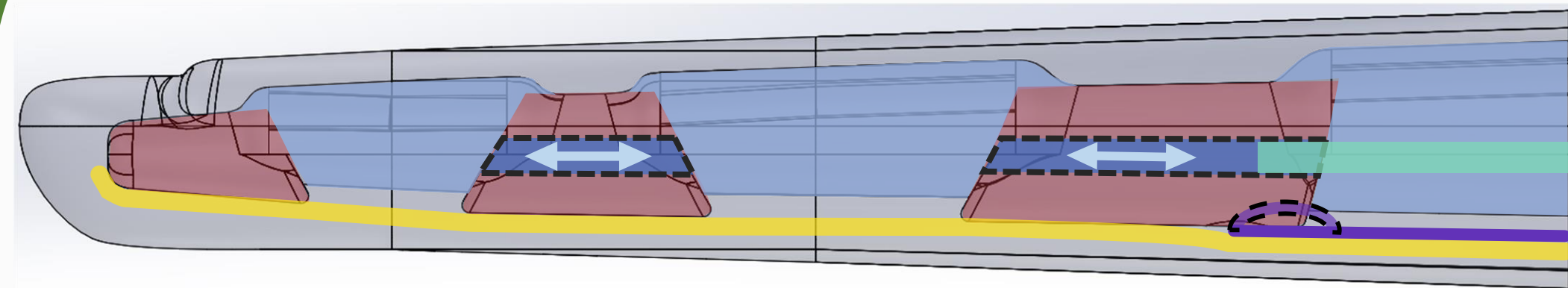


Abstract

Soft prosthetic hands have difficulty replicating the motion and feel of hands, due to their lack of firmness. Our soft robotic hand achieves segmented finger motion due to the presence of PLA bones and a firm, human-like grip. Silicone is used throughout the robot for human-like feel, a compliant grip, and to facilitate the pneumatic actuation. Overall, this project represents an approach to prosthetic hand development that prioritizes recreating key characteristics of biological human hands via a novel bone-in design.

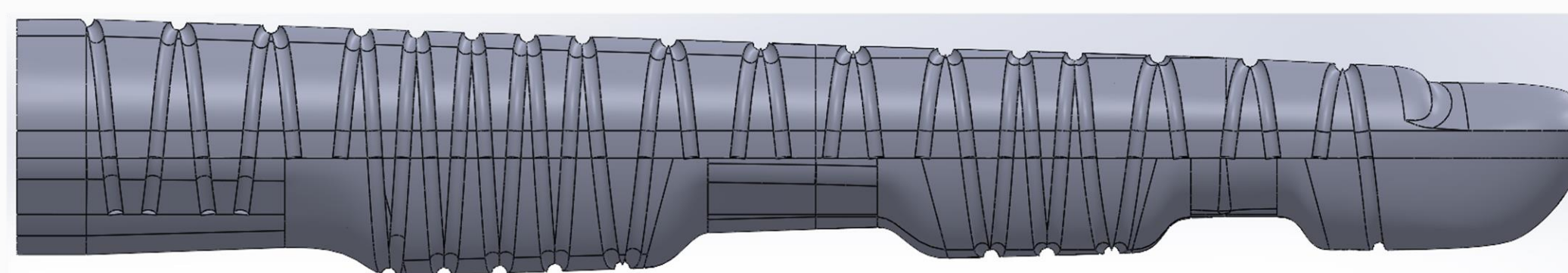
Finger Design

interior:



- Air Chamber
- Air Passage
- Bone
- Nylon Fabric Inextensible Layer
- Kevlar Cable
- Kevlar Tie-off Loop
- Tube

exterior:



