

Chapter 16

PECA: Power Efficient Clustering Algorithm for Wireless Sensor Networks

Maytham Safar

Kuwait University, Kuwait

Hasan Al-Hamadi

Kuwait National Petroleum Company, Kuwait

Dariush Ebrahimi

Kuwait University, Kuwait

ABSTRACT

Wireless sensor networks (WSN) have emerged in many applications as a platform to collect data and monitor a specified area with minimal human intervention. The initial deployment of WSN sensors forms a network that consists of randomly distributed devices/nodes in a known space. Advancements have been made in low-power micro-electronic circuits, which have allowed WSN to be a feasible platform for many applications. However, there are two major concerns that govern the efficiency, availability, and functionality of the network—power consumption and fault tolerance. This paper introduces a new algorithm called Power Efficient Cluster Algorithm (PECA). The proposed algorithm reduces the power consumption required to setup the network. This is accomplished by effectively reducing the total number of radio transmission required in the network setup (deployment) phase. As a fault tolerance approach, the algorithm stores information about each node for easier recovery of the network should any node fail. The proposed algorithm is compared with the Self Organizing Sensor (SOS) algorithm; results show that PECA consumes significantly less power than SOS.

DOI: 10.4018/978-1-4666-2157-2.ch016

1. INTRODUCTION AND RELATED WORK

A wireless sensor network (WSN) is a form of network that consists of randomly distributed devices/nodes in a known space. Each node is typically equipped with radio transceiver, power source (usually a battery), processor, memory and/or other wireless communication device such as GPS receiver. WSN was originally developed for military purposes in the battle field. For example in a rescue operation these sensors that can be dropped by an airplane prior the actual operation, can reduce the risk of the operations by having the rescue crew aware of the overall situation (Akkaya, 2005). However, the development of such networks has encouraged the healthcare, industrial, environmental and other industries to utilize this technology. The size of each sensor node varies from 1 foot squared box to the size of a golf ball.

There are few challenges that faces the routing protocols, and hence the network formation in WSN. 1) Although in some applications the nodes' locations in Wireless Sensor Networks (WSN) are known and prefixed, however, the majority uses random distribution of nodes, which makes it difficult since the locations of the nodes are unknown. 2) The data flow from multiple nodes to a central base station. 3) Data redundancy, since many nodes could sense the same phenomena and hence producing redundant data. 4) Last and most important of all, is the power constraint and the limitation of radio transmission and communications among the WSN nodes (Akkaya, 2005).

According to Akkaya (2005) power consumption in WSN is closely related to its architectural issues, that is 1) Network dynamics, 2) Network deployment, 3) Energy consideration 4) Data delivery model 5) Node capabilities, and 6) Data aggregation. The WSN formation and setup has a great influence on power consumption and hence the network life time.

The main contribution of this paper is a new algorithm that significantly reduces the power consumption during the setup of a wireless sensor network, and hence prolongs the network life.

This solution relies on GPS technology to locate each node in the network. According to Sivaradje (2006) this may be a limitation especially in the urban areas where GPS signals are estimated to be around 15-40% less accurate due to magnetic disturbances, masking, unfavorable error propagation and other line of sight limitations. On the other hand WSN is normally applied in areas where human intervention is not probable; therefore the urban areas limitation is considered a major limitation.

Normally WSN nodes are distributed in an environment in which usual maintenance of the node is very difficult or highly undesirable, therefore the power source within the node is only and most valuable resource since it cannot be replaced. Hence keeping the network alive by using minimum resources is a big challenge (Pemmaraju, 2006). The transmission of data between WSN nodes consumes most of the node's power. One way to reduce this consumption is by grouping nodes into small groups within the transmission range of each node (cluster). Each cluster has a cluster-head that is usually at the center of the cluster radius and has the largest number of nodes within its transmission range (Guru, 2004). Figure 1 illustrates clustering in WSN.

The cluster approach normally puts a large constraint on the cluster head since it is the communication center, and hence loses its battery power rapidly (Shin, 2006). The cluster algorithms in WSN aim to build the network in a way in which data can be transferred between the network and base station with minimum radio transmission to reduce power consumption, on the other hand good algorithms must also build the network with maximum fault tolerance rate possible, which is another challenge beside power consumption (Kumar, 2006).

8 more pages are available in the full version of this document, which may be purchased using the "Add to Cart" button on the publisher's webpage:
www.igi-global.com/chapter/peca-power-efficient-clustering-algorithm/72765

Related Content

Identifying Overlying Group of People through Clustering

P. Manimaranand K. Duraiswamy (2012). *International Journal of Information Technology and Web Engineering* (pp. 50-60).

www.irma-international.org/article/identifying-overlying-group-people-through/75124

A Case Study for External Users

Roberto Paiano, Anna Lisa Guidoand Andrea Pandurino (2009). *Designing Complex Web Information Systems: Integrating Evolutionary Process Engineering* (pp. 179-194).

www.irma-international.org/chapter/case-study-external-users/8171

Heuristic Based Coverage Aware Load Balanced Clustering in WSNs and Enablement of IoT

Surjit Singhand Rajeev Mohan Sharma (2018). *International Journal of Information Technology and Web Engineering* (pp. 1-10).

www.irma-international.org/article/heuristic-based-coverage-aware-load-balanced-clustering-in-wsns-and-enablement-of-iot/198354

A Multi-Agent Temporal Constraint Satisfaction System Based on Allen's Interval Algebra and Probabilities

Elhadi Shakshuki, André Trudeland Yiqing Xu (2007). *International Journal of Information Technology and Web Engineering* (pp. 45-64).

www.irma-international.org/article/multi-agent-temporal-constraint-satisfaction/2626

A Detector and Evaluation Framework of Abnormal Bidding Behavior Based on Supplier Portrait

Xinqiang Ma, Xuewei Li, Baoquan Zhong, Yi Huang, Ye Gu, Maonian Wu, Yong Liuand Mingyi Zhang (2021). *International Journal of Information Technology and Web Engineering* (pp. 58-74).

www.irma-international.org/article/a-detector-and-evaluation-framework-of-abnormal-bidding-behavior-based-on-supplier-portrait/275734