Task for the preparation of a Master Thesis

Course:	Master Computer Science
Discipline:	Technische Informatik
Name:	**Ziyuan Zhang**
Matriculation number:	4659711
Matriculation year:	2016
Title:	Hardware implementation of Preemtable Scheduling Approaches for the Robot Operating System (ROS) via actionlib

Objectives of work

The aim of this research work focuses on the actionlib stack from ROS/ROS2. The main question to answer is whether it is possible to have a reliable scheme for preemtable tasks following the actionlib for Field Programmable Gate Arrays (FPGAs). This would require an analysis of the state-of-the-art on Hardware (HW) schedulers, with a focus on preemtable tasks. The impact of the HW implementation of a client and server on HW must be compared to the standard one on Software (SW) and be quantified to draw conclusions. It is important to evaluate how the exchange of data between HW and SW should be and whether it is benefitial to have the Finite State Machines (FSMs) completley on HW. The benefits must be highlighted. Besides, the impact on the preemtion of HW accelerators must be considered. Finally, the outcome should be a **generalizable** approach, considering that a system will have **multiple** HW-actions (accelerators).

Focus of work

- Research state-of-the-art for similar techniques
    - Real-time and preemtable HW schedulers
    - VHDL implementations of FSMs
- Become familiar with the Robot Operating System (ROS)
    - Understand the differences among **topics**, **services** and **actions**
    - Propose usecases for actionlib as proof of concept for one and multiple actions
- Implement Client and Server FSMs on HW (VHDL)
    - **Proof of concept** for *one action*
    - **Generalize** for *multiple actions* at the same time
        * Are multiple "actionlib" FSMs needed? If so, define the interaction among them
        * Is a *general* FSM needed to coordinate all "child" FSMs?
- Define Performance Metric (e.g., latency, throughput, tasks' and scheduler-FSMs- delays, HW resources) as in the state-of-the-art.
- Evaluate the implementation and compare it using the performance metric with traditional SW actionlib.

Supervisor:	Ariel Podlubne
Issued on:	December 1, 2021
Due date for submission:	July 4, 2022

Prof. Dr. Diana Göhringer
Supervising professor