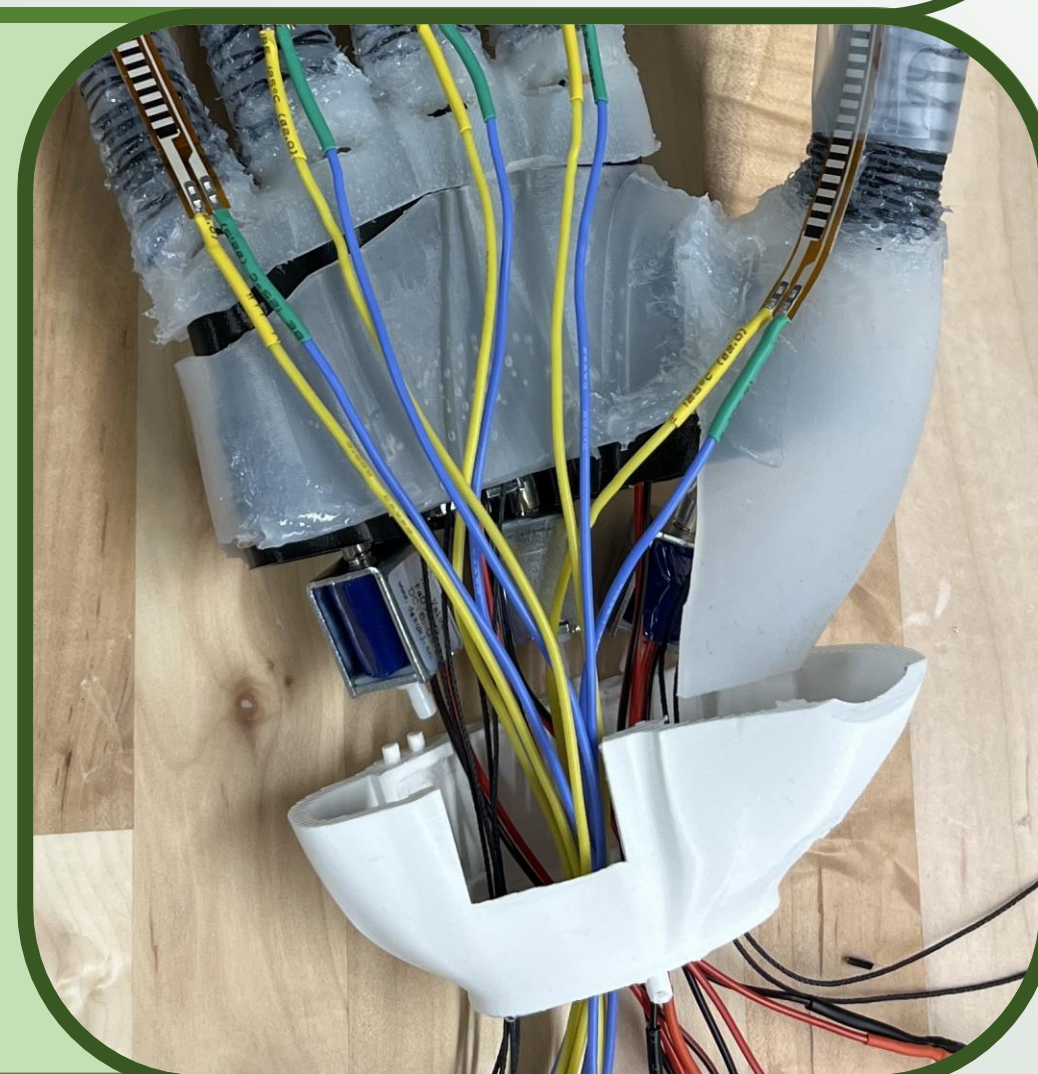
- Kevlar fits in the grooves and helically wraps around finger
 - Acrylic nails fit in divot at top
 - Flex sensor is attached to bottom of finger

