SCARA robot

The project:

This project involves the creation of a 3D-printed robotic arm, designed with four articulated joints for precise movement. The robot is composed of 40 lightweight 3D-printed parts, made using Autodesk Fusion for the 3D model and KiCAD 8.0 for the circuit diagram. It incorporates four Nema17 stepper motors, controlled by A4988 stepper drivers, enabling smooth and accurate joint movement. Powered by a 12V DC system, the robotic arm uses an Arduinoexecution. Additionaly, it has custom C# software application for controlling and debugging. Uno for task

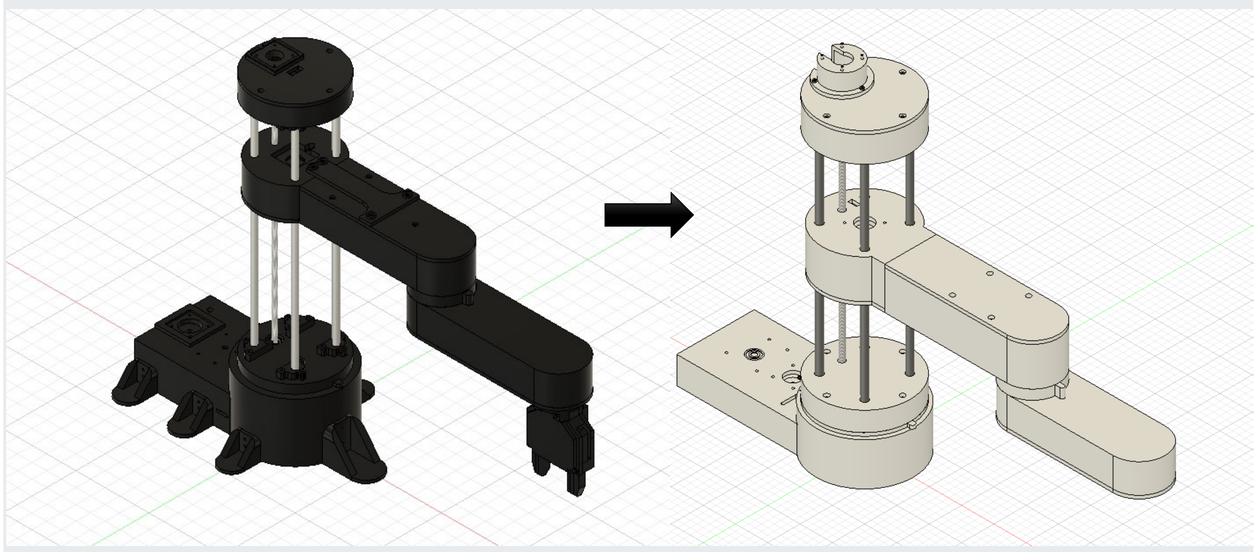

Abb. 1: Concept development, left V.1 – right V.2 (final)

The goal:

The primary goal of this project was to build a cost-effective, lightweight, and functional robotic arm capable of executing tasks with flexibility in movement. By utilizing 3D printing and a mix of affordable electronic components, the aim was to create a high-performance system that could be controlled via a PC application. The robot's design includes optimized gear ratios for each joint, ensuring stability and efficiency in motion. Additionally, the system was designed to be easily customizable for future iterations and enhancements.

Abb. 2: Assembling proces

The goal:

A key objective was to develop a custom communication protocol for interaction between the PC and Arduino via UART cable. This protocol allows for the execution of motor control, debugging, inverse kinematics, and point-by-point path execution, providing a robust framework for the robot's operation

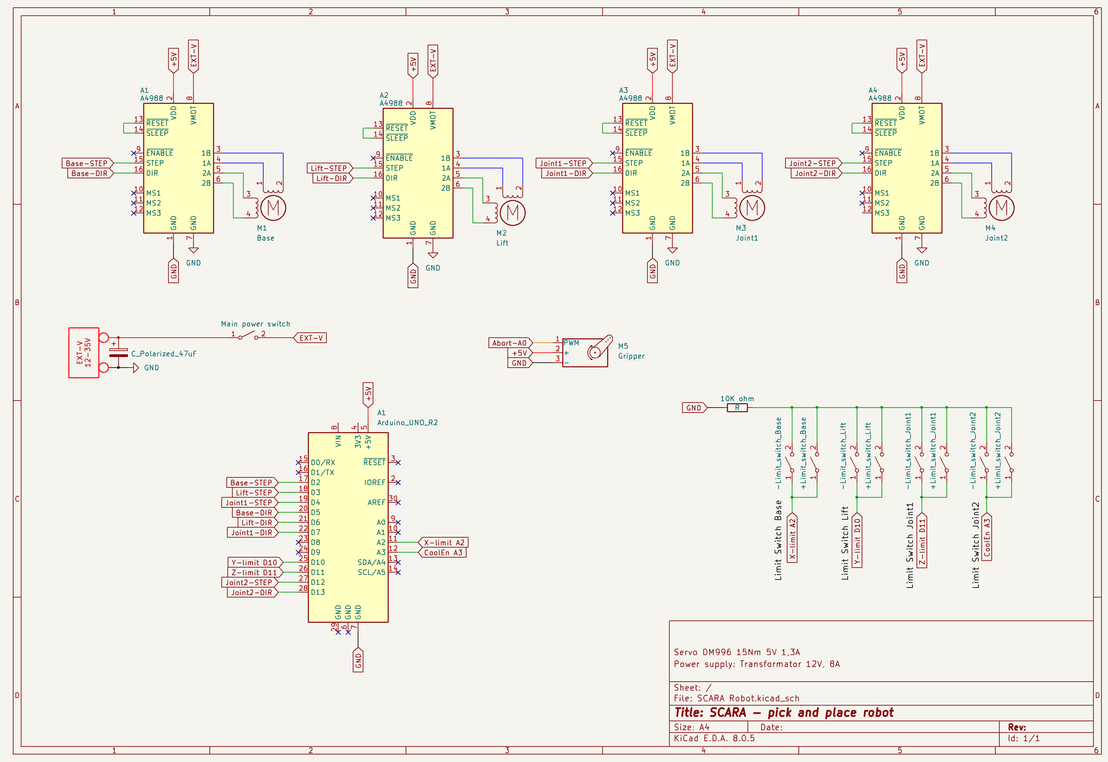

Abb. 3: a) Circuit diagram

The result:

The resulting robotic arm successfully operates with four joints, each equipped with specific gear ratios for enhanced movement control. It functions smoothly, with precise motor control facilitated by the A4988 drivers and custom Arduino-based software. The arm weighs approximately 7kg and can handle a payload of up to 0.5kg. The project was completed over a four-month period, with a total cost of €215 for mechanical and electronic components (excluding the prints). The arm is equipped with limit switches for calibration and position control, ensuring reliable operation for various tasks.

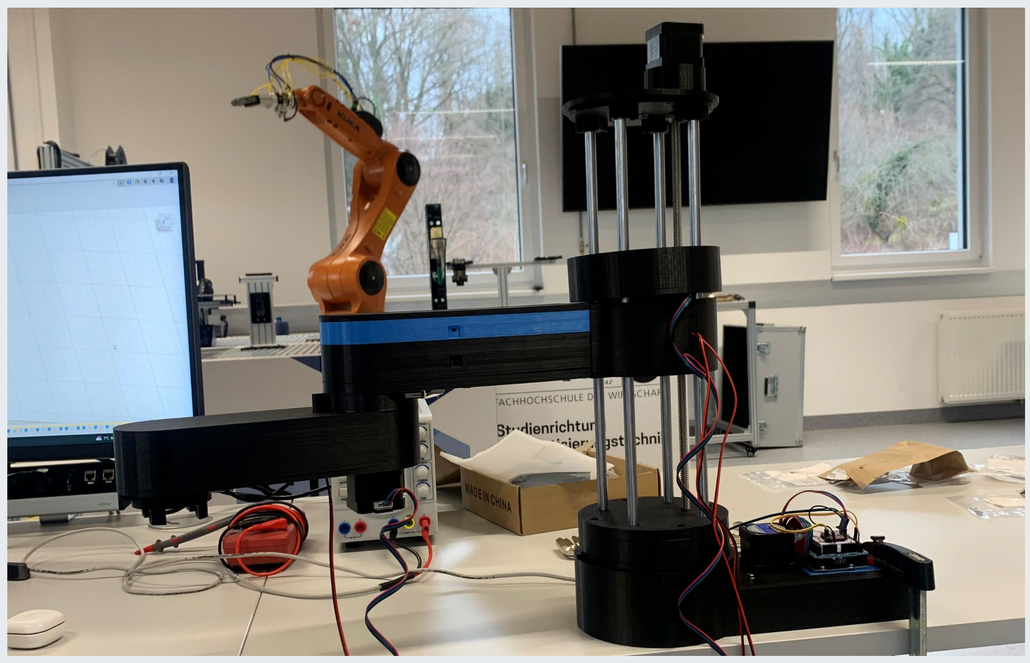

Abb. 4: Result

Author of the work: Marcel Borkowski
Supervisor: FH-Prof. DI Dr. Tech. Christian Gasser