The Sleep Control Strategy for Wireless Sensor Networks

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Abstract

The sensor node in a wireless sensor network has the characteristics of low power consumption and a non-rechargeable sensor node. Therefore, power consumption is limited. Effectively controlling the power of the sensor node and extending the life time of the whole network become very important issues. In this paper, we offer the optimal sleep control for wireless sensor networks: randomly setting the sensor nodes in the entire network and determining the sleeping probability by the distance between the sensor node and sink. This method reduces the transmission frequency of the sensor nodes that are closer to the sink and effectively reaches the network's loading balance. However, the sensor nodes process their sleeping schedules according to their own residual power to save energy.

Keywords*: WSNs, Sleep Control, Zigbee, Energy-Efficient*

1. Introduction

A Wireless Sensor Networks (WSNs) [1-3, 18] formed with many tiny sensitive devices is a product combining the three techniques of communication, computation and sense. Because of improvements in miniature manufacturing, particularly in communication and batteries, sensors have become widely applied to many fields, including military, medicine, commerce, and environmental protection. Wireless Sensor Networks are usually used in environments that humans cannot reach. Therefore, sensor devices are distributed randomly and densely to observe and sense something in the target areas. The information is transmitted by a specific protocol directly to the operating station or particular sinks.

WSN studies are divided into five areas: routing protocol, localization, data collection, fault tolerance and power consumption. Of these, power consumption is the most important issue because a sensor cannot be charged if the power will be exhausted. Sensor power saving to increase the effectiveness of an entire network is a primary focus for many researchers. Power saving technology is separated into four study aspects [4]: 1) Scheduling between sensor sleeping and waking. 2) Power control in sensors adjusts the sense range: sensors are generally set up at the most sensitive range when sensing, but using power control to adjust the sense range can save energy. 3) Effective routing paths: finding a shortest path and transiting data to a sink to save power are important. 4) Reducing data overhead: when a sensor delivers data, other nodes that close it may receive information that is not transited to them. This situation causes power consumption, so the near nodes are normally set up to sleep to avoid the overhead. The sleep control strategy in this paper utilizes the optimal sleeping time control to save sensor power. The main design concept includes saving power and increasing the lifetime of the entire network. We use the optimal sleep control to avoid data transmission latency and reduce the delivery frequency and have high sleeping probabilities for the sensor nodes near the sink.

The rest of the paper is organized as follows. Section 2 introduces the sleeping mechanism and related work, following the method in this paper, which reduces the delivery frequency of the sensor nodes near the sink. Section 3 describes the optimal sleep control strategy for WSNs, introducing the relative scheme hypothesis of the primary environment and the power consumption formula. The sleeping probability for each sensor node is calculated after establishing the power list. Each sensor node implements the scheduling of sleeping and awakening according to its residual power. Section 4 shows the simulation results. Finally, we indicate future work and our conclusions.

2. Related work

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