JOINT SUCCESS STORY

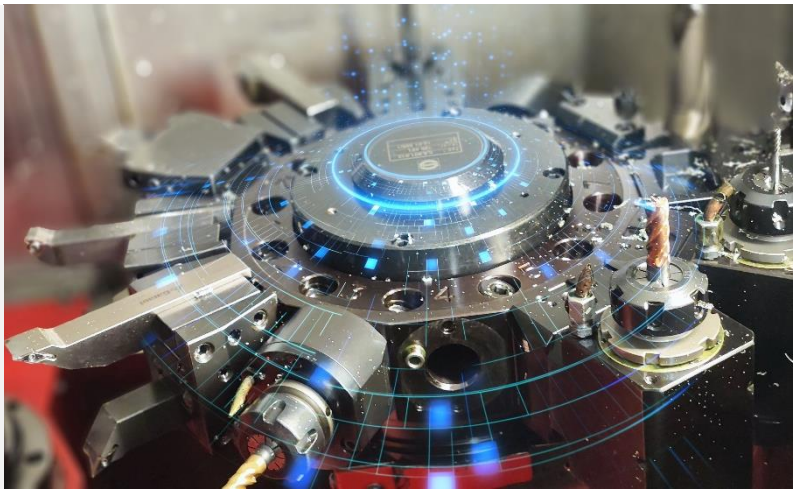
Pro²Future :: Products and Production Systems of the Future

ACDP :: Austrian Center for Digital Production

Programme: COMET – Competence Centres for Excellent Technologies

Programme line: COMET-Centre K1

Type of project: Common Research Programme II (CRP II), Sustainable Products and Production, 4 Years



ENHANCED FAILSAFE MANUFACTURING SYSTEM FOR PRODUCTION MACHINES

EFFICIENCY AND QUALITY IMPROVEMENT IN CNC-PRODUCTION BY INCORPORATING ADDITIONAL AND NON-INVASIVE SENSORS

Failsafe Manufacturing Systems are designed to ensure a high level of reliability and quality in production processes. An important aspect of these systems is the **integration of sensors** and the combination of **multi-sensor data**, which enables **early detection** of potential failures. By detecting and addressing problems at an early stage, **fail-safe manufacturing** systems help to prev**ent quality issues and errors before they can occur**, ensuring a more sustainable production process with **less waste and greater efficiency**.

A joint project involving the COMET centres Pro²Future and CDP and the universities TU Graz and WU Vienna will explore additional strategies to support failsafe manufacturing and p**redictive maintenance** of production machinery. The use case for this project is the EMCO Maxxturn 45, a special model of a CNC (Computer Numerical Control) turning machine commonly used in **manufacturing processes** such as turning, milling, and drilling. These machines often do not have **integrated diagnostic capabilities** for failure detection, such as anomaly detection. Therefore, a prototype system was designed and developed, which is located in the Pilotfactory of the TU Vienna. The main part of the prototype is the aforementioned CNC Maxxturn 45 machine. The machine is equipped with external sensors that can detect vibrations in **real time and react by adjusting the cutting parameters** (see Figure 1).

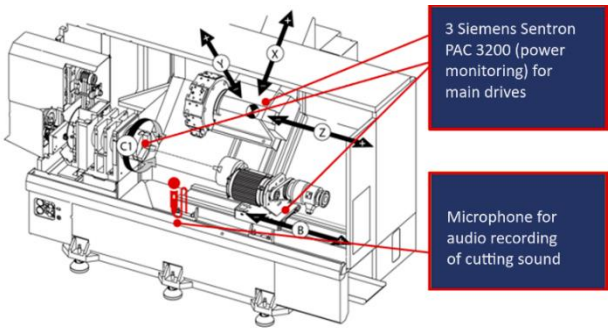


Figure 1: Layout of the prototype

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The aim is to enable an **early assessment** of part quality based on measurements and real cutting forces during the process. In addition, the CNC machine is retrofitted with a **microphone** connected to an edge device (**Raspberry Pi**) housed in the machine's network cabinet. This microphone records audio signals within the machine. The signals are then **analysed in real time to detect any anomalies during the machine's operation**.

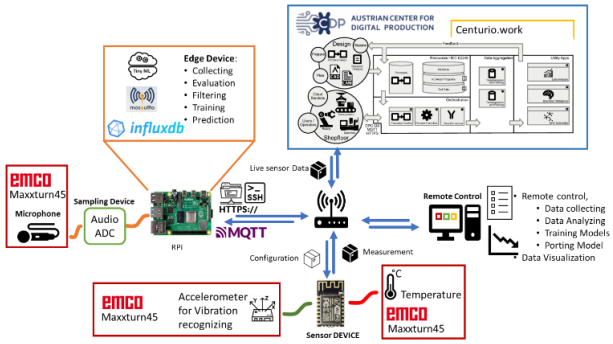

Figure 2: Architecture for effective data acquisition

The architecture shown in Figure 2 was developed to collect the data efficiently. An internal **MQTT** broker runs on the edge device, which makes it possible to perform different tasks independently in different processes without disrupting the underlying functionalities of the system. Communication between the edge device and the **Centurio.work** host system can be easily customized. Information such as the **rotation speed**, **torque or current of the mill** can be integrated simultaneously with data from **external sensors** to be analysed and thus provide additional insights into the health of the machine (e.g., wear of the gobble head).

Impact and Effects

The integration of these two additional sensors has several effects on the production process. Firstly, it gives the production team the opportunity to perform **quality assurance** checks on parts **before further production steps** take place.

Secondly, it enables the e**arly detection of potential defects** by detecting anomalies during the production process. In addition, any unusual behaviour reflected by sound, such as abnormal noise patterns, can be detected by the sensor data.

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