ETH
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Institut für Technische Informatik
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Computer Engineering and
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Semester Thesis:

A Framework for Energy-aware Scheduling

Motivation and Informal Description: In recent years, more and more embedded systems are designed with energy-harvesting capabilities. This way, the system's operation is limited not only by its initial battery charge, but also by its environment. A challenge while designing a subset of these systems is to make them work constantly even though the availability of harvestable energy is intermittent. Having a huge battery to supply the system in every scenario is not always a viable solution due to size and weight constraints. A example is the nano-blimp [1], a lightweight vehicle which harvests photovoltaic energy in order power a propeller and hover at a desired altitude.

Figure 1: Another indoor energy-harvesting system in an ETZ office

We thus explore scheduling algorithms that monitor and adapt to the system's surroundings. To avoid running out of battery, the system might degrade its performance, e.g. it can reduce its processor's clock rate, or it can stop the execution of tasks deemed less important. Therefore, it is important to understand how a schedule performs in various lighting environments before the system is deployed.

This thesis is about learning theoretical concepts and applying them to build an analysis framework. You are expected to build a framework for stochastic analysis of energy-harvesting systems. The framework should be able to model:

- A stochastic energy harvesting source. The source model may be either static (harvested energy does not depend on time) or dynamic (harvested energy is a function of time).
- A system. This includes modeling of the battery (leakage, capacity e.t.c), the processor (different modes of operation with different power dissipation) and peripherals.
- Tasks. Periodic and aperiodic tasks may be considered. Tasks may have precedence constraints.
- Scheduling schemes. The schemes should be able to make decisions based on the environment and the system's state, e.g. harvested power and the battery level.

Requirements: You should have basic knowledge in Embedded Systems (scheduling), and high level programming. You should be motivated to work independently. Familiarity in statistics is an asset.

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[1] Palossi, Daniele, Andres Gomez, Stefan Draskovic, Kevin Keller, Luca Benini, and Lothar Thiele. "Self-Sustainability in Nano Unmanned Aerial Vehicles: A Blimp Case Study." In *Proceedings of the Computing Frontiers Conference*, pp. 79-88. ACM, 2017.