Palm

Hollow palm bone houses air valves, wires, tubing and knuckle cables

Edge of palm bone acts as a fulcrum for the knuckles

2x thumb cables for mild splay

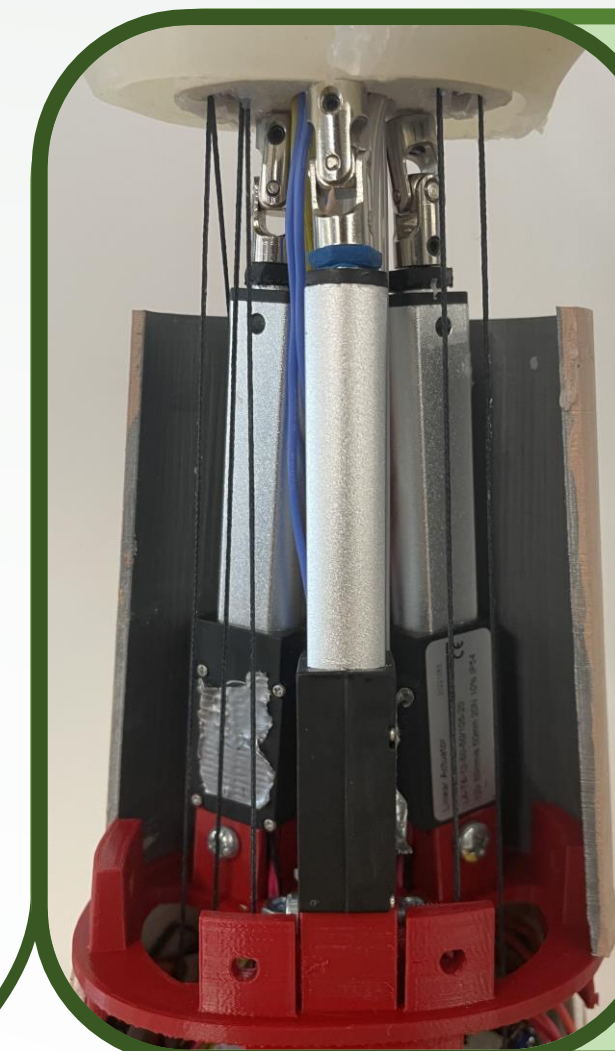


Wrist

3x Linear actuators

Running in parallel

2 degrees of freedom

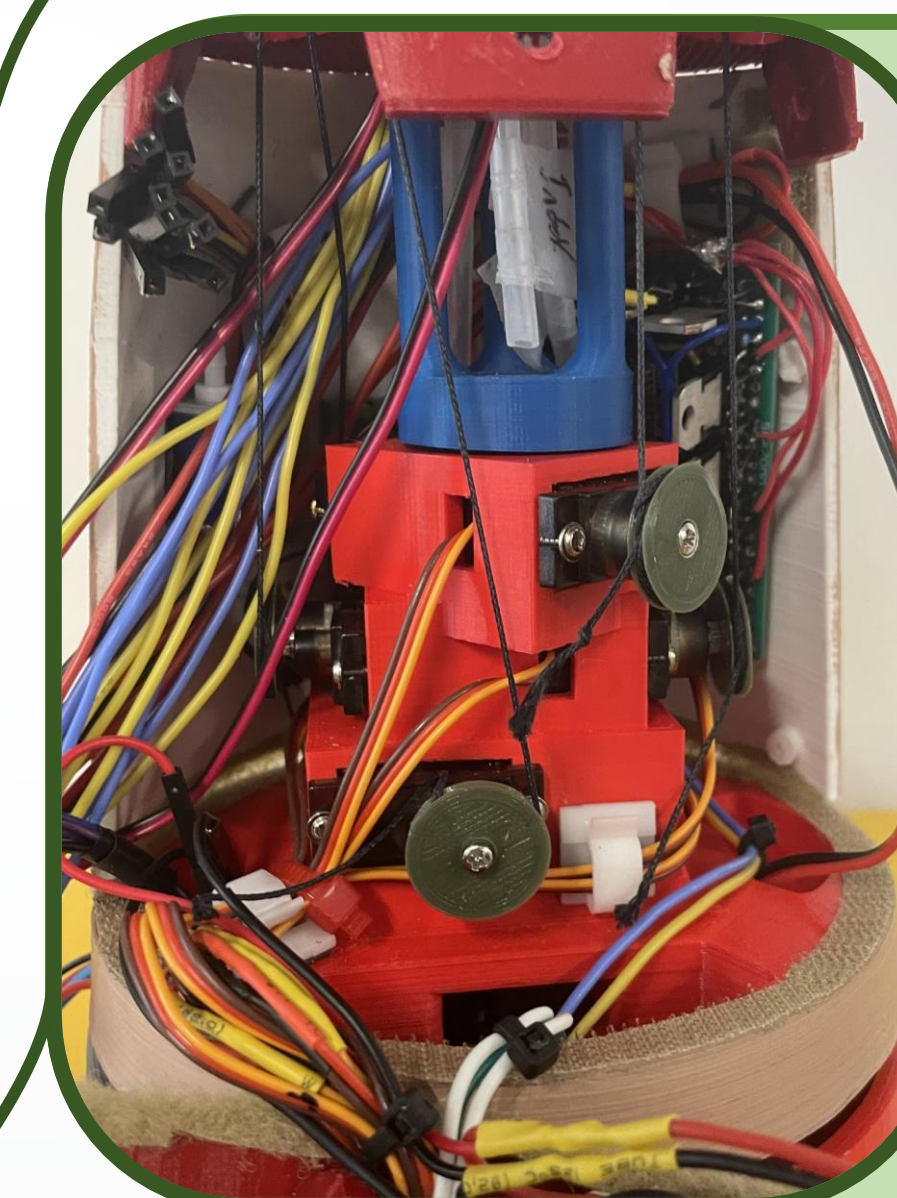


Knuckle Pulleys

Bends knuckles joints with cables

6x Servos (2x for thumb bend/splay)

