An energy efficient load balanced cluster-based routing using ant colony optimization for WSN

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Abstract

Purpose – Wireless sensor networks (WSNs) have emerged as one of the most promising technology in our day-to-day life. Limited network lifetime and higher energy consumption are two most critical issues in WSNs. The purpose of this paper is to propose an energy-efficient load balanced cluster-based routing protocol using ant colony optimization (LB-CR-ACO) which ultimately results in enhancement of the network lifetime of WSNs.

Design/methodology/approach – The proposed protocol performs optimal clustering based on cluster head selection weighing function which leads to novel cluster head selection. The cluster formation uses various parameters which are remaining energy of the nodes, received signal strength indicator (RSSI), node density and number of load-balanced node connections. Priority weights are also assigned among these metrics. The cluster head with the highest probability will be selected as an optimal cluster head for a particular round. LB-CR-ACO also performs a dynamic selection of optimal cluster head periodically which conserves energy, thereby using network resources in an efficient and balanced manner. ACO is used in steady state phase for multi-hop data transfer.

Findings – It has been observed through simulation that LB-CR-ACO protocol exhibits better performance for network lifetime in sparse, medium and dense WSN deployments than its peer protocols.

Originality/value – The proposed paper provides a unique energy-efficient LB-CR-ACO for WSNs. LB-CR-ACO performs novel cluster head selection using optimal clustering and multi-hop routing which utilizes ACO. The proposed work results in achieving higher network lifetime than its peer protocols.

Keywords Clustering, Routing protocols, Ant colony optimization (ACO), LB-CR-ACO, Load balanced, Wireless sensor networks

Paper type Research paper

1. Introduction

Wireless sensor networks (WSNs) (Akyildiz *et al.*, 2002) are composed of numerous low-cost sensor nodes which are low power devices deployed to execute the task of sensing, processing and aggregating the data at cluster head and thereafter transmitting it to sink node located at the far end. WSNs and ad-hoc networks (Al-Karaki and Kamal, 2004; Singh *et al.*, 2012) have a lot of features in common. However, the difference lies in following areas: The number of nodes deployed are relatively more in WSNs in comparison to ad-hoc networks and this results in a requirement of routing protocol to be scalable enough. Second, WSNs show resource-constraint behavior in terms of network lifetime or battery life, energy, storage space and computational ability when compared to ad-hoc networks. Therefore, it further sets a restriction that routing protocol designed for WSNs should put very minimal network overhead as possible. Third, the WSNs may be left unnoticed for several years. This results in the requirement that the routing algorithm should be robust and self-healing because of the inherently dynamic behavior of WSN and changing network conditions because of node failure. The WSNs includes a wide variety of applications, namely, structural

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