Development of a Low-Power Environmental Sensor System with Digital Signal Processing

EduSens - Educational Environmental Sensor

Graduate

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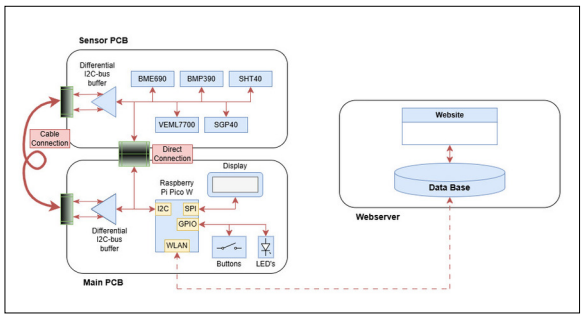
Introduction: This bachelor's thesis presents the design and implementation of a low-power, modular environmental sensing system for educational applications in electrical engineering. The system measures air quality, temperature, relative humidity, air pressure, and light intensity using distributed sensor modules. The sensor module and the main module are designed as an independent unit.

Approach / Technology: The work focuses on the development of an energy-efficient hardware platform, including appropriate sensor selection, microcontroller integration, power management, and low-power data visualization. Measured data are displayed locally and transmitted to an online platform for further analysis.

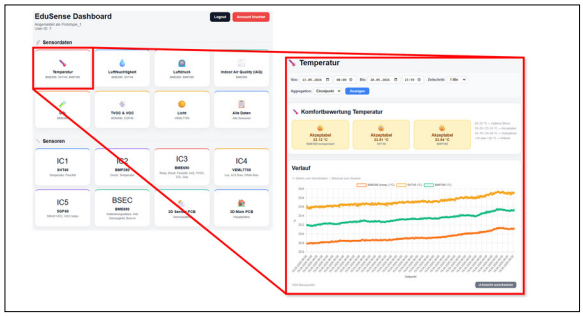
On the software side, basic and advanced digital signal processing methods are applied to evaluate environmental conditions, including statistical analysis, comfort assessment, mold risk estimation, and simple forecasting based on historical data. The system aims to provide a scalable and practical solution for teaching and experimentation in embedded systems and environmental monitoring.

Result: The web application was functionally extended: in addition to sensor data correlation analysis and the implementation of data smoothing algorithms, it now also covers expanded air quality measurements - specifically TVOC, VOC, and CO2 readings as a complement to the existing IAQ monitoring.

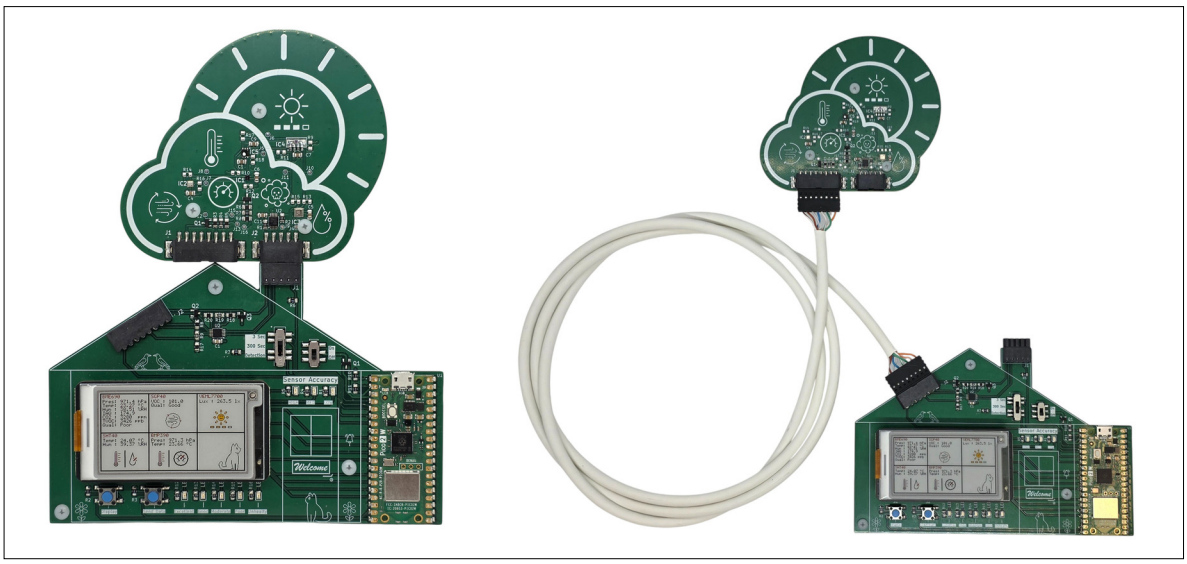
System overview of the sensor PCB, main PCB and webserver.
Own presentment



Website to analyse the data measured from the sensors.
Own presentment



Measurement hardware connected either directly to the main hardware or through a cable.
Own presentment



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Subject Area
Digital Signal Processing