Open Thesis / Project

Towards a Battery-Free IoT

Thesis Type

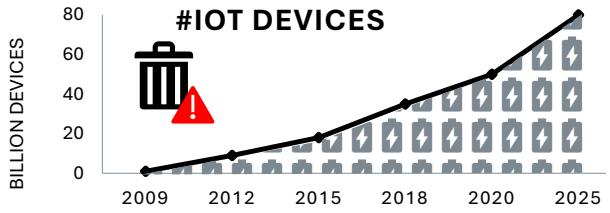
Master Project / Master Thesis

Motivation

With the increasing adoption of IoT devices in our homes and factories, we gain insights into the efficiency of processes and habits that would otherwise remain unseen. These allow us to cut down our carbon footprint; unfortunately, however, the "smart" devices enabling all this also produce a huge amounts of waste in the form of batteries. With a predicted 500 billion connected devices deployed by 2030 (many powered by batteries) the problem cannot be neglected, as the production and ultimately disposal of these devices and their batteries represents a looming environmental disaster. Battery-free systems tackle this sustainability issue by simply getting rid of batteries and instead relying on energy harvested from the environment.
Unfortunately, such devices are often purpose-built for a specific problem, with every aspect of the system tuned for a single application. Recently, hardware platforms such as Riotee [1] or our own BPMx [2] allow for generic battery-free IoT devices. However, there is still one problem left to tackle: *the software* – specifically, the lack of integration into mainstream IoT operating systems. Such integration would allow to abstract the details from the developer, allowing devices to operate seemingly unaffected by the intermittent and oftentimes unreliable energy supply (e.g., by autonomously checkpointing and restoring processes).

[1] `https://tinyurl.com/riotee`

[2] `https://tinyurl.com/tubpmx`



Goals and Tasks

Within this context, students can explore several directions and perform different tasks, such as:

- Getting familiar with intermittent and energy-neutral IoT devices (e.g., Riotee or BPMx).
- Getting familiar with operating systems for IoT devices (e.g., Zephyr or Contiki-NG).
- Getting familiar with the modeling of the availability of harvested energy (from sources such as RF, solar, thermal, or kinetic energy).
- Enhancing an IoT operating system with the means to transparently checkpoint and restore processes as well as relevant data with as little user input or configuration as possible.
- Building a demonstrator to showcase the operation of an IoT device from an intermittent power source without the need for user to be in the loop.

Target Group

- Students of ICE/Telematics;
- Students of Computer Science;
- Students of Electrical/Digital Engineering.

Required Prior Knowledge

- Solid skills in C programming;
- Hands-on experience with embedded systems and low-power micro-controllers;
- Basic knowledge of wireless systems.

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