2x ESP32s + electronics stored on walls

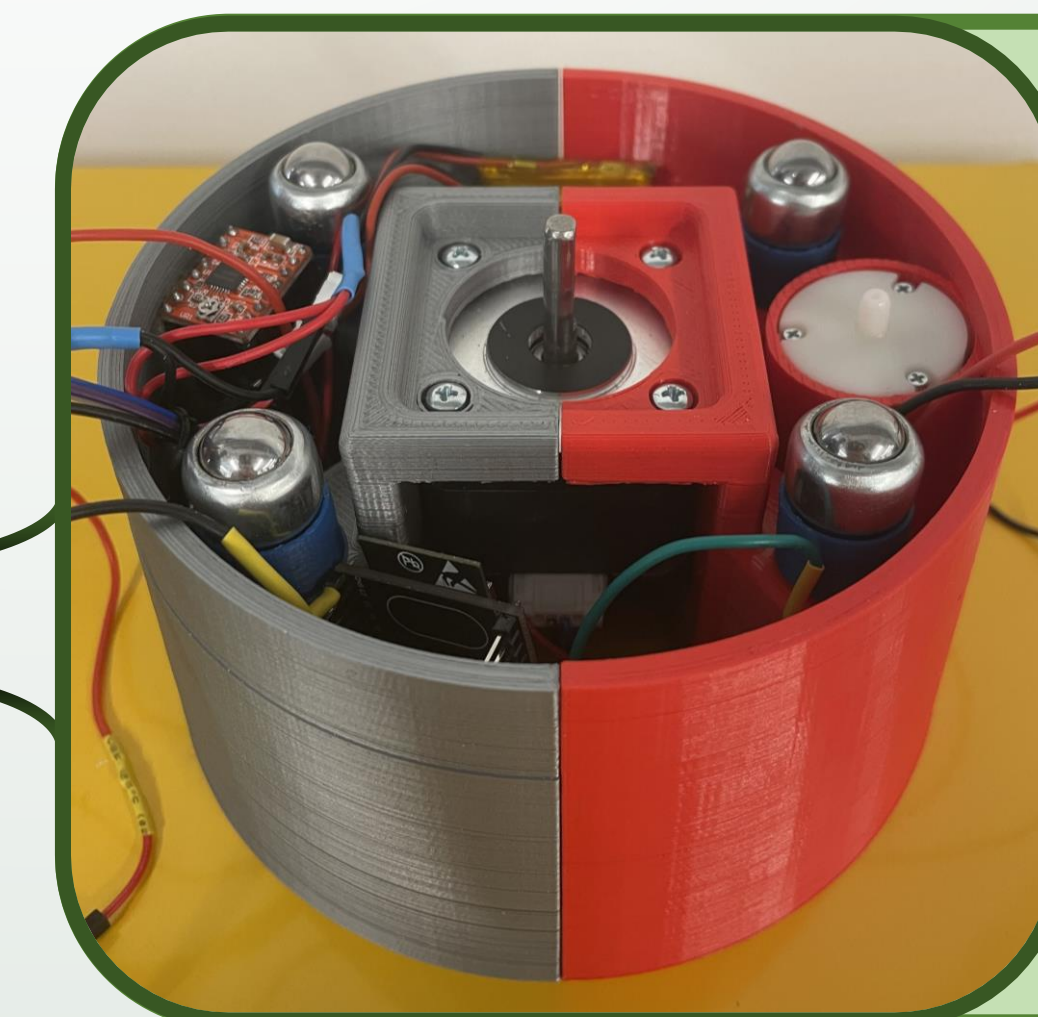


Forearm Turntable

Stepper motor provide-s 