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Density Grid-Based Clustering for Wireless Sensors Networks

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Abstract

Wireless Sensor Networks WSNs are special networks consist of devices (sensor nodes) in large numbers and spatial distribution. They have various sensing capability and cooperate to accomplish common task. Clustering is one of the most effective techniques used to solve the problem of energy consumption in WSNs. Grid based clustering has proven its efficiency specially for high dynamic networks. The girds' strategy used in this research is implemented on dense network and divides the network area into multiple grid cells with different densities (High, Low, and empty). Then grids are combined to form clusters as normal and advanced clusters. Cluster head is elected for each cluster based on high energy. This new suggested strategy is implemented and tested using MATLAB. The results show that this suggested strategy works well at 150 node WSN and grid size between 5-10 units where the network life time is 633 seconds approximately.

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Keywords: Grid-Based Clustering; Density-based Clustering; Clustering Algorithms; Wireless Sensor Network; Cluster head Election

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1. Introduction

A wireless sensor network (WSN) is a group of spatially scattered hundreds or thousands sensor nodes that has the ability of sensing, communicating and computing. It embedded in physical spaces, continuously gather a big amount of data from the environment. Thereafter WSN is beneficial technology in many domains such as tracking, monitoring, scientific investigations and more.

Any WSN incorporate single or several sinks, single or several sources and many sensor nodes organized in an area with a certain topology. The sensor nodes can contain different sensors such as temperature sensor, sound sensor, pressure sensor, humidity sensor, et cetera. When this sensor nodes sense elements from the environment that it embedded in, the analogue signal is converted in to digital data by using the processing units inside the sensor nodes through the analogue to digital converter module, after that the data is send to the base station for processing. Wireless sensor node can communicate directly to base station also it can communicate with each other [1,2,3].

As shown in **Fig. 1**. sensor networks contain the following components [2]:

- Data collecting: that has the ability of sensing and acquisition during transducers.
- Data transport: during the wireless/adhoc channels.
- Processing: that has the ability of analyzing date.

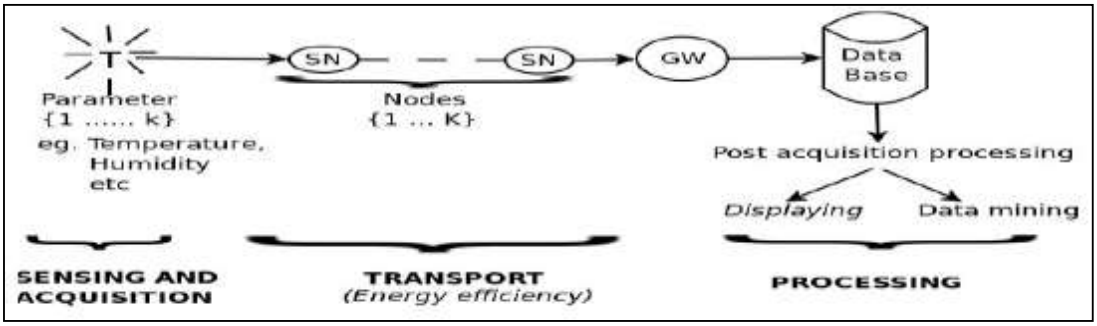

Fig. 1. WSN Components [2].

WSNs face many challenges in its design, where it is rigid to rules and policy changes such as user access and business operation. Any changes in business requirements will be hard to overcome by algorithms and it will need reprogramming or manual reconfiguration that is difficult to manage [4].

There is also many challenges comes from the intent of cost saving and the sensor node size where it has to be compact to suite the purpose. Being compact results in limited memory storage, limited computation strength and limited power source. In WSN the amount of data to be permanently stored into a data warehouse should be reduced by a certain summarization algorithm to accommodate the limited memory storage. Also because of the small size of the nodes, the node power is very important. While it is more practical to save the power and extend the life time of the network by using more efficient routing algorithm.

Clustering is the process of organizing objects into groups whose members are similar in some way[5]. The cluster routing is an energy efficient protocol where the nodes will be grouped into a few groups and for every group one cluster head (CH) is elected. The data is collected and aggregated by CH from the nodes in the same cluster, and then it is transported to the base station. The cluster head is the only cluster node that is permitted to communicate with the base station. This will minimize the total used energy and minimize the congestion of the network [2,6].

In density -grid clustering algorithms, the data object is mapped first to a grid then these grids are clustered based on its density. Density-based clustering algorithms are remarkable not only to find arbitrarily shaped clusters but also to deal with noise in data. In density-based clustering algorithms, dense areas of objects are considered as clusters which are segregated by low-density area.

This paper focuses on cluster in a large-scale Wireless Sensor Networks in density area. This type of network contains a large number of densely deployed sensors in a certain area. This is like managing mobile nodes and improves the network resources efficiency in a density area. Moreover it inherits all the WSNs challenges that mentioned before (limited power capacity, Limited memory, etc.) The communication between the network nodes must be done in energy efficient manner. So, cluster routing techniques are used where the nodes will be grouped