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Some Target Coverage Issues of Wireless Sensor Network

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Abstract - Wireless Sensor Network is an emerging field that is achieving much importance due to its immense contribution in varieties of target specific applications. One of the active issues is Target Coverage that deals with the coverage of a specific set of targets. Static sensor nodes are being deployed in a random manner to monitor the required targets and collect as much information as possible. In this Paper we have presented an overview of WSN and some of the strategies of the Target Coverage Problem.

Keywords: Wireless Sensor Network, Target Coverage

I. INTRODUCTION

A Wireless Sensor Network (WSN) consists of a large number of sensor nodes that co-operatively monitor a specific region of interest. Typically, a sensor node is a small hardware device consisting of a processing unit, a sensing unit, a communication unit and a power unit that is used for sensing, data processing and communication purposes. These nodes collectively gather sensed information and forward it to the special node called base station which acts as interface between the sensor nodes and users as shown in Figure 1.
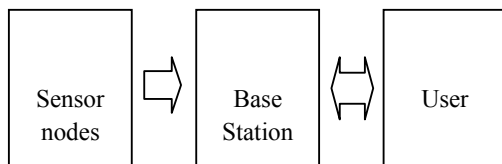

Figure1 Typical WSN Architecture

The uniqueness of a sensor node lies in its small size and light weight. However, there are a lot of constraints such as limits on resources in terms of energy, memory, computational speed, bandwidth and so on.

Wireless Sensor Networks have a great contribution in the fields of National Security[1],

Habitat Monitoring [15,16], Environment observation and forecasting[17],Health Applications[1,18], Home and Office Applications[19].This has attracted numerous researchers making WSN as an active area of application research.

This Paper is organised as follows: In section II we present the Coverage Problem of WSN. In section III we mention Target Coverage Problem and some of the Target Coverage issues. Lastly, section IV concludes our work.

II. COVERAGE PROBLEM OF WSN

Coverage Problem is one of the active issues of the WSNs that determines how efficiently the sensor network is being covered by a set of sensor nodes. This problem deals with the QoS of the network ensuring that the particular sensor network is monitored or observed by at least one sensor node. It may be broadly classified into three main categories:

- Area Coverage where the sensor nodes are deployed to cover a specific area or region
- Target Coverage Problem where the sensor nodes are deployed to cover a specific set of targets or points.
- Coverage dealing with the determination of the maximum support /breach path.

III. TARGET COVERAGE PROBLEM

In Target Coverage Problem, the fixed number of targets are continuously observed by a number of sensor nodes with the aim of maximising the lifetime of the network. Possibly, each target is monitored by at least one sensor node as shown in Figure 2.
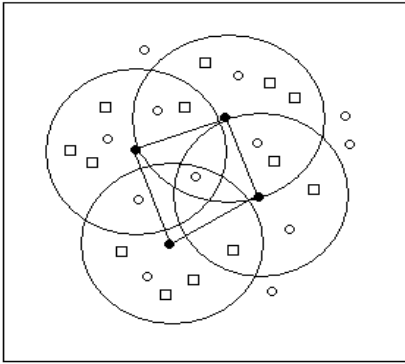
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Figure 2 (Target Coverage)

There are a specific number of targets which are to be covered by a set of sensor nodes. After getting deployed, the sensor nodes start the task of monitoring the said targets. Since sensor nodes are provided with only some limited resources and can't withstand extreme environmental conditions, they are deployed in large number much more than actual requirements.

While covering the targets, several issues like maximisation of network lifetime, minimum participation of sensor nodes, minimum consumption of energy, etc must be taken into consideration in order to achieve much efficient target coverage.

Some of the Strategies to cover a specific set of targets are mentioned below:

A. Activating all the sensors at a time:

 In order to cover all the specific targets, the simplest method is to activate all the sensor nodes deployed for coverage at a time. However, this simultaneous activation of sensor nodes may make them exhaust of their energy at a time. So, only for a limited amount of time they would be able to perform the coverage task.

B. Formation of disjoint set covers of sensor nodes[14]:

An energy efficient method to cover all the targets is to make the sensor nodes alter between active and sleep modes. During active mode, a sensor node is capable of keeping track of the targets and their important information. If a sensor node is having no task, it may enter into sleep mode which consumes a negligible amount of energy. So, some dis-joint set covers of active sensor nodes may be made in such a manner that each set cover is covering all the targets. These set covers are activated one after another till the sensor nodes are out of their energy. So, rather than making all the sensor nodes active at a time, they can be partitioned into a number of dis-joint set covers with each set cover capable of monitoring the targets.

C. Formation of non-disjoint set covers of sensor nodes[4]:

Another energy efficient method for target coverage is to make the sensor nodes be part of more than one set cover. With the sensor nodes altering between the active and sleep modes.. several non-disjoint set covers of active sensor nodes are made to activate successively where each set cover is capable of keeping track of all the specific targets until the energy exhaustion of sensor nodes. This procedure is much more energy efficient as compared to dis-joint set cover method of target coverage, thus maximising the network lifetime to some more extent.

D. Partial Target Coverage[8]:

Till now we have mentioned full coverage of targets which ensures that all the required targets are to be covered. Information collected by a subset of targets may also be beneficial. A number of set cover of sensor nodes may be activated for partial coverage of the targets, not necessarily covering all the targets. The gathered information about a subset of targets by the sensor nodes may prove to be very important where the main objective is to maximise the lifetime of the network.

E. k-Coverage[3] : In k-coverage $(k \geq 1)$ approach, a minimal subset of the sensor nodes is determined that can keep track of the required targets, with each target being covered by at least k sensor nodes. The activated nodes collectively gather information about the specific targets and send it to the base station.

IV. CONCLUSION

Coverage of the specific targets is gaining popularity day by day. The coverage issue can be Area Coverage, Target Coverage and Coverage dealing with maximum support/breach path.. Several research works are being carried out on the Target Coverage Problem. In future scope of work, we will design an algorithm for Target Coverage in order to achieve improved lifetime and minimum energy consumption.

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