

Hex-Grid Based Relay Node Deployment for Assuring Coverage and Connectivity in a Wireless Sensor Network

Shweta R. Malwe and Kumar Nitesh

NIIT University, Neemrana RJ 301705 (contact no.: 7023557756; E-mail: shweta.malwe@niituniversity)

(E-mail: kumar.nitesh@niituniversity.in)

Abstract: Efficient placement of relay nodes is an important issue in a two-tier wireless sensor network. This ensures the coverage and connectivity of the complete network with least number of relay nodes. Since the relay nodes are comparatively expensive than the sensor nodes, the overall cost of the network is also required to be maintained. In this proposal, we aim to propose an efficient relay node deployment scheme that results in a covered and connected network. The proposed scheme generates a set of positions by dividing the whole network area of interest into a hexagonal grid, where each vertex and the center is considered as the potential position for relay nodes. These positions are later optimized to find the optimal positions for the relay nodes. The algorithm runs in $O(n^2)$ time for n sensor nodes and is simulated to compare with the existing algorithms namely CRNSC and MRNCC. The result demonstrates a significant improvement of the proposed technique in terms of performance metrics like number of relay nodes required and performance ratio.

Keywords: Coverage, connectivity, deployment, hexagonal grid, relay node, wireless sensor network.

1. Introduction

Sensor networks have gained an enormous interest as a research area in the domain of wireless networks due to its wide range of applications like health care, disaster management, home automation, intrusion detection etc. [1-3]. Deployment of sensor nodes can be random or in specific positions depending upon its utility. Moreover, routing gathered data from sensor nodes (SNs) to sink may lead to energy depletion of sensor nodes. Hence, relay nodes (RNs) are required to form the upper tier in the network to relay information from sensor nodes which form the lower tier in the wireless sensor network (WSN) [4,5].

In recent years, there had been a continuous progress of WSNs, but still one of the crucial research challenge related to wireless sensor communication is to reduce the energy consumption of sensor nodes to enhance their lifetime and restrict the network cost in terms of hardware requirement [6,7]. Relay nodes having larger communication range and higher on-board power supply hence can be used for multi-hop routing to the sink [4-8]. The relaying of information from sensor node to sink via other relay nodes helps in energy conservation at sensor nodes and is depicted in Fig 1.

