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# Efficient Coverage and Connectivity Preservation Using Self-Pruning in Wireless Sensor Network

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**Abstract**-The prime objectives of wireless sensor networks is to provide full coverage of sensing field as long as possible. More tasks such as object tracking and battlefield intrusion detection wants full coverage at any time. With the finite energy of sensor nodes, formulating these nodes into a maximal number of subgroups capable of monitoring all discrete points of interest and then equally activating them is a prevalent way to provide better quality of surveillance. In addition to maximizing the number of auxiliary groups, how to guarantee the connectivity of sensor nodes is also critically important while achieving full coverage. In existing, maximum connected load balancing cover tree (MCLCT) algorithm to achieve entire coverage as well as BS-connectivity of each sensing node by dynamically forming load-balanced routing cover trees. Such a aid is particularly formulated as a maximum cover tree problem, which has been proved to be nondeterministic polynomial complete. In this paper, Self-Pruning technique is used to provide guarantee for connectivity of sensor nodes. A sensor node can be safely turned off if its removal will not destroy the k -coverage and k-connectivity properties of the network. Extensive simulation conclusions show that our solution outperforms to guarantee the k-coverage and k-connectivity.

## 1. INTRODUCTION

Wireless Sensor Networks (WSNs) are formed by connected wireless sensor nodes that each is compact and has the ability of sensing, processing, and saving environmental information as well as communicating with other nodes. High fault tolerance, strong adaptability, and comprehensive sensing coverage are the main merits. These features allow wireless sensor networks to be applied to a variety of range of applications, e.g. home health care, battlefield surveillance, machine and environmental observing, and so on. Usually, wireless sensor nodes powered by batteries are arranged near the discrete points of interest (DPOIs) in remote region. The events appearing at the locations that are inside the sensing exposure provided by each sensor node will be detected. Sensor nodes furnished with wireless transceivers can provide connectivity among any two nodes or between a node and the BS. The information about events sensed by each sensor node will be transferred to the end BS in an energy-efficient multi hop appearance with the connected WSN. In order to assurance the quality of service (QoS) provided by WSNs, achieving the peculiar coverage requirement and maintaining connectivity are necessary. Here, the exposure in concurrence with the connectivity problem has been addressed. Coverage problem are related to how well each DPOI in a sensing field is covered. The

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coverage preservation issue is one of the major problems in WSNs that can be studied in different aspects. In this study [1], node placement planning based on picky rules were utilized to determine the optimal placement position.

## 2. RELATED WORK

The problem of maximizing network lifetime while contributing for coverage and connectivity in Wireless Sensor Networks is address. Static sensor nodes are deployed randomly in the region in order to provide sensing coverage to a set of points of interest in the region, called target points, and to provide for communication among the active sensors to generate the data at all times in the network. Sensors have independent sensing and transmission ranges, with no peculiar relation between the two. Sensor nodes are energy-constrained and hence only a minimal set of sensor nodes needs to be mobilized at any given time. Node activation schedules, such that mutually exclusive sets of sensor nodes are activated in succession, are resolved in order to achieve extended lifetime of the network. The optimal solution to the problem is NP-Complete which motivates the need to devise adequate heuristic solutions has been observed. First, considering a simpler problem of energy-efficient coverage and originate it using Linear Programming techniques. The structure of the formulation implements some insights towards developing algorithms for the lifetime coverage and connectivity problem.

The Connected Set Covers (CSC) problem that objective at finding a maximum number of cover sets such that every sensor node to be mobilized is connected to the BS and proved its NP- Completeness [2]. To cope with the CSC problem, they employed two consolidated algorithm: an integer programming based heuristic (IP-CSC) and a breadth-first search based heuristic (Greedy-CSC). For rational implementation, another distributed heuristic was also presented (named Distr-CSC) to deal with the CSC problem based on the Minimum Spanning Tree (MST), Ostovgfehari et al. [3] presented a distributed method for connected point coverage. The node was able to agree whether it can serve as a sensing node after a specific waiting time interval or act as a relaying node in the composed Modified Virtual Robust Spanning Tree (MVRST). Instead of using the distance between nodes to estimate the edge cost in the MST, the MVRST took the hop count into account in the estimation of edge costs.

Greedy Iterative Energy-efficient Connected Coverage (GIECC) algorithm is used to address the CSC problem. To find an attainable connected cover set, the GIECC first selected some necessary sensor nodes that could together informant all the DPOIs. After that, the Shortest Path Tree, Greedy Incremental Tree, and Implicit Connectivity Tree were used for find the routing path for each sensor node of the cover. The authors regarded the number of the found wraps as the network lifetime. More cover sets to be found represented a longer network lifetime achieved by a WSN [4]. Two energy consumption patterns were predefined for sensing and communication and did not involve distances between nodes. That is, all the nodes allocating as the sensing nodes/relaying nodes consume the

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same amount of energy. In fact, energy consumption is relevant to the size of the data to be transmitted, the transmission distance, the frequency of event happened at DPOIs, and the time period of listening packets. These factors must be considered when the energy consumption of WSNs is evaluated. To find an available connected cover set, the GIECC first selected some necessary sensor nodes that could together observe all the DPOIs.

