

Project Summary

What is the ModuGrip?

The ModuGrip is a 3-DOF (three degrees of freedom) robotic arm with a modular end-effector system.

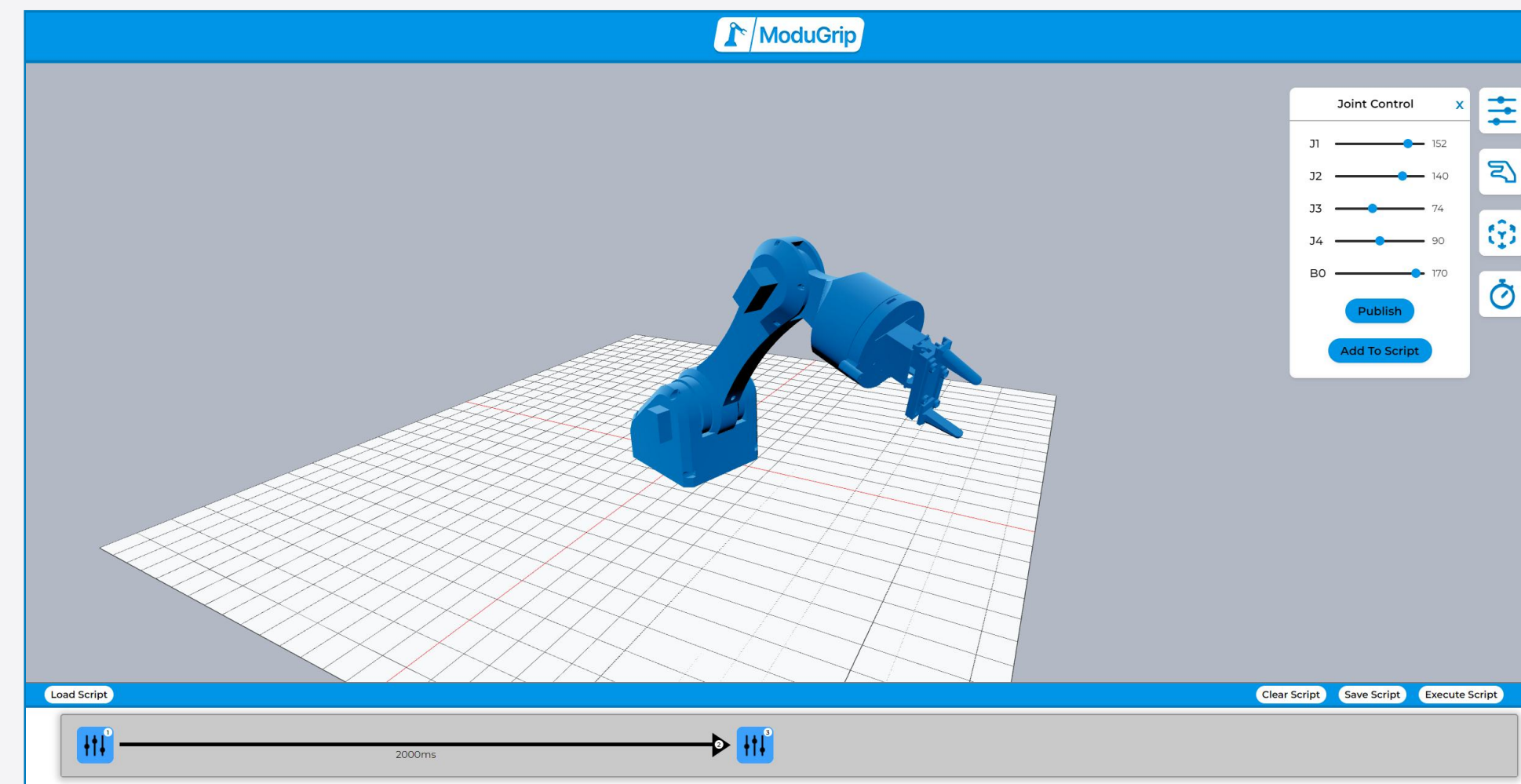
The modular end-effectors allow the user to remotely swap tools during use, enabling the operator to complete multiple jobs without entering the operating environment.

The ability to swap tools makes the ModuGrip a great asset when working in remote, dangerous, or controlled environments.

How it Works:

1. The ModuGrip is operated through my Nextjs web application featuring a virtual model, script generation and multiple control options.
2. The user sets the desired position of the ModuGrip and publishes the values to Ubidots, a cloud-based MQTT broker.
3. The ESP32 is the brains of the ModuGrip. It connects to Ubidots over Wi-Fi and waits for new values to be published.
4. When new values are received, the various actuators move the ModuGrip into position.

Web Application



Control Methods

Different tasks require different methods of control.

The web application features manual control of each joint using sliders, and direct control over the end-effector position using coordinates.

The application runs inverse kinematics calculations to convert coordinates into motor movements.

Script Creation

Script creation is an essential feature in any robot control software.

The ModuGrip web application empowers the user to chain together a sequence of movements and save them for later. The freedom to swap tools mid-script enables the ModuGrip to complete complex, multi-process tasks.

Virtual Model

I wanted to ensure that the operator could remotely control the ModuGrip from anywhere in the world, even when it's out of sight.

The virtual model gives an accurate representation of the desired state of the robot before executing a movement. This is a vital feature for both safety, and user experience.

Technologies Used

Software:

NextJS: An open source React framework.

React Three Fiber: A React renderer for ThreeJS.

Java Spring Boot: An open source Java framework for backend development.

MongoDB: A NoSQL database.

Hardware:

DS3240SG: 45kg-cm servo motor.

DS3225MG: 28kg-cm servo motor.

Parallax #900-00005: 2.74kg-cm servo motor.

RS 180-5278: Unipolar stepper motor.

Tools:

Fusion 360: Autodesk's CAD software.

Sovol SV06 Plus: 3D Printer.

Sovol3D Cura : 3D Slicer application.

AWS EC2: Amazon cloud computing platform.

Vercel: Serverless NextJS deployment platform.

Ubidots: A cloud hosted MQTT broker.

Hardware Design

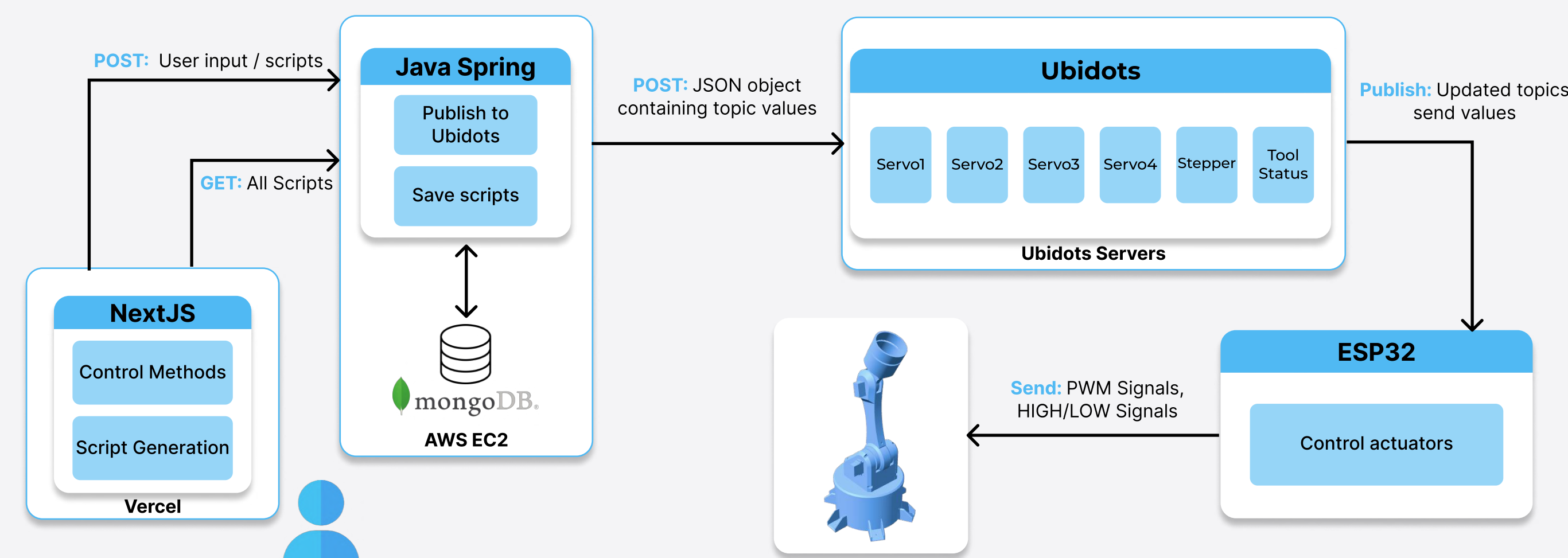
The ModuGrip was designed using AutoDesk's Fusion 360 software and 3D printed with a Sovol SV06 Plus.

The arm was printed with PLA filament, sanded, and coated in multiple layers of paint and polyurethane clear coat to provide a durable surface.

The entirely original design features five servo motors, one stepper motor, and a mechanical locking system.



Project Architecture



See the ModuGrip in Action

