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Energy Consumption Optimization in Wireless Sensor Network

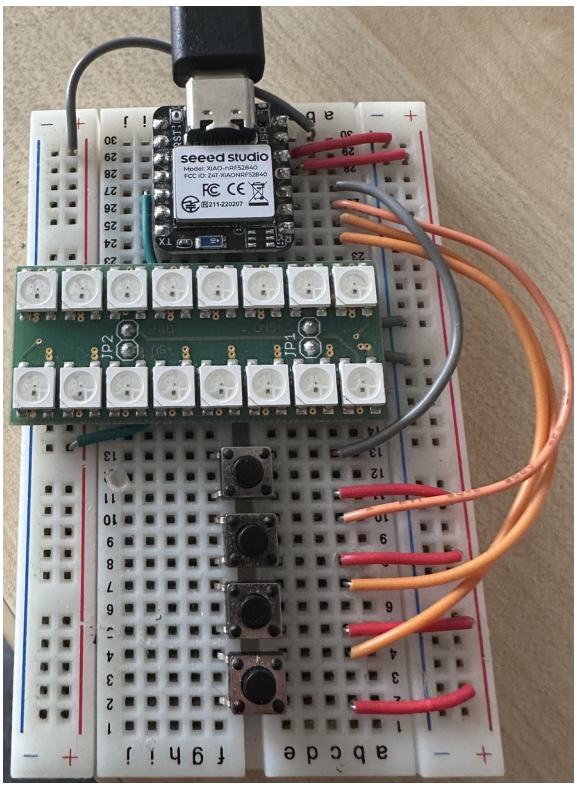
Project topic for Oberseminar Informationstechnik 2025/2026

Description:

The amount of sensor data gathered for various automated operations, such as building temperature control, automated factory operations, automated lighting control, etc. is increasing exponentially. In many instances this data is gathered by a network of sensor nodes that are battery powered, which is why optimization efforts in terms of energy consumption are crucial.

Reception and transmission of Radio Frequency signals are among the most energy consuming tasks done by a wireless sensor node. One way of optimizing for energy consumption could be the lowering of sensor sampling rates, however the application at hand may or may not allow for this. An enhancement to this could be the interpolation of the missing samples, however this can mean extra compute time, and the interpolated values may have errors.

The main goal here is to evaluate, with real hardware, the tradeoff between the accuracy and the energy consumption of the sensor nodes in the network.



Tasks:

1. Microcontroller programming in C.
2. Learn the basics of the RIOT Embedded Operating System.
3. Using the network stack provided by RIOT, build a working Wireless Sensor Network based on the IEEE 802.15.4 Low Rate Wireless Personal Area Network (LR-WPAN) standard.
4. Measure nodes' energy consumption to profile which task (sensing, transmitting, computation, etc.) consumes how much energy.
5. Build an energy optimized solution, measure, analyze, and evaluate the tradeoffs of this solution.

Keywords: Internet of Things, Wireless Sensor Networks, Embedded Systems, RIOT OS, Energy Consumption Optimization
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