3rd wrist degree of freedom

4x bearings

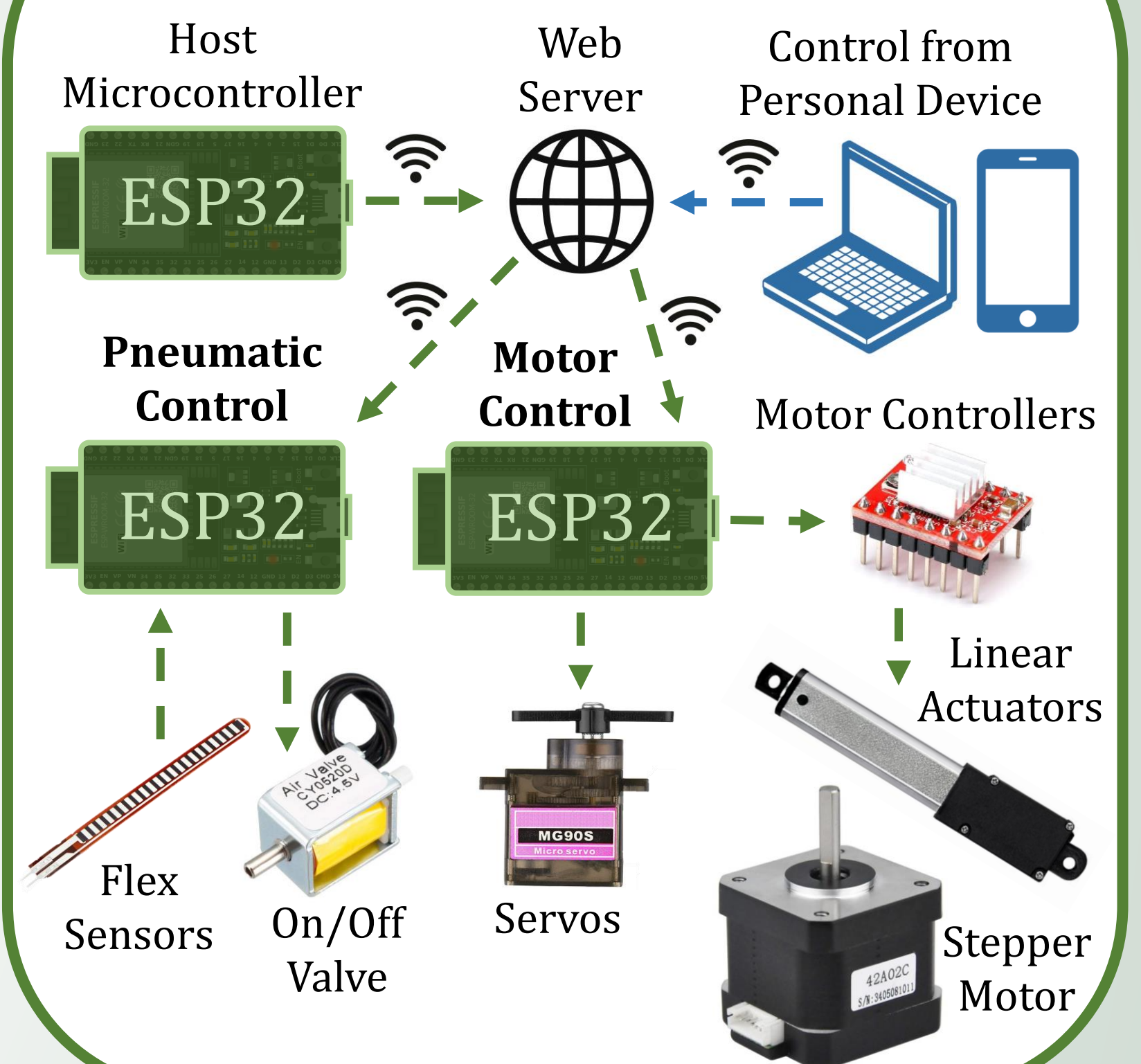
Stores batteries, air pump, few electronics



