Research Project and Seminar
« Beyond Energy-aware Rate-based Scheduling »

Motivation
In the past years, the field of sensor networks with energy-neutral-operation (ENO) has drawn considerable research interest. Apart from using harvested energy directly, ENO systems also store energy to bridge time spans with low energy income to ensure uninterrupted operation. For budgeting stored energy, numerous variants to adapt the duty cycle or to schedule tasks of a sensor node exist. However, modern sensor nodes offer MCUs with high computation power and often multiple sensors or radio modules. This allows for advanced processing of sensor data but consequently requires more complex energy-aware task scheduling, since various dependencies between components exist.

Previous work shows that simple program structures can be scheduled by adapting the rate, i.e. number of task executions per time interval, to ensure depletion-free operation. However, by design, it is hard to fulfill time requirements between tasks, e.g. sampleTemp is executed four times before before calcAvg. Up until now, it is unclear if these algorithms are applicable for complex program structures and how they perform.

Work Description
Based on two common approaches for scheduling recurring tasks in sensor networks, a simulation environment is developed for assessing the performance of scheduling approaches. Real-world harvesting traces and task definitions (including rate, energy consumption etc.) are inputs of the simulation environment. After implementation, the second step is to evaluate the scheduling approaches by (a) showing existing weaknesses and (b) highlighting simple workarounds, e.g. increasing the rates for tasks. The key metric is energy overhead due to suboptimal scheduling but also algorithm complexity, i.e. time overhead for computing a schedule. Additionally of interest are risk of depletion, utility of harvested energy and tasks. If possible, improvements are developed and evaluated.

Prerequisites
The following skills are expected for a successful thesis completion:
- Practical experience with programming in C or similar languages
- Experiences with microcontrollers and energy harvesting
- Profound reading and understanding of English texts
- High degree of autonomous working and self-motivation

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