Reducing Power Consumption in a Network of iMote2/TinyOS Sensor Nodes

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Wireless sensor networks (WSNs) are one of the fastest changing ICT related areas both in industry and research fields, having a big impact on modern society. Nevertheless, designing a WSN requires considering a set of constraints and low energy is one of the most important of them [1]. From previous approaches we saw that the energy efficiency issue is addressed at different levels, including MAC and network protocols, physical layer communication, operating system, algorithms, etc. All these should be able to dynamically adapt in order to minimize power consumption [2]. Therefore, several optimizations have been proposed such as adaptive modulations and power, MAC protocols such as T-MAC, S-MAC, B-MAC, power aware routing algorithms like SPIN or LEACH, etc [2].

Our implementation is related to cross-layer design which is based on interaction between non-adjacent layers. Such approach can improve energy efficiency by joining design optimizations across hardware, link layer, MAC and routing protocols [2]. Our solution is based on accessing, from the application layer, the services provided by lower layers. These services are available as libraries and they perform power aware operations on the nodes without sacrificing the abstraction of low-level functionality. The power consumption is reduced using two methods: minimizing the communication process as it is one of the most consuming processes within the network, and periodically activating deep sleep mode for the nodes.

We used a WSN composed of two types of nodes: the sensing nodes for measuring environment data, and the gateway node through which the network is sending the data to a PC for storing and possible further processing. They transmit messages based on two types of communication: wireless communication between the nodes and the gateway, and wired communication between the gateway and the PC. The sensors located on the nodes are able to measure temperature, humidity, light and 3D acceleration. For developing the applications, few tools were used - namely .NET Micro Framework, Visual Studio 2005 and SQL Server. The application running on the sensor nodes periodically reads the sensor data and checks if the difference between the current value and the last sent value is above a threshold. If the difference is above, it saves these new values and sends a new message to the gateway. Otherwise, it discards the last sensed value. In both situations, the next step is activation of the deep sleep mode for a predefined timeslot. In this way, not only the power consumption is reduced but also the data redundancy. The node which acts as a gateway for the network performs the following tasks: receives the messages that are sent by the sensor nodes, converts them to the correct format and then sends them to the PC through serial port without looking in its content. The application running on the PC side executes the next operations for each new message received through the USB interface: message loading, identification of the actual information/fields in the message, computation of the real values from the sensor measurements and finally saving them into the database.

References:

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