

FP7–Benchmarking design paradigms of batteryless systems

Dr.-Ing. Mojtaba Masoudinejad

Department of Computer Science, Chair 12
TU Dortmund University, Germany

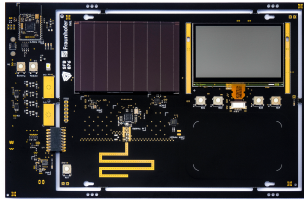
April 14, 2021

Batteryless systems

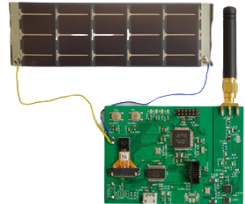
- IoT has boosted development of CPS and ES
- Classification from *energy* point of view:
 - Power line
 - Battery based
 - Batteryless



Industrial smart label. Powered by main. [Fraunhofer IML]



PhyNode material flow node. Powered by battery. [SFB876]



Wireless face detection. Batteryless. [ETH Zurich]

Batteryless systems' specification

- Obviously no battery or continuous supply is available
- Energy is stored in small scales
- Storage using capacitor (and sometimes supercaps)
- Energy is supplied from energy harvesting sources
 - Very small scale (micro and milli range)
 - Dynamic
 - Unstable
 - Intermittent
 - sometimes periodic

Batteryless design paradigms

Pure Hardware

- Unique application
- Pre determined energy statusing
- Threshold (Voltage or time)
- Intermittent
- Low to mid reliability

Mixed

- Dynamic statusing and decision making
- Mostly application dependent
- High reliability

Pure software

- User, Compiler, Operation implementation
- Demand for NVM
- Energy overhead for storage/restore
- Intermittent operation
- Possible high reliability
- no time guarantee

Road-map

- ① Seminar phase, to familiar with the topic
- ② Setting up environments (tool-chain, programming)
- ③ Implementation planning (in the group)
- ④ Implementation
- ⑤ Integration and Testing
- ⑥ Finalizing documentation, giving presentation

Overall plan:

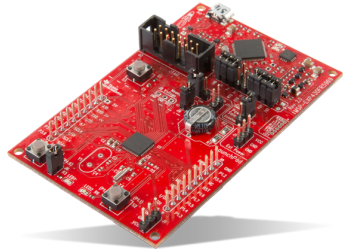
- (Bi-)weekly meetings to synchronize
- Prepare a written report (10-15 pages), stated implemented details
- Give a final presentation (with demo)

Topics

- ① Batteryless system paradigms and categories
- ② Benchmarking specification and design
- ③ Energy measurement hardware and toolchain implementation
- ④ InK: Reactive Kernel for Tiny Batteryless Sensors (Initial Suggestion)
- ⑤ LATICS: A Low-Overhead Adaptive Task-Based Intermittent Computing System (Initial Suggestion)
- ⑥ FlexiCheck: An Adaptive Checkpointing Architecture for Energy Harvesting Devices (Initial Suggestion)

Hardware test platform

- Texas Instrument MSP430
- Versions with FRAM (to enable NVM storage)
- Evaluation board will be provided
- Programmable energy supply and measurement device (SMU)



MSP430 evaluation board. [Texas Instrument]