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**SURVEY ARTICLE**

# A Survey on Sensor Coverage in Wireless Sensor Networks

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*Abstract* -- ***Most important problem in the wireless sensor networks is only on the sensor coverage, which reflects in the loss of sensing quality. Several approaches to maintain the sensing quality are available with different considerations. Sensor death and migration are two issues that affect sensing quality. To tackle the node sensor node migration problem, sensor coverage and sensor connectivity are used. We have surveyed sensor coverage, connectivity, allocation and relocation with respective algorithms, coverage problem deals with mobility of node and connectivity is supported to coverage. Sensor allocation and relocation are done when the sensor node in the network reaches the death stage. Localization is used to identify the current location of the sensor node with parameter values in 2D manner.***

**Keywords:** Coverage, connectivity, localization, sensor allocation and relocation.

## I. INTRODUCTION

A wireless sensor network (WSN) consists of spatially scattered independent sensors to supervise physical or biological conditions, such as temperature, sound, weight, and to cooperatively overtake their data through the network to a central location. Wireless Sensor Networks have emerged as a new analysis paradigm based on the shared effort of a huge number of sensing nodes [1][6][9]. Modern scientific advances have led to the emergence of small, compact sensors for communication capabilities. It collates and delivers the sensed data to at least one destination node, usually via multiple wireless hops.

A WSN is a network consisting of frequent sensor nodes with sensing, wireless communications and computing capabilities. These sensor nodes are dotted in unattended surroundings. The sensed data can be collected by a little sink nodes which have access to infrastructure networks like the Internet [5]. Finally, an end-user can remotely fetch the sensed data by accessing infrastructure networks. Fig. 1 shows the two kinds of network topologies. The sensor nodes each form a flat Network topology where sensor nodes also act as routers and transfer data to a destination through Legend multi-hop steering, or a hierarchical network topology [4][5][7]. Where more powerful permanent or mobile relay is used to gather and route the sensor information to a sink.

 

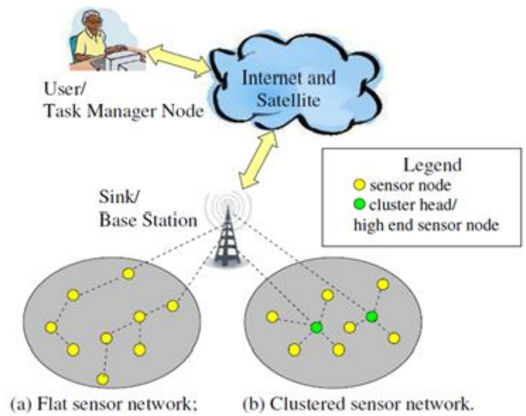


**Fig.1 . Operation of WSN**

To make sure sensing coverage, the WSN must sense the required bodily quantity over the entire area being monitored — while doing this, both power utilization and the effectiveness of data aggregation are crucial consideration. The common deployment of WSN in the field for monitoring is deferred by energy consumption challengers are raised by the fact that sensor are powered by battery, which is small component in sensor owing to size of sensor .most of the sensors are not rechargeable, thus increase the over head further .feasible solution to maintain the sensing quality is battery replacement for those not manually and once deployed node may needs replacement to avoid the coverage hole. The two tasks are performed by each node in WSN simultaneously: (1) sensing the environment and (2) communicating the sensed information to its neighbor to reach central location. Coverage and connectivity are two main issues regarding sensor communication. Coverage problem involves monitoring the region of interest and information tracking [10].

A spare node will not cause any loss of connectivity upon removing it. Owing to critical resource constraints, such a resolution must be controlled within a petite area in order to evade getting to any other nodes involved. Endeavor to provide an optimization in dropping the cost of renovate process: not only the stirring distance of node(s) in each single renovate process, but also the total number of renovate processes required for any hole that has occurred in the networks [3][8]. The challenge to achieve such an optimization is the deficient in global information. The hierarchical organization information model based on eye theory to sustain the information of coverage and connectivity. Such information is used to synchronize the renovate processes and determine the additional node for moving [2].

