

# Development of an Embedded Communication Hub for the Acquisition of Sensor Data in a Robotic System

## Project Thesis

### Background

Collaborative robots are an upcoming trend in the automation industry which enable a closer interaction between humans and robots to realize/materialize productivity gains and relieve workers from repetitive, unergonomic or tiring tasks.

To fulfill the challenging tasks in this field, extensive sensor integration and sensor fusion is leading to a wide variety of different interfaces and measurement principles that need to be integrated into the embedded system.

The embedded system processing such critical data additionally must fulfill demanding machine and functional safety requirements by a certification body like TÜV. Furthermore, the development of devices within the scope of TSN Ethernet initiative will allow to research further compatibility during the long and partly contentious process of standardization of RTE Networks.

### Problem /Task

The goal of this project thesis is to develop an embedded system to collect and process sensor data within the robot axes. Therefore, the following tasks must be done:

- Analysis of requirements and needed IO interfaces for the system while taking into account the state of the art for RTE Industrial Networks
- Develop the embedded system as a functional EtherCAT Slave Device with an approach to open-source tools
- Provide within the embedded system a platform capable of the following functions
  - Readout of different sensors e.g. IMU (SPI), Encoders (BiSS-C),...
  - Control of status RGB LEDs e.g. WS2812b (incl. animations)
  - Preprocessing data acquired by the sensors (e.g. filtering)
- Design of a PCB prototype using Altium Designer
- Test the system functionality

### Contact

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## Further development for a Master Thesis

The previously mentioned device must comply a formal design based on the theory of software for embedded systems; therefore, a correct integration of a RTOS is necessary to ensure a deterministic behavior within a Time-Sensitive Network. Once the device is functional by implementing a RTE communication protocol, its performance can be characterized. Thus leading to improvement of features or recognition of limitations closely related to the used open-source tools.

The benchmark characterization and analysis within the technical report must take into account the so far IEEE TSN Profile for Industrial Automation, providing then valuable reference work for future projects within formal academic and industrial fields.

## Requirements

The student pursuing this thesis should be highly motivated and self-organized, bringing in experience in embedded soft- as well as hardware design with ARM  $\mu$ Cs.

It is beneficial if the student has experience using Altium Designer and STM32 products as well as their toolchain.

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