A Review on Coverage in WSNs

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Abstract:

Wireless Sensor networks are growing areas of research. Wireless Sensor Networks are mostly used to monitor targets in the field of interest. One of the most active areas of research in Wireless Sensor Networks is that of coverage. Coverage and Connectivity are two of the most initial issue in the WSN. Coverage in Wireless Sensor Networks is usually defined as a measure of how well the sensing field is monitored or sensors are able to observe the physical space. Connectivity can be defined as the ability of the sensor to reach the data sink. In this paper we will discuss on the coverage issues in the Wireless Sensor Network. Three coverage issues are discussed in this paper.

Keywords: Wireless sensor network, coverage, k-coverage, deployment strategy.

1. Introduction

Wireless Sensor Networks (WSNs) have achieved a lot of interest by the research section in the past few years. A WSN consist of a large number of small, light-weight highly energy constrained and inexpensive devices called sensor. Sensors are equipped with batteries, sensing hardware processing and storage resources. However, when a group of sensor nodes collaborated with each other the can accomplish a much bigger task efficiently .There are various applications of Wireless Sensor Networks including industrial, military, health applications, environmental etc. different applications would requisite different types of coverage in the sensing field. So, the coverage requirements vary across applications and should be kept in mind while developing new deployment strategy. In the easiest word, the types of coverage at a particular position in the sensing field can be related to the number of sensors whose sensing range cover that position. There are many things that must be considered when developing a plan for coverage in a sensor networks. Many of these will be dependent upon the particular application that is being addressed.

2. Coverage Problem

In WSN applications the area under consideration is said to be covered if and only if every point of interest is under the sensing range of at least single sensor node which is active throughout the lifetime of the network.

2.1.Blanket/Area/Region Coverage

The main goal of the sensor network in the area coverage is to cover (monitor) an area (the collection of all space point with in the sensor field) and each point of the area required to be covered. The coverage depends upon the requirement of the applications that it needs a full area coverage or partial area coverage. In the full area coverage and partial area coverage required number of sensors is different.

2.1.1. Full Coverage

A few of the application require a full area coverage in WSNs. This types of application wants each location should be covered by at least one sensor node (I-Coverage) or by k- sensor nodes where k>1 (K-Coverage).Types of full coverage are:

2.1.1.1. Simple Coverage

In WSNs it is required to ensure full coverage of the covered area while deploying the minimum number of sensor node. In simple coverage the number of sensor node has been kept as minimum as possible by ensuring coverage and connectivity.

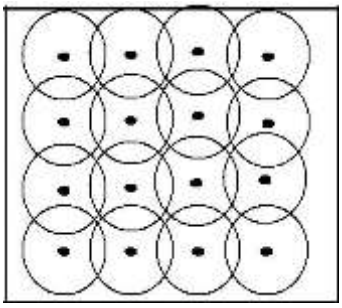

Figure 1: Simple Coverage

2.1.1.2. Multiple Coverage

When simple coverage increased by multiple nodes covering single point location then it is called as multiple coverage. Some applications are distributed detection, mobility tracking intelligence system, critical area monitoring require multiple coverage

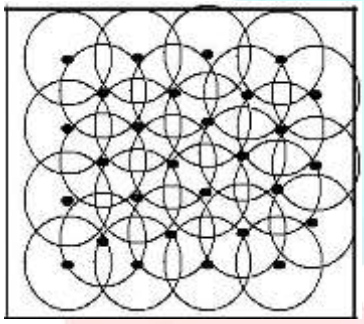

Figure 2: Multiple Coverage

Multiple coverage required because simple coverage will produce certain data losses even when a single node failure occurs.

2.1.2. Partial Coverage

Partial Coverage is a technique of decreasing the energy cast of sensor nodes and increasing the network lifespan since the number of sensor nodes position is less then the number of required to fully covered the area considered. A few of the applications of WSN require to cover the partial area but the whole area is not to be covered because the task of application is not critical. In these type of applications partial coverage secure a given degree of coverage is satisfactory.

2.2. Point / Target Coverage

The point coverage scheme focuses on determining sensor nodes exact positions where guarantee efficient coverage application for a limited number of in mobile points (targets). The main goal of point coverage is to cover a set of point (target) with known location that require to be monitored. Many applications of WSN require only observing of a particular point and not the whole area. Thus, there is a require of covering particular point only by at least one sensor node. Observing only particular points will expand the performance of network. A better coverage and connectivity can be provided certainly by using some sensor nodes at point of interest (PoI). The PoI can be either fixed or mobile.

2.2.1. Fixed / Static PoI

If some position is indicate for a PoI, then it is said to be fixed or static PoI. A static PoI is easy to monitor and cover, because there will be a prior knowledge will be available about its position. An example of static PoI monitoring shows. In this example sensor nodes do not only cover the PoI but also maintain the connectivity with the sink to report detect the events.

2.2.2. Mobile/ Moving PoI

If the PoI changes its position again and again then it is called as the mobile PoI. Mobile PoI can be used in two ways. One is use the mobile sensor which can cover mobile PoI and keep a path of movement of this PoI. Second is to use the static sensor but the deployment of static sensor nodes will be in such a way that every new position of the moving PoI can be covered by at least single sensor node.

2.3. Barrier Coverage

Barrier coverage deals with the chance calculation of movement of objects in the targeted area. The chances or probability can be determined by movement rate of object and sensing intensities of the sensors for each and every point on the path followed by the object. Barrier coverage is also known as sweep coverage. Example of such applications including movement detection are the deployment of sensors along international borders to detect illegal intrusion, around forests to detect the spread of forest fire around a chemical factory, to detect the spread of lethal chemicals, and on both sides of a gas pipeline to detect potential sabotage.

The major goal of barrier coverage is to detect intruders as they cross a border or as they penetrate a protected area. If the intruders try to cross this barrier of sensors then this movement will be detected by the sensor nodes and reported to the sink/base station immediately. Barrier coverage can be classified as weak k-barrier and strong k-barrier coverage.

2.3.1. Weak K-barrier Coverage

This type of coverage guaranteed that any target crossing a region along with orthogonal path is detected by at least k sensors.

2.3.2. Strong K-barrier Coverage

This type of coverage guaranteed that target is detected by k sensors however, the path followed by the target does not matter.

3. Conclusion

Coverage in wireless sensor network can be thoughts of as how well the wireless sensor network is able to monitor a particular field of interest. This paper reviewed the types of coverage with different types of deployment strategies for each coverage types. This review will help the reader to gain knowledge of different coverage required by the application of WSNs. We summarized the different approaches/strategies in a tabular form.

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