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Research Paper

SECURE DATA RETRIEVAL USING ATTRIBUTE UNIONS FOR MILITARY NETWORKS

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Wireless sensor network coverage needs to guarantee that the region is monitored with the required degree of reliability. Locations of sensor nodes constitute the basic input for the algorithm that examines coverage of the network. Coverage problems can be broadly classified as area coverage problem and target coverage problem. Area coverage focuses on monitoring the entire region of interest, whereas target coverage concerns monitoring only certain specific points in a given region. The main purpose of this paper is to deploy sensor nodes at optimal locations such that the theoretically computes network lifetime is maximum and to schedule these sensor nodes such that the network attains the maximum lifetime. The overall objective is to identify optimal deployment locations of the given sensor nodes with a pre-specified sensing range, and to schedule the sensor nodes such that the network lifetime is maximum with the required coverage level. It gives an overview of the routing algorithms and their real purpose to direct traffic form sources to destinations maximizing network performance while minimizing the costs.

Keywords: Access control, attribute-based encryption (ABE), disruption-tolerant network (DTN), multiauthority, wireless sensor network, sensor deployment

INTRODUCTION

In a standard WSN random deployment, there is more chance of targets being not detected or targets not being covered with the required level of coverage. Sensor network this may not hold true with dense deployment of nodes.Possibility of some targets being monitored by many sensor nodes, and some by a few sensor nodes. This difference in the number of sensor nodes monitoring each target will affect the network lifetime.

In WSN there are two types of sensor node deployments: random deployment and deterministic deployment. Random deployment is suitable for applications where the details of the regions are not known, or regions are inaccessible. An example of random deployment of sensor nodes would be in battle eld surveillance. In such a deployment, the most common way of extending the network lifetime is by scheduling the sensor nodes such that only a subset of sensor nodes that is enough to satisfy

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coverage requirement need to be active at a time. In deterministic deployment, the details of the region will be known a priori and since a provision of deploying nodes at specic locations prevail, there exists two ways by which network lifetime can be maximized.

One is at deployment phase and the other is at scheduling phase. Given a region with targets being monitored by sensor nodes, the upper bound of network lifetime can be mathematically computed. This information can be used for computing locations which would be appropriate for coverage to be satised as well as network lifetime to be maximum. Once the deployment locations are computed, sensor nodes can be scheduled to achieve the optimum lifetime.

Sensor deployment and scheduling in this way contributes equally to extend the network lifetime. Hence the problem can be summarized as: Given some sensor nodes that can be deterministically deployed, where to deploy them and how to schedule them so as to achieve the required target coverage level and maximize the network lifetime? There are several ways of computing deployment locations. Bio-inspired algorithms prove to be effective for solving optimization problems.

FEATURES WIRELESS SENSOR NETWORK

Wireless Sensor Networks (WSNs) are important for many applications such as military sensing, physical security, air traffic control, traffic surveillance, video surveillance, industrial and manufacturing automation, environment monitoring, and building and structural monitoring. Network lifetime (dened as the time instant from which the network starts functioning to the time instant where the desired coverage criterion is not satised) is a crucial factor that determines the efficiency of a wireless sensor network. Energy usage should be curbed to achieve enhanced lifetime.

This is because sensor nodes are battery powered and cannot be easily recharged or replaced. Coverage in a WSN needs to guarantee that the region is monitored with the required degree of reliability. Locations of sensor nodes constitute the basic input for the algorithms that examine coverage of the network. Coverage problems can be broadly classied as area coverage problem and target coverage problem.Area coverage focuses on monitoring the entire region of interest, whereas target coverage concerns monitoring only certain specic points in a given region. Target coverage can be categorized as simple coverage, k-coverage and Q-coverage. With simple coverage, each target should be monitored by at least one sensor node. For k-coverage, each target has to be monitored by at least k sensor nodes, where k is a pre-dened integer constant. In Q-coverage, the target vector T = {T1, T2, . . . , Tn} should be monitored by Q = {q1, q2, . . . , qn} number of sensor nodes such that target Tj is monitored by at least q j number of sensor nodes, where n is the number of targets and 1 d” j d” n. There are two types of sensor node deployments: random deployment and deterministic deployment.

Random deployment is suitable for applications where the details of the regions are not known, or regions are inaccessible. An example of random deployment of sensor nodes would be in battleeld surveillance. In such a deployment, the most common way of extending the network lifetime is by scheduling the sensor nodes such that only a subset of sensor nodes that is enough to satisfy coverage requirement need to be active at a time .

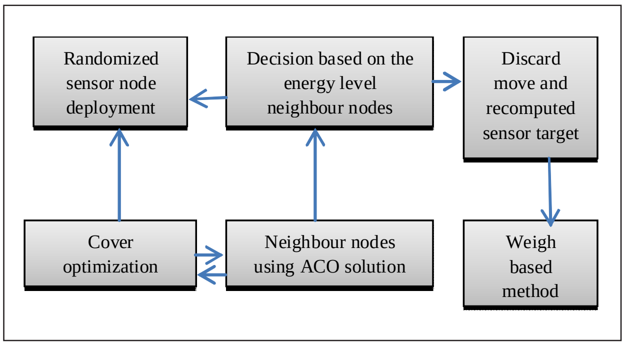
A. Sensor Coverage

Sensor coverage is important while evaluating the effectiveness of a wireless sensor network. A lower coverage level (simple coverage) is enough for environmental or habitat Monitoring or applications like home security. Higher degree of coverage (k-coverage) will be required for some applications like target tracking to track the targets accurately, or if sensors work in a hostile environment such as battle elds or chemically polluted areas. More reliable results are produced for higher degree of coverage which requires multiple sensor nodes to monitor the region/ targets. In some cases, for the same application, the coverage requirement may vary. For example, for forest re detections, the coverage level may be low in rainy seasons, but high in dry seasons.

An example of Q-coverage is video surveillance systems deployed for monitoring hostile territorial area where some sensitive targets like a nuclear plant may need more sensors cooperate to ensure source redundancy for precise data. Both sensor deployment and scheduling are important to ensure prolonged network lifetime. Traditionally, the problems of sensor placement and scheduling have been considered separately from each other. A balanced performance is crucial for most applications. Different sensor deployment strategies can cause very different network topology, and thus different degrees of sensor redundancy. A good sensor deployment with sufcient number of sensors which ensures a certain degree of redundancy in coverage so that sensors can rotate between active and sleep modes is required to balance the workload of sensors.

ARCHITECTURE

The sensor nodes can be deterministically deployed; the optimal deployment locations and the schedule are decided at the base station, prior to actual deployment. The proposed method has two phases: sensor deployment and sensor scheduling. The nodes are initially deployed randomly. Based on the theoretical upper bound of network lifetime, we compute the optimal deployment locations using ABC algorithm. A heuristic is then used to schedule the sensor nodes such that the network lifetime is maximum.



Here we propose a heuristic for sensor deployment (Algorithm 2). Initially, place the sensor nodes randomly. If any sensor node is idle (without monitoring any target), the node is moved to the least monitored targets' location. This is to ensure that all sensor nodes play their part in monitoring the targets. The sensor nodes are then sorted based on the number of targets it cover. The sensor node is placed at the middle of all the targets it covers. The next nearest target is identied and the sensor node is placed at the middle of all these targets. If it can cover this new target along with targets it was already monitoring, allow this move, else discard the move. This is done till the sensor node cannot cover any new target. At the end, upper bound is computed. The drawback of this approach is that it depends on the initial position of the sensor nodes. Though it may perform well for dense deployments, consistency cannot always be guaranteed.

PROPOSED METHOD

Since the sensor nodes can be deterministically deployed, the optimal deployment locations and the schedule are decided at the base station, prior to actual deployment. The proposed method has two phases: sensor deployment and sensor scheduling. The nodes are initially deployed randomly. Based on the theoretical upper bound of network lifetime, we compute the optimal deployment locations using ABC algorithm. A heuristic is then used to schedule the sensor nodes such that the network lifetime is maximum.

A. ABC Based Sensor Deployment

Artificial Bee Colony (ABC) Algorithm is an optimization algorithm based on the intelligent behaviour of honey bee swarm. The colony of bees contains three groups: employed bees, onlookers and scouts.The employed bee takes a load of nectar from the source and returns to the hive and unloads the nectar to a food store. After unloading the food, the bee performs a special form of dance called waggle dance which contains information about the direction in which the food will be found, its distance from the hive and its quality rating. Since informationabout all the current rich sources is available to an onlookeron the dance floor, an onlooker bee probably could watch numerous dances and choose to employ itself at the most qualitative source. There is a greater probability of onlookers choosing more qualitative sources since more information is circulating about the more qualitative sources. Employed foragers share their information with a probability, which is proportional to the quality of the food source. Hence, the recruitment is proportional to quality of a food source.Exploitation is carried out by employed bees and onlookers, while exploration is carried out by scouts.

