IoT System for Data Acquisition, Transformation and Visualization

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Abstract. *This project presents the design and implementation of IoT systems in the Smart City concept for data acquisition from various data sources such as microcontrollers and other systems, and then processing and visualisation of these data on a Raspberry Pi server. We used data from a small meteorological station built for this project and from PLC devices. In this case, a meteorological station functions as an Internet of Things (IoT) device, utilizing various sensors to gather data, which is subsequently collected by ESP32 microcontrollers. The station operates exclusively on power supplied by (a) solar panel(s) and batteries; therefore, the entire design prioritizes minimal power consumption. Moreover, the station reports data on battery voltage, individual sensor statuses, and the overall status of the device. All of the data from the station is sent as a JSON object through the MQTT protocol. Since some IoT devices can be placed in unavailable places, the station's firmware can be changed through OTA updates. The server side of this project is focused on the design and implementation of data acquisition from various IoT devices, the transformation and storage of this data, and the provision of visualization. This server also monitors the status of IoT devices and can notify the user through email in case of anomalies or exceeding variables in data. Also, this server can save and visualize the number of connected devices and save program logs. The server utilizes containerization software Docker for improved maintenance, integration, and consistency, Node-RED for data transformation, and Grafana for visualization. The system is scalable, allowing for the addition of more data acquisition devices and accommodating various data types. This initial system is designed for direct use in IoT and Smart City projects.*

Keywords. microcontrollers, JSON, MQTT, Raspberry Pi, Docker, Node-RED, IoT, Smart City

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