## II. RELATED WORK

### 2.1 Coverage Verification

One of the most famous approaches for addressing the coverage problem has been the computational geometry approach, in which standard geometric tools are used to determine coverage [1]. A known example of utilizing this geometric approach is solving the Art Gallery Problem, where one identifies the number of observers necessary to cover an art gallery such that every point in the gallery is tracked by at least one observer[1][4].

### 2.2 Localization

At the heart of a 2D localization space into separate regions by the upright bisectors of lines combination pairs of reference nodes. Each separate region shaped in this manner can be individually identified by a location sequence that represents the distance ranks of indication nodes to that region. An algorithm to build the location sequence table that maps all these possible location sequences to the corresponding regions by using the locations of the indication nodes. The strange node first determines its own location sequence based on the calculated strength of signals between itself and the indication nodes. It then searches through the table to determine the "nearest" possible sequence to its own calculated sequence [2].

The method for localization of unfamiliar nodes using location sequence is given as follows:

- Find out all possible location sequences in the localization space and list them in a location sequence table.
- Establish the location sequence of the anonymous node location by using received signal strength (RSS) dimensions of localization packets exchanged between itself and the indication nodes. The RSS based location sequence will be a ruined version of the original location sequence.
- Search in the location table for the "nearest" location sequence to the anonymous node location sequence. The centroid mapped to that sequence is the location approximation of the anonymous node

### 2.3 Range-Free Localization

The hypothetical technique used to narrow down the possible area in which an aim node resides is called the Point-In-Triangulation Test (PIT). In this test, a node chooses three anchors from all audible anchors and tests whether it is inside the triangle formed by connecting these three anchors. APIT repeats this test with different audible anchor combinations until all combinations are exhausted or the required truthfulness is achieved. At this point, APIT calculates the center of gravity (COG) of the meeting point of all of the triangles in which a node resides to decide its estimated position [3]. The APIT algorithm can be broken down into four steps:

- Beacon exchange,
- PIT Testing,
- APIT aggregation,
- COG calculation.

### 2.4 Sensing Coverage and Connectivity

Consider the issues of maintaining coverage and connectivity by maintenance a minimum number of sensor nodes to operate in the energetic mode in wireless sensor networks. Begin with a discussion on the relationship between coverage and connectivity, and show that if the radio range is at smallest amount two times of the sensing range, then entire coverage implies connectivity [4]. Hence, if the condition holds, only need to consider the coverage difficulty. Then, derive, under the ideal case in which node density is adequately high, a set of optimality conditions under which a subset of working sensor nodes can be chosen for full coverage[1][4].

Based on the optimality situation, formulate a decentralized and localized density control algorithm, OGDC. OGDC outperforms the PEAS algorithm, the hexagon-based GAF-like algorithm, and the supporter area algorithm with respect to the number of working nodes needed and achieves almost the same coverage as the finest algorithm. In OGDC, every node desires to know its individual location. However, maintain that this requirement can be relaxed to that each node knows its relation location to its neighbors. Also look into the issue of *k*-coverage and its impact on fault tolerance. Also, to better estimate OGDC (or other density control algorithms), need to derive the upper bound of the network natural life in large areas [4].

### 2.5 Sensor Allocation and Relocation

To maintain the large-scale optimality in the wireless sensor network greedy algorithm is used [6][7]. Cluster head in each grid is liable for maintaining the information about the grid members of the individual grid, which is maintained in the Information Table. The table consists of information about deployment time, battery level and id of sensor. It is periodically updated and it is conserved in rising order based on the battery level.

A verge value for the battery level is considered. In case of tie arises in battery levels between two or more sensors it is broken by cluster head using the id of sensor, if there is tie again in the deployment time of corresponding entries.

Each cluster head monitors the obtainable information and when the battery level of any sensor falls below the verge value then the corresponding cluster head communicates the information to the actor along with the id of sensor, deployment time and grid id. During the communication process the peak of the information table entry is selected without any considerations.

Actor performs the sensor allocation by replacing the wanting node with the spare sensor nodes that are available. The wanting node is placed in the recharging unit, after it reaches the maximum level it is transferred to the spare sensor location [7].

