Department of Electrical Engineering and Information Technology

Project Lab Embedded Systems

SS2025

Real-Time Embedded System for Signal Optimization in Bioimpedance/Battery Analysis

Project type: ▒ Hardware ▒ Software ✓ Hardware/Software ▒ Simulation ▒ AI/ML

A group of 3 students is preferred. The tasks can be adapted according to the number of the students.

Project description:

The aim of this project is to develop a real-time embedded system that demonstrates optimized signal processing techniques for either bioimpedance analysis or battery characterization. The system will acquire signals, perform real-time optimization and analysis, and display results through an interactive demonstration platform.

Tasks:

Member 1: PCB and Circuit Implementation Specialist

- Design and fabricate custom PCB for signal acquisition and conditioning
- Implement analog front-end circuitry for impedance measurement
- Design power management circuits for system stability
- Create interface circuits between analog components and microcontroller
- Test and validate hardware performance metrics

Member 2: STM32 Programming and Signal Processing

- Develop firmware for STM32 microcontroller
- Implement real-time signal acquisition and optimization algorithms
- Program digital filters and signal processing routines
- Optimize code for real-time performance
- Handle communication protocols between STM32 and Raspberry Pi

Member 3: Raspberry Pi Interface and User Experience

- Develop graphical user interface on Raspberry Pi
- Implement control systems for parameter adjustment
- Create real-time data visualization dashboard
- Manage data storage and retrieval
- Design the overall demonstration workflow and user experience

Task 4: Integration and System Optimization (All Team Members)

- Integrate hardware and software components
- Optimize performance for smooth operation

Task 5: Documentation

Competences:

- Member 1: Basic to solid knowledge in analog and digital electronics
- Member 2: Basic to solid knowledge in STM32 programming
- Member 3: Basic knowledge in Python & Raspberry PI

Contact:

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