Development of a Tool for Estimation and Plannability of Batteryless Energy Harvesting Systems

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1 Abstract

This abstract will lay the groundwork for an upcoming bachelor's thesis. The conditions and objective under which this abstract came to be, will be laid out under "Research Problem and Objectives" while the applied methodology as well as the solution's architecture are explained in "Applied Methods".

1.1 Research Problem and Objectives

Research Problem Beginning with the problem that is to be researched, there is no definitive information about energy availability in batteryless energy harvesting systems under all circumstances. This can be explained by the variability of energy harvester systems and environmental conditions on-site. Definitive information about energy availability is valuable when designing sensor node architectures, thus there is a need for an empirically justified way of easing said design process.

Objectives Leading over to the pursued objective of this thesis: improving the design process for batteryless sensor node architectures by providing a tool for empirically justified estimation of energy availability with regard to the utilized energy harvesting system as well as related environmental conditions. The empirical aspect composes itself from various pre-recorded energy harvesting circumstances with their energy availability as well as analysis through statistical means.

1.2 Applied Methods

The applied methods are classified as either "On-site" or "Remote" in order to determine the environment in which certain computational means are available.

On-site methodology The On-site methodology has access to the computational means of a batteryless sensor nodes, containing at minimum of an MCU as well as a energy harvesting system. Energy traces of the energy harvesting system are recorded via an analog frontend to the MCU. Further, the obtained energy data may either be transmitted in real-time for remote processing or exported to the HDF5 file format for manual usage. Not only may energy trace data be recorded but also environmental parameters that are relevant to energy availability in order to capture as much data as possible.

Remote methodology Due to On-site limitations, there needs to be a remote endpoint which receives transmitted data in real-time or through importing as well as means for analytical processing of said data. The proposed remote architecture builds upon Web technology because of its wide use and standard interfaces.

Frontend In order to allow for researchers to interact with the backend system, there needs to be a capable user interface which allows for insight and import of energy trace data. Furthermore, the containing data is visualized in two-dimensional curves and three-dimensional surfaces. In the end, the frontend's objective is to enable comparability of various collected traces with respect to their metadata.

Backend At last there is also need for a interfaceable processing architecture that executes methods such as statistical analysis or returns queries of persisted data.

1.3 Conclusion

To pass the proposed architecture in review: this project provides a proof-of-concept system architecture for benchmarking and evaluating energy availability in batteryless energy harvesting systems.