Communication Weighted Greedy Cover (CWGC), to maximize the number of cover sets [5]. Specifically, they constructed cover trees that had three properties: 1) Each leaf of the tree was a sensing node; 2) The root node of the tree was the sink node; 3) Every DPOI could be monitored by at least one sensing node in the tree. Then the procedural time interval of each cover tree could be maximized by finding a minimum sum of the link load weights from every node to the BS. Although the CWGC had a better performance on the extension of network lifetime the CWGC did not include any policy regarding the poorly covered DPOIs (i.e., critical DPOIs). Because the critical DPOIs are closely related to the upper bound of network lifetime, it is necessary to apply efficient mechanisms to the sensor nodes (named critical nodes) that wrap the critical DPOIs. With the scheduling optimization for these critical nodes, Zorbas and Douligeris [6] further showed that the network lifetime can be effectively prolonged.

Optimized Connected Coverage Heuristic (OCCH) to create the connected cover sets, where the critical nodes would not serve as relaying nodes by allocating different weights to edges between nodes. By doing so, the major energy of the critical nodes could be preserved so as to prolong the network lifetime. Nodes responsible for relaying data are also as significant as the critical nodes, especially for the nodes which are much closer to the critical nodes. Christo Ananth et al. [7] discussed about Reconstruction of Objects with VSN. By this object reconstruction with feature distribution scheme, efficient processing has to be done on the images received from nodes to reconstruct the image and respond to user query. Object matching methods form the foundation of many state- of-the-art algorithms. Therefore, this feature distribution scheme can be directly applied to several state-of- the-art matching methods with little or no adaptation. The future challenge lies in mapping state-of-the-art matching and reconstruction methods to such a distributed framework. The reconstructed scenes can be converted into a video file format to be displayed as a video, when the user submits the query. This work can be brought into real time by implementing the code on the server side/mobile phone and communicate with several nodes to collect images/objects. This work can be tested in real time with user query results.

## 3. SELF PRUNING ALGORITHM

### 3.1 K-Connectivity Redundant Condition

A sensor node *si* is not needed for preserving the k-connectivity property of the sensor network S if it is k-connectivity unnecessary. It denotes the set of remaining sensors after removing *si* from S by *Snsi*.

**Definition1**. (K-connectivity redundant)

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A sensor node *si* is k-connectivity redundant if the communication graph induced by *Snsi* is still k-connected.

K-Connectivity Redundant Condition:

A sensor node *si* is k-connectivity redundant if for any two one-hop neighbors *sn* and *sm* of *si*, there are k node disjoint replacement paths connecting sn and sm via several intermediate nodes in Nl (i) (if any) with lower priority than si, where Nl (i) is node *si's* l-hop communication neighbors. The node priority can be any blend of the remaining energy, node id, and random numbers. The only requirement is that the priority should be adept to set up a total order among all sensor nodes so as to resolve the cyclic dependent relationship among neighbors, use a similar condition to construct a k-CDS for MANET. B. k-Coverage Redundant Condition a sensor node *si* is not needed for preserving the k-coverage property of the target region if it is k-coverage redundant.

**Definition2.** (K-coverage redundant)

A sensor node *si* is k-coverage redundant if the target region is still completely k-covered by Snsi. The k-coverage redundancy of sensor node si is detected by utilizing the order-k Voronoi diagram.

The shared, localized self-pruning algorithm is based on the following idea. A sensor node si can be safely turned off if its removal will not destroy the k-coverage and k-connectivity properties of the network [8]-[10]. That is, the remaining sensor nodes after removing *si* from the sensor network still form a k-connected k cover set for the target region. Sensor node si is not needed for k-connectivity if every pair of its one-hop neighbors has k alternate replacement communication paths not involving *si*. And sensor node si is not needed for k-coverage if each point in its coverage area is covered by at least k other sensors. When a sensor node satisfies both the above two conditions simultaneously, its removal will still preserve the k-connectivity and k-coverage characteristics of the sensor network. When several nodes rely on each other to satisfy the above two conditions, node arrangements are used to resolve the cyclic dependency. And to limit the communication overhead in a reasonable level, each node makes its own decision based on neighborhood information only within l connection hops, where l is a small integer. Although the partial neighborhood information may generate fragmentary communication graph and incorrect Voronoi diagram and thus cause more sensors than optimal to be active, the properties of k-connectivity and k-coverage are still approved.

## 4. CONCLUSION

By addressing the issue of constructing a minimal k-connected k- cover set (KCC) for a target region and propose a general framework for this problem. Different algorithms for detecting k-connectivity and k-coverage redundancy in a localized manner can be integrated into the self-pruning framework. And different connectivity and coverage requirements can be specified flexibility in our framework. It shows that the proposed self-pruning algorithm can construct the k-connected k-cover set reliably and reduce the number of active sensor nodes while maintaining the k-connectivity and k-coverage properties of the original network, which is helpful to reduce system energy consumption and prolong the network lifespan.

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