Sensor allocation can be made only till the availability of spare sensor nodes. To maintain the spare sensor node availability, sensor relocation is performed at the former stage. When the verge value of number of spare sensor node is reached sensor relocation is initiated. Actor maintains the spare sensor nodes information. Sensor relocation involves selection of the long inactive sensor node from the grids to the spare sensor node location. Actor communicates with the cluster heads and sensors with high outstanding energy or high battery value is chosen. Ties are broken using the same techniques. Each cluster head chooses one member from corresponding grids. Actor picks the sensor among the N sensors with high outstanding energy [7].

### 2.6 Coverage hole

This technique allows for speedy convergence but requires node adjustments in the whole grid network, causing many needless node actions just for providing the coverage for a particular hole. In the early work [8], a localized control technique based on the 1-hop neighborhood is planned. Every time a empty area is detected, a snake-like cascading repair process is initiated to move nodes to cover the opening region. Due to the lack of synchronization, the existence of a hole will incur multiple repair processes, causing redundant processes and some unnecessary node movements. In the early work [9], a synchronization based on a single Hamilton cycle connected the whole network is provided. However, due to the length of such cycle, a long stretch pathway in the repair process is required available. A more efficient localized repair result is needed [5].

### 2.7 Virtual Scanning for Surveillance

Assume n sensors are arbitrarily placed on a road segment of length l. Every sensor has a conservative sensing range of radius r, which is long enough to cover up the width of the road. This statement holds true for the majority of commercially available sensors. Therefore, we can represent sensing coverage using a linear sensor network model, where n sensors are linearly placed. At the moment, left side of the segment be the entrance point E of targets and the right side of the segment be the protection point P. Let w be the smallest working time needed by a sensor in order that the sensor can consistently detect a target over several samplings. Let v be a maximum target rate. Suppose that targets enter only from the point E and move towards the point P. In this scenario, we can use the conventional full coverage algorithms where sensors turn on the entire time. This approach can be described as Always-Awake [6].

### 2.8 Detecting Coverage boundary

Detecting Coverage Boundary Nodes is a deterministic one that can be applied to any randomly deployed sensor network, it is actually localized, only need single-hop neighbors' information, which provides the scalability and energy efficiency of the algorithms and it requires only a restricted number of simple local computations. Distributed, localized algorithms for detecting coverage boundary nodes in WSN. In contrast to prior proposals, algorithm does not need information about the allocation of sensor nodes, and only depend on single-hop information and a small number of simple local computations [12].

### 2.9 Distributed Lifetime Maximization

Distributed, coordinate-free algorithm for attaining maximum lifetime in sensor networks, subject to ensure the *k*-coverage of the target field during the network lifetime. The lifetime attained by algorithm approximates the highest possible lifetime with a logarithmic approximation factor. This is simple distributed mechanism for detecting the termination of the network lifetime. By definition the network lifetime terminates when there no longer exists a sensor cover such that every sensor in the cover has non-zero energy. Each node executes the activation phase at the initial of each successive time slot, and decides whether to activate itself in slot based only on state information in its neighborhood. Centralized approximation algorithm similar to that is [14] has been proposed by Zhao *et al.* in [15] for target coverage problem, *i.e.*, the problem of increasing lifetime while ensuring coverage of a given set of target points and connectivity of the network. Thai et al [16] have proposed a distributed algorithm to maximize the network lifetime up to an $O(\log n)$ factor, while ensuring coverage of a given set of targets. Also, the coverage and lifetime guarantees in [16] are probabilistic, whereas we provide deterministic guarantees on both coverage and lifetime [13].

## III. CONCLUSION

Sensor coverage in the wireless sensor network is a new research area, with a restricted, but quickly rising set of research results. In this paper, we showed a comprehensive survey of several techniques in wireless sensor networks which have been presented in the literature. They have common objective of focusing coverage and connectivity for improving the quality of sensing. Overall, the algorithms and techniques based on the network structure. Although many of these techniques look promising, there are still many issues and challenges that need to be solved in the sensor networks. The challenges are highlighted and future research directions are pinpointed in this regard.

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