Node Placement Strategy in Wireless Sensor Network

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**ABSTRACT**

The performance and quality of services in wireless sensor networks (WSNs) depend on coverage and connectivity. Node placement is a fundamental issue closely related to the coverage and connectivity in sensor networks. Node placement influences the target position, coverage area, and connectivity in sensor networks. In random deployment, sensor nodes are deployed randomly in a non-invasive way. The deployment process may cause issues like coverage holes, overlapping, and connectivity failure. Enhancing coverage and connectivity are important for sensor networks to provide a reliable communication within sensing. Placing many sensor nodes in a WSN application area is not the best solution due to cost and it results in multiple sensors used. Mobile sensor node is used as an alternative to overcome the random deployment problem. The virtual force based self node deployment is used in the mobile sensor to improve the coverage and connectivity area. Virtual Force Algorithm (VFA) approach using virtual repulsive and attractive forces is used to find the optimal node placement to minimize the problems. Simulation results proved that a uniform deployment achieved using VFA approach with an optimal sensing range to cover the region of interest.

**Keywords:** Mobile Sensor Node, Node Placement, Quality of Service, Virtual Force Algorithm, Wireless Sensor Network

**INTRODUCTION**

Wireless sensor network (WSN) have become one of the most promising technology in sensing application environment. WSNs environment are able to provide a flexible deployment and maintenance of sensor networks. The sensor nodes can be deployed in highly dynamic environments and hence enable sensor networks to be potentially used in a wide range environment including military applications, security surveillance, environmental monitoring, habitat monitoring, hazard and disaster monitoring and relief operations, healthcare applications (Nematy, Rahmani, Teshnelab, & Rahmani, 2010), home applications as smart home and smart agriculture system (Akyildiz,
The basic goals of WSN generally depend on the application and function including to determine the value of parameter at given location, detect the occurrence events and tracking an object. In an environmental network, sensor nodes can be used to measure the temperature of atmospheric pressure, amount of sunlight and humidity. Sensor nodes also used to detect a vehicle moving through an intersection and estimate the speed and direction of the vehicle. In a military sensor network, sensor used to track an enemy as it moves through the geographic area covered by the network.

WSN consists a number of sensor nodes and one or more base stations spread across a geographical region of interest. Each sensor node has a wireless communication capability and some level of intelligence for signal processing and networking of the integrated data (Fan & Jin, 2010). In addition, with integration of sensing, computation, and wireless communication, the sensor nodes can sense a physical information from the environment, process the information, and report them to the base stations. As illustrated in Figure 1, the sensor node will sense the target point and link the information to the base station by a group of collaborating sensors via a multi-hop communication. The information is transmit to the outside world via the internet or satellites.

In WSN, node placement is the fundamental issue that will affect the performance of the WSN application and operation and closely related to coverage and connectivity. According to Mulligan and Ammari (2010), coverage is usually interpreted as how well a sensor network will monitor the region of interest and as a measure of quality of service (QoS) in WSN environment application. Connectivity can be defined as a connection between sensor nodes that can communicate to transfer the information from the target area to the base station. In addition, it is important to maintain the connectivity in order to have the best sensing coverage area. However, these wireless sensors have several constraints especially in random deployment strategy such as a coverage hole, overlapping and also may cause a connectivity failure which is related to the limited sensing and communication range as well as limited battery capacity. An effective node placement can improve and provide a good coverage and connectivity to cover the region of interest efficiently.

Figure 1. Wireless sensor network environment