International Journal of Innovative
Computing, Information and Control
Volume **8**, Number **9**, September **2012**

 ISSN 1349-4198
pp. **6037-6047**

IMPROVING LIFETIME IN HETEROGENEOUS WIRELESS SENSOR NETWORKS WITH THE ENERGY-EFFICIENT GROUPING PROTOCOL

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Received May 2011; revised September 2011

Abstract. *Improving the lifetime in wireless sensor networks is important because the sensor nodes in wireless sensor networks are constrained by limited energy. The way to improve a WSN lifetime is to develop energy-efficient protocols for reducing energy consumption. One of the well-known energy-efficient methods is the clustering based algorithm which is designed for homogeneous wireless sensor networks. The clustering algorithms were also improved and applied to the heterogeneous wireless sensor networks. In this paper, an energy-efficient protocol with grouping design is proposed. The proposed method divides sensor nodes into several groups whose total energies are the same. The proposed scheme not only extends network lifetime but is also applicable to the multi-level heterogeneous wireless sensor networks.*

Keywords: Wireless sensor networks, Cluster, Energy consumption, Heterogeneous wireless sensor networks

1. **Introduction.** The rise of informatics drives the rapid development of network and wireless communication technologies [1,2]. Wireless Sensor Networks (WSNs) are increasingly useful [3-6] and are applied to many applications, such as smart living, environmental monitoring, automatic measurement, healthcare, and traffic monitoring. A WSN consists of a large number of sensor nodes, which include small volume, low-cost, limited computation and limited power capacity [7]. The sensor node collects the sensed data by the sensor and transmits the data to an external base station (BS) by wireless communication components. Once the sensor nodes set up to form a WSN, the network continues carrying out the data while the node battery power is sufficient. Minimizing energy consumption for maximizing WSN lifetime becomes a key challenge [8].

In the sensor node, energy is consumed by data sensing, data processing and data transmission. Since the node spends up to 90% overall energy for communication [9], this work focuses on the data transmission method. The transmission protocols can be classified into direct type and indirect type. In the direct type protocol, all the nodes send the sensed data to the BS directly. The node's energy consumption depends on the distance between the node and the BS. The node farther from the BS will die faster [10]. In the indirect type protocol, a node may send the sensed data to another node closer to the BS. Since the distance from the sending node to the forwarding node is shorter than