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UNIVERSITY OF ALBERTA

Neuromuscular Control & Biomechanics Laboratory

DEVELOPMENT OF A LOW-COST LIGHTWEIGHT EMG-CONTROLLED TRANSRADIAL PROSTHESIS

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Motivation

0.5% of population need orthotic and prosthetic services

35-40M of people

(WHO, 2017) [1]

85-95% of people in need of

an orthopedic device such as a prosthesis or orthosis, **don't** have access to those

(WHO, 2017) [1]

1.57% Peruvians with arm or leg disability

(National Census - INEI, 2017) [2]

0.001% Peruvians with locomotion disability use a prosthetic arm

(National Survey Specialized on Disability - INEI, 2012) [3]

Motivation

Mechanical prosthesis
Price: $ 1.500 USD [4]

Aesthetic prosthesis
Price: $ 1.000 USD [5]

Prosthesis from the National Rehabilitation Institute (INR), Peru

Hero Arm Prosthesis, Open Bionics. Price: $ 6.600 USD [6]

Michelangelo Hand Prosthesis, Ottobock.
Price: $ 60.000 USD [6]

Myoelectric Prosthesis from International Market

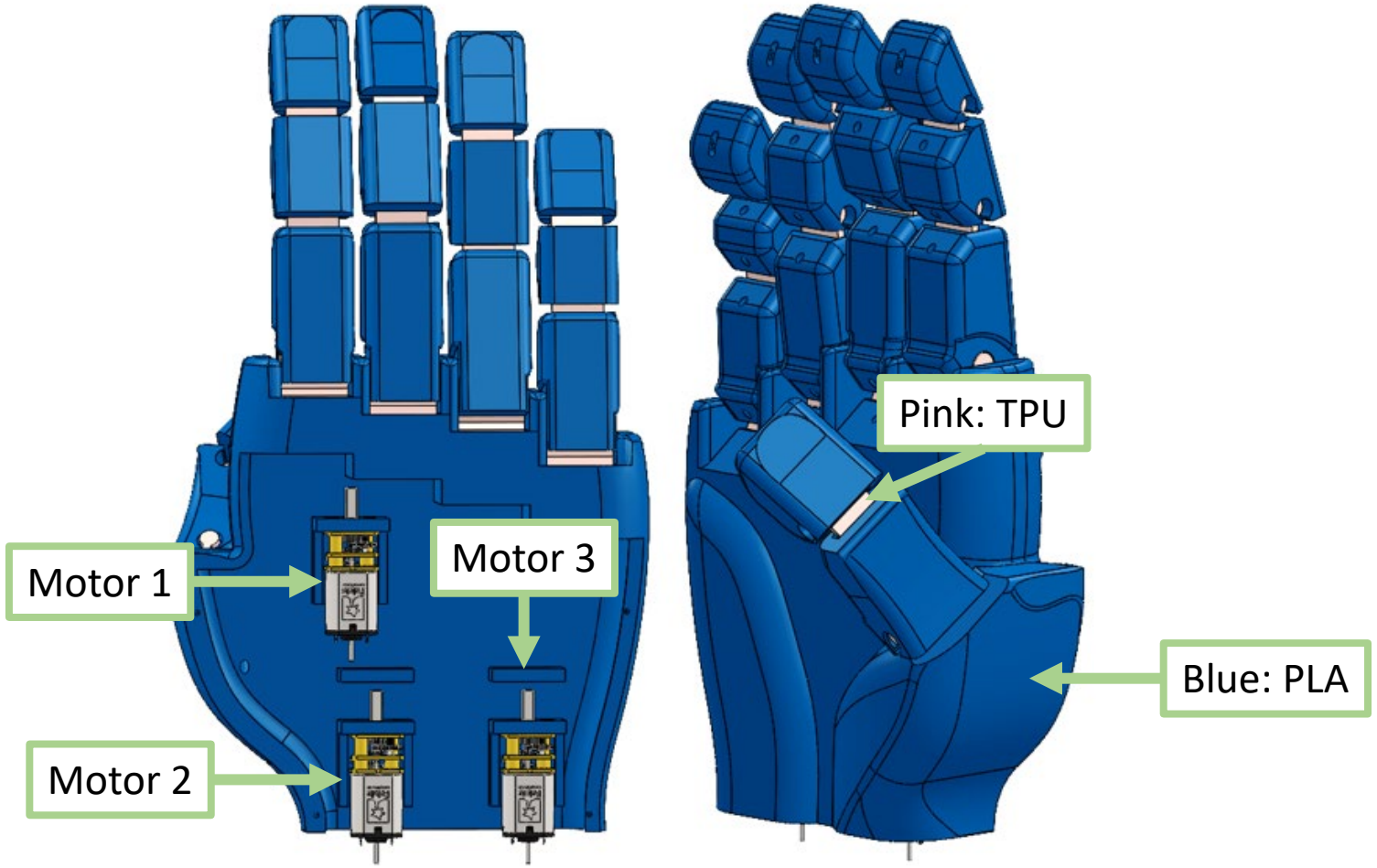
Justification

- **Accessibility:** less cost of implementation
- **Open source:** easy replication by maker community
- **Functional:** actuation system with myoelectric signal
- **Scalability:** fast updates with software