B. PSO Based Sensor Deployment:

Particle Swarm Optimization (PSO) consists of a swarm of particles moving in a search space of possible solutions for a problem. Every particle has a position vector representing a candidate solution to the problem and a velocity vector. Moreover, each particle contains a small memory that stores its own best position seen so far and a global best position obtained through communication with its neighbor particles. It consists of a swarm of *w* candidate solutions called particles, which explore an *nd*-dimensional hyperspace in search of the global solution (n represents the number of optimal parameters to be determined). A particle *p* occupies position *x pd*and velocity *v pd*in the *dth*dimension of the hyperspace, 1 d” *p* d” *w* and 1 d” *d* d” *nd*. In the global-best version of PSO, the position where the particle *p* has its best cost is stored as (*pbestpd*). Besides, *gbestd*, the position of the best particle. In each iteration *tr*,velocity *v* and position *x* are updated using (5) and (6). The update process is iteratively repeated until either an acceptable *gbest*is achieved or a fixed number of iterations *trmax*is reached.

v pd(tr+ 1*) = w.vpd(tr)* + ˜ 1.*r*1*(tr). pbestpd*

– *x pd* +˜ 2.*r*2*(tr).(gbestd*” *x pd)* ...(5)

x pd(tr+ 1*) = x pd(tr)* + *v pd(tr*+ 1*)* ...(6)

Here, ˜ 1 and ˜ 2 are constants, and *r*1*(tr)* and *r*2*(tr)* are random numbers uniformly distributed in [0,1].

C. Heuristic for Sensor Deployment

Here we proposea heuristic for sensor

deployment. Initially, place the sensor nodes randomly. If any sensor node is idle (without monitoring any target), the node is moved to the least monitored targets' location. This is to ensure that all sensor nodes play their part in monitoring the targets. The sensor nodes are then sorted based on the number of targets it cover. The sensor node is placed at the middle of all the targets it cover. The next nearest target is identified and the sensor node is placed at the middle of all these targets. If it can cover this new target along with targets it was already monitoring, allow this move, else discard the move. This is done till the sensor node cannot cover any new target. At the end, upper bound is computed. The drawback of this approach is that it depends on the initial position of the sensor nodes. Though it may perform well for dense deployments, consistency cannot always be guaranteed.

D. Cover activation

The nodes in the optimized cover are activated. The total energy consumes by the sensor nodes will not fall beyond the minimum usage of energy, E min, if it is beyond its limit then the node will be automatically inactive state and will be able to monitor the targets further. Let us assume that number of sensor nodes deployed in the area is greater than the optimum required to monitor the targets so the sensor cover switches from one node from other in a scheduling manner such that only the minimum nodes should be active.

E. Cover Optimization

By optimizing the generated cover, minimized energy usage can be there by the proposed scheme attempts. During this a problem will be raised with the formation of the cover at its phase that it cannot cover all the nodes and targets. But this can be solved by step by step addition till the targets are covered. The nodes in the cover set are subject to optimization using least priority first approach. This method of elimination the high priority nodes being discarded and the least priority nodes will be in the cover and cannot be eliminated as it satisfies the k- coverage requirement. Elimination starts from the last but one node as per increasing priority. A node Si $\in$ Cov _S, $1 \leq i \leq$ length (Cov _S), represented as Si Cov _S will not be added to the optimized cover set O pt. Cov _S if Cov _S – {Si .Cov _S} meets k/Q coverage requirement.

F. Advantages

- To achieve area coverage, we look at target coverage with a goal to maximize network lifetime.
- ABC algorithm to solve simple coverage problem.
- The number of targets is more compared to the number of sensors to be deployed.
- To save energy by minimizing the sensing range requirement for the sensors.
- Heuristic to schedule the sensor nodes which maximizes the network lifetime.
- No backward and forward secrecy problem.

CONCLUSION

The deployment locations will be computed for sensor nodes using artificial bee colony algorithm such that the network lifetime is maximum. Artificial bee colony algorithm performs better than PSO algorithm for this problem. In order to avoid the battery drain of all nodes at a time, sensor node scheduling can be done so that only minimum number of sensor nodes required for satisfying coverage requirement needs to be turned on. The other nodes can be reserved for later use. This method helps to prolong the network lifetime. A heuristic is used which is powerful enough to schedule the sensor nodes in such a way that the network lifetime matches the theoretical upper bound of network lifetime. Network life time is extended by using this method of deploying at optimal locations such that it achieves maximum theoretical upper bound and then scheduling them so as to achieve the theoretical upper bound. For future work, the plan is to extend this method of deployment and scheduling for probabilistic coverage in wireless sensor networks.

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