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Design of temperature measurement system and data visualization

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***Abstract* — In this paper we deal with temperature measurement and visualization system. After justifying the need to create our system its individual parts were described. In the last part we focused on designing the concept of the system and explaining how it works. The proposed system contains IoT elements, allows to collect and visualize the necessary amount of data for future analysis of the measured machine.**

***Keywords* — data visualization, Grafana, InfluxDB, MQTT, Python, temperature measurement**

I. INTRODUCTION

Research in temperature and heating is expanding in industrial electrical engineering. The use of temperature analysis has a wide range. It is known that temperature affects other physical quantities. In practical applications, this affects the change in the properties of construction materials, their dimensions, machine life, quality of machined surfaces, etc. Proper temperature monitoring is required to understand the individual events and determine the effect of temperature. There are currently a number of sensors and measuring instruments for measuring temperature. But if you want to carry out a detailed analysis of the events affecting the heating of the system and the subsequent effect of temperatures on other parts of the system, it is necessary to create a robust database with the appropriate data. Such an extensive database will allow us to research the effects of processes and heating in the system. Therefore, in this article we will focus on tools and a suitable concept for data collection and visualization with a focus on temperatures. The design of our system consists of the InfluxDB database, the Grafana visualization tool, sensors and the ESP8266 microcomputer. The communication of the system between the individual nodes of the measuring system is ensured by the Mosquitto broker in combination with the MQTT communication protocol. The following chapters explains the individual elements and system concept for data collection and visualization.

II. PARTS OF THE MEASUREMENT SYSTEM

This chapter focuses on describing the individual parts of the system. We will briefly describe each part focusing on the use of elements in systems with automatic measurement. And we will explain the benefits of using specific elements.

A. InfluxDB

InfluxDB is a time series database designed to handle high load during writing and querying. Contains dashboards, queries, tasks, and agents. In our case we use it to store all measured data. Subsequent data analysis requires a suitable selecting of data from the database. Another use is the direct connection of InfluxDB with the Grafana visualization tool [1].

B. Grafana

Grafana is a platform that allows you to visualize data by creating graphs, dashboards and other visualization elements. To display the data, it uses a link to databases where the necessary data is stored.

Another feature of Grafana is the ability to create alerts. In the case of temperature measurement this can be used in systems, where we set the trigger to a specific critical temperature and after exceeding it an alert is triggered and defined tasks are performed. Fig. 1 shows a simple visualization of the measured temperature data of three sensors.

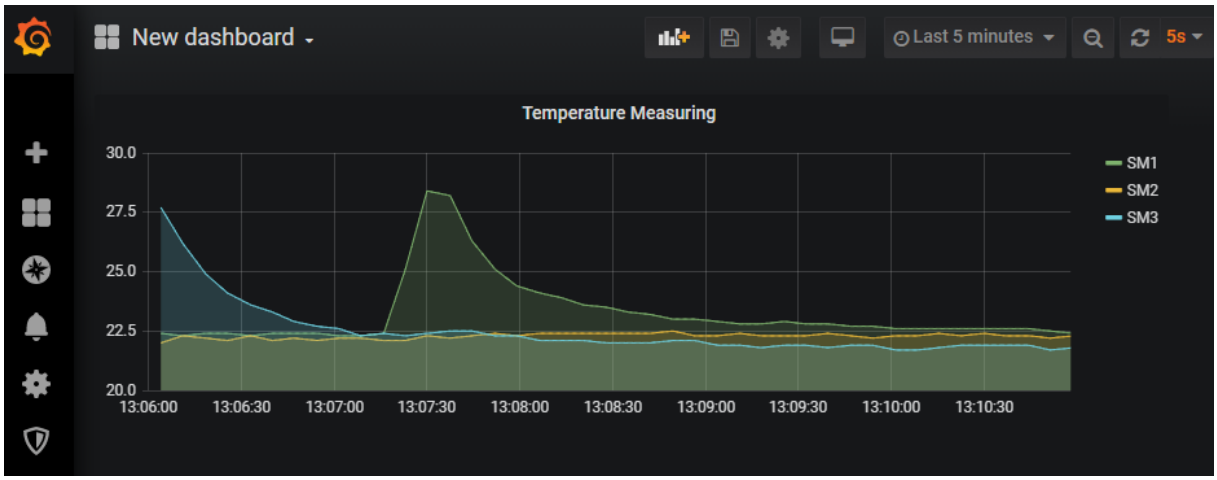

Fig. 1 Grafana visualization

C. MQTT

MQTT is a standard messaging protocol for the Internet of Things (IoT). It is designed as an easy messaging for publishing and subscribing in which is ideal for connecting remote devices and is widely used in industry. The basis of MQTT communication is a publish / subscribe system. For example, reports can be produced by scanners that publish them to a single center (MQTT Broker). Each message is published with the topic name which the broker sends to all clients who have subscribed to it [3].

D. Python/Micropython

Another tool is the Python and Micropython(Python version for ESP8266) programming languages. Python creates programs for collecting data and sending them to the InfluxDB database. Communication between individual nodes will be provided by libraries implementing the MQTT protocol.

III. System Concept

When designing the visualization system, we focused on the possibility of future expansion of the system. The current proposal is focused on measuring temperatures with Dallas 18B20 sensors [4]. The measurement is aimed at analysing one machine but the design of the system allows adaptation to the analysis of several machines simultaneously.

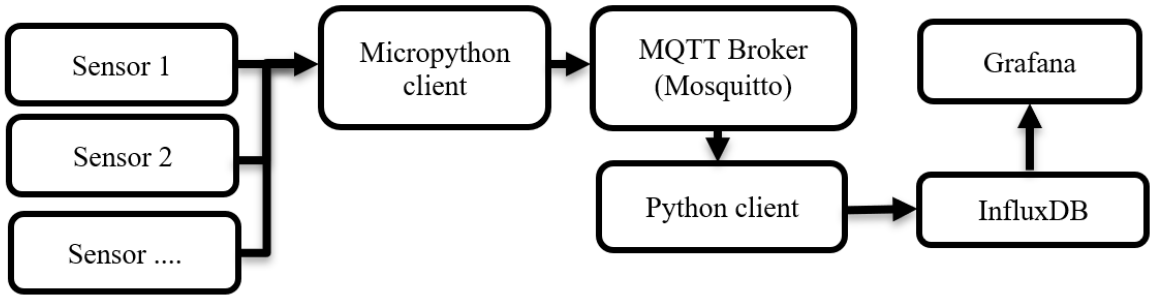

Fig. 2 The system diagram

Fig. *2* shows the communication connection of the individual nodes of the system. Micropython client obtain data from the sensors and then publish them using the MQTT protocol. MQTT Broker shifts the data to the Python client which is a subscriber of the measured data. Python client can subscribe more device with certain information. After collecting all appropriate data Python client send data to the InfluxDB database. After saving the data to InfluxDB they are accessible for the Grafana visualization tool. According to the created configuration of Grafana visualization the measured data are displayed to the user.

IV. CONCLUSION

The aim of the article was to design a visualization system. By creating a system concept and clarifying the individual elements we created a sufficient analysis necessary for the implementation of the system. In the next steps we will apply the system to a CNC machine.

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