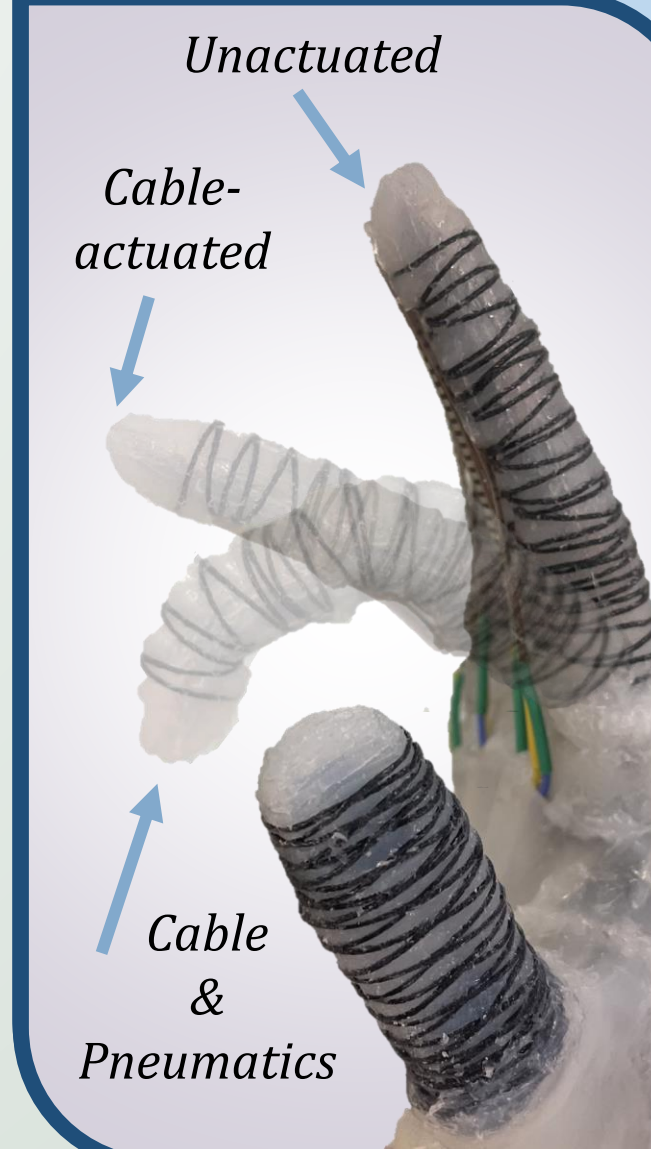
Objectives

- Design and create a realistic soft prosthetic hand*
- Mimic the motions of the human hand as much as possible*
- Integrate hard material to emulate the hand having realistic bones*

Software & Control



Results



- **Single finger strength of 1.2 N**
 - **Degrees of Freedom (DOF)**
 - 4x Fingers — 2 DOF
 - Thumb — 3 DOF
 - Wrist — 3 DOF
 - Total — 14 DOF
 - **Emulates look and feel of human hand**
 - soft outside and rigid PLA components imitating bones
 - **Fully-wireless and portable**
 - everything fits in arm and hand
 - accessible components
- Curvature of 25 m⁻¹**