Bachelor Thesis

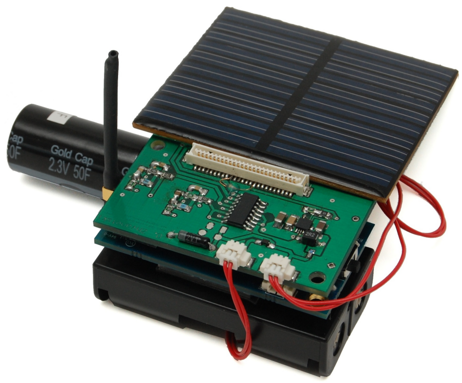
« Modeling the Charging Process of a Solar Energy Harvester »

Background

Wireless sensor nodes are tiny devices intended to observe environments in order to gather data or react on events. To achieve easy installation, they are equipped with wireless communication modules and are battery-powered. As batteries are small in size and capacity, energy-efficiency is crucial to improve a node's lifetime. However, the latter is still limited, so that next-generation nodes are equipped with energy harvesting modules and advanced energy storage facilities—e.g., a combination of solar panels and supercapacitors. Yet in this setup, a sufficient amount of energy is available during sunny periods only, so that nodes still have to save energy during the night or on cloudy days. To prevent empty energy buffers, nodes must be aware of incoming and outgoing currents. Gaining knowledge of these factors enables nodes to choose appropriate duty cycles, task schedules, and energy modes.

Work Description

In the Institute of Telematics, an energy harvesting power supply with a supercapacitor as its energy buffer and a solar cell as its power source has been developed. Due to the novelty of the device, no models and estimations of incoming energy are available yet. However, they are required in order to allow for valid and fine-grained lifetime prediction of sensor nodes. Once the amount and times of incoming energy can be estimated, the availability of future energy resources become predictable. This in turn enables energy-aware scheduling in order to circumvent energy starvation, which would lead to lost or corrupted sensor readings.



The goal of this thesis is to develop a model for the amount of energy gathered by the solar cell of the harvester module depending on the environment and weather conditions. Furthermore, this model has to be validated and shall be transformed into an algorithm for real sensor node hardware, so that nodes are enabled to estimate the time and amount of incoming energy, finally yielding the possibility to realize energy-aware scheduling.

Requirements

- Programming skills in the C language
- Basic understanding of electrical circuits and components
- Estimation techniques (system theory, stochastics)

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