deployment

Sensor deployment is an important issue in designing sensor networks. In this paper, we design and evaluate distributed self-deployment protocols for mobile sensors. After discovering a coverage hole, the proposed protocols calculate the target positions of the sensors where they should move. We use Voronoi diagrams to discover the coverage holes and design three movement-assisted sensor deployment protocols, VEC (VECtor-based), VOR (VORonoi-based), and Minimax based on the principle of moving sensors from densely deployed areas to sparsely deployed areas. Simulation results show that our protocols can provide high coverage within a short deploying time and limited movement.For the given target area, how to maximize the sensor coverage with less time, movement distance and message complexity.Given an area to be monitored, our distributed self-deployment protocols first discover the existence of coverage holes (the area not covered by any sensor) in the target area based on the sensing service required by the application. After discovering a coverage hole, the proposed protocols calculate the targetpositions of these sensors, where they should move to eliminate or reduce the size of coverage hole [9].

2.9An Efficient Genetic Algorithm for Maximum Coverage Deployment in Wireless Sensor Networks

In this paper, it introduced the maximum coverage deployment problem in wireless sensor networks and analyze the properties of the problem and its solution space. Random deployment is the simplest way to deploy sensor nodes but may cause unbalanced deployment and therefore, we need a more intelligent way for sensor deployment. We propose an efficient genetic algorithm using a novel normalization method and the proposed genetic algorithms could be improved by combining with a well-designed local search. To cover a wide range of a target area with a minimum numberof sensors and can be accomplished by efficient deploymentof the sensors. Sensor coverage models measure the sensing capability and quality by capturing the geometric relation between a point and sensors.Our genetic algorithm was not only about twice faster than existing, but also showed significant performance improvement in quality [10].

2.10 Optimal Surface Deployment Problem in Wireless Sensor Networks

We tackle the problem of optimal sensor deployment on 3D surfaces, aiming to achieve the highest overall sensing quality. In general, the reading of sensor node exhibits unreliability, which often depends on the distance between the sensor and the target to be sensed, as observed in a wide range of application. Therefore, with a given set of sensors, a sensor network offers different accuracy in data acquisition when the sensors are deployed in different ways in the Field of Interest (FoI). We introduce a new model to formulate the problem of sensor deployment on 3D surface. We assume stationary and homogeneous sensors deployed on surfaces. They do not move after deployment and have the same sensing radius and identical sensing capacity. The accuracy of their collected data depends on the distance between the sensor and the target point to be sensed. We present the optimal solution for 3D surface sensor deployment with minimized overall unreliability. A series of algorithms are proposed to approximate the optimal solution in order to increase effectiveness of WSN [11].

2.11 Probabilistic Sensor Deployment in Wireless Sensor Network: A New Approach

In this paper it proposed a new approach to find out least covered regions in a sensor network where further sensor deployment is desirable. This approach used some graph-theory based algorithm. The experimental output of the proposed approach is a satisfied one for the improvement quality of network coverage. Moreover in case of sensing or detecting, use of closest sensor of a cluster to a particular point of event makes the overall computation less expensive for the proposed technique. The main aspiration of the proposed approach is to find the probability of detecting any event over the Voronoi edges of considered Voronoi diagram based network. The clustering algorithm generates clusters from a large number of deployed sensors without any user-definedarguments about the large number of sensor nodes. Proposed method assumes that sensor nodes should be location aware and locationdependent. Moreover every sensor node stores topological andsensing information. Then each node receives and forwardsthat information to its cluster head. It can be shown by the expectedexperimental results that the probability of detecting any evententirely depends on the number of deployed sensors [12].

III. Proposed System Mechanism

We motivate towards the designing of new deployment scheme, the motivating factors are cost of the existing sensor nodes, complex and time consuming shipping process. Deploying nodes at random location we can define an appropriate sensing performance measure. Our main goal is to mitigate energy conservation, load balancing and maximize success ratio of random node deployment. Data Acquisition network Monitor and collect data by assessing and evaluating the information storing, Whereas Data Distribution network serve useful data to external network.

In proposed system hexagonal cells are used for distribution of sensor nodes in 3D environment, due to 3D model we can distribute maximum number of sensor nodes at random locations. Sensor nodes sends data to the nearest sink node, Sink nodes are the nodes which is having large battery power and which act as a cluster head for communication between sensor nodes and after that data is send to the user. When the communication range is limited, a WSN is divided into several disconnected sub-graphs.Proposed sensor deployment leads to accuracy model as shown in following architecture.

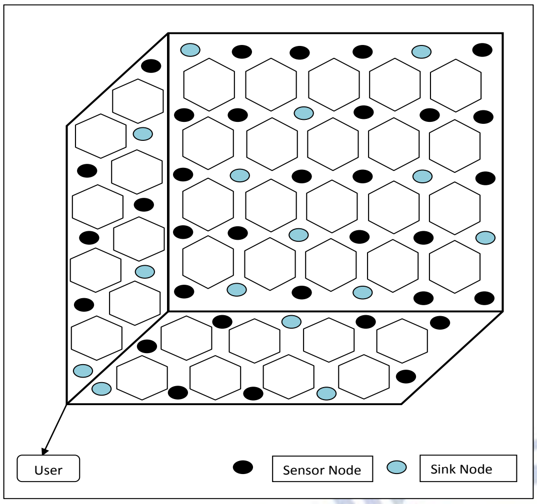

Fig.Node Deployment Architecture

IV. Conclusion

We introduce the system model for both homogeneous and heterogeneous WSNs and formulate the problems of sensing and connectivity. Node deployment strategy has significant influence on optimizing network lifetime. We studied the deployment of sensor nodes for static and dynamic locations. Coverage is one of the most important performance metrics for sensor networks reflects how well a sensor field is monitored. By changing the sink node role among other sensor nodes dynamically in WSN, each node is expected to have the same amount of energy over time which helps to minimize Energy Hole problem. Our future work includes increase the capacity of sensor nodes by providing solar energy support to nodes which helps nodes active for long time.

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