

Chapter 12

Fuzzy–Topsis–Based Cluster Head Selection in Mobile Wireless Sensor Networks: Cluster Head Selection in Mobile WSN

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ABSTRACT

One of the critical and vital parameter of Wireless Sensor Networks (WSNs) is its lifetime. There are various methods to increase WSN lifetime, clustering technique is one of them. In clustering, selection of desired percentage of Cluster Head (CHs) is performed among the sensor nodes (SNs). Selected CHs are responsible to collect data from its member nodes, aggregates the data and finally send to the sink. In this chapter, Fuzzy-TOPSIS techniques based on multi criteria decision making to choose CH efficiently and effectively to maximize the WSN lifetime are presented. These five criteria includes; residual energy, node energy consumption rate, number of neighbor nodes, average distance between neighboring nodes and distance from sink. Threshold based intra-cluster and inter-cluster multi-hop communication mechanism is used to decrease energy consumption. Moreover impact of node density and different type mobility strategies are presented in order to investigate impact over WSN lifetime.

INTRODUCTION

Wireless Sensor Networks (WSNs) consists of large number of sensor nodes (SNs) randomly deployed to sense and monitor the physical and environmental. WSNs become a reality because of development and advancement in micro-electro-mechanical systems (MEMS), communication system and digital electronic circuitry; resulting in number of small chip fits SNs mechanic parts as well as wireless communication

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components (Akyildiz, Weilian, Sankarasubramaniam, & Cayirci, 2002). The capabilities and functionalities of these tiny SNs have enable sensing, processing, data gathering and communication feasible.

WSNs have numerous applications, such as environmental monitoring, structural health monitoring, military and natural disasters (Li, Wang, & Guo, 2010). Cost-effectiveness in data sensing, gathering and communication is primary concern. Due to compactness of wireless SNs limited power and energy is available; therefore, the efficient and effective utilization of energy in WSNs is required (Lhadi, Rifai, & Alj, 2014).

Motivation

In recent years, WSNs is an emerging field in the broader area of wireless networking; with application ranges from surveillance to health care. Most of research is done on static cluster based protocols but they are less energy efficient compare fuzzy-TOPSIS based CH selection in mobile WSNs due to some of the following reasons.

1. Small lifetime and stability of WSNs is CH selection is based on few criteria i.e. one or two parameters.
2. Number of CHs varies from round to round.
3. High network energy consumption per round

Problem with power-efficient gathering in sensor information system (PEGASIS) protocol (Raghavendra & Lindsey, 2002) is that distance between each node is not same therefore some nodes have to send their data from longer distance as than others, hence those nodes consume more energy.

In single hop communication, nodes away from BS die earlier compare to nodes closer to BS because former consume more energy to cover larger distance communication. Similarly, in simple multi hop communication nodes close to BS die earlier compare to nodes away from BS because former consume more energy to transport packets on the behalf of away nodes from BS. Which results in drastically reduces lifetime of WSNs.

To overcome above mentioned problems in this chapter several different techniques for CH selection is compared with MCDM approach. In order to select a potential node to act as a cluster head, MCDM approach uses five criteria; i.e. remaining energy of the node (residual energy), node energy consumption rate, number of neighbor nodes (node density), average distance between neighboring nodes and distance from the sink.. To overcome the problem of PEGASIS, the multi-hop communication model is considered mostly for both inter and intra-cluster communication based on threshold; it depends upon the distance from the CH or sink is greater than some threshold. In this way energy consumption of the sensor nodes can be minimized, which will result in improve network lifetime.

WIRELESS SENSOR NETWORKS

In recent years, a lot of research and development has been carried on Wireless Sensor Networks (WSNs) due to its enormous applications. As, there is no single set of requirement which clearly classifies all WSNs; therefore, many areas are need to be explored to support a lot of very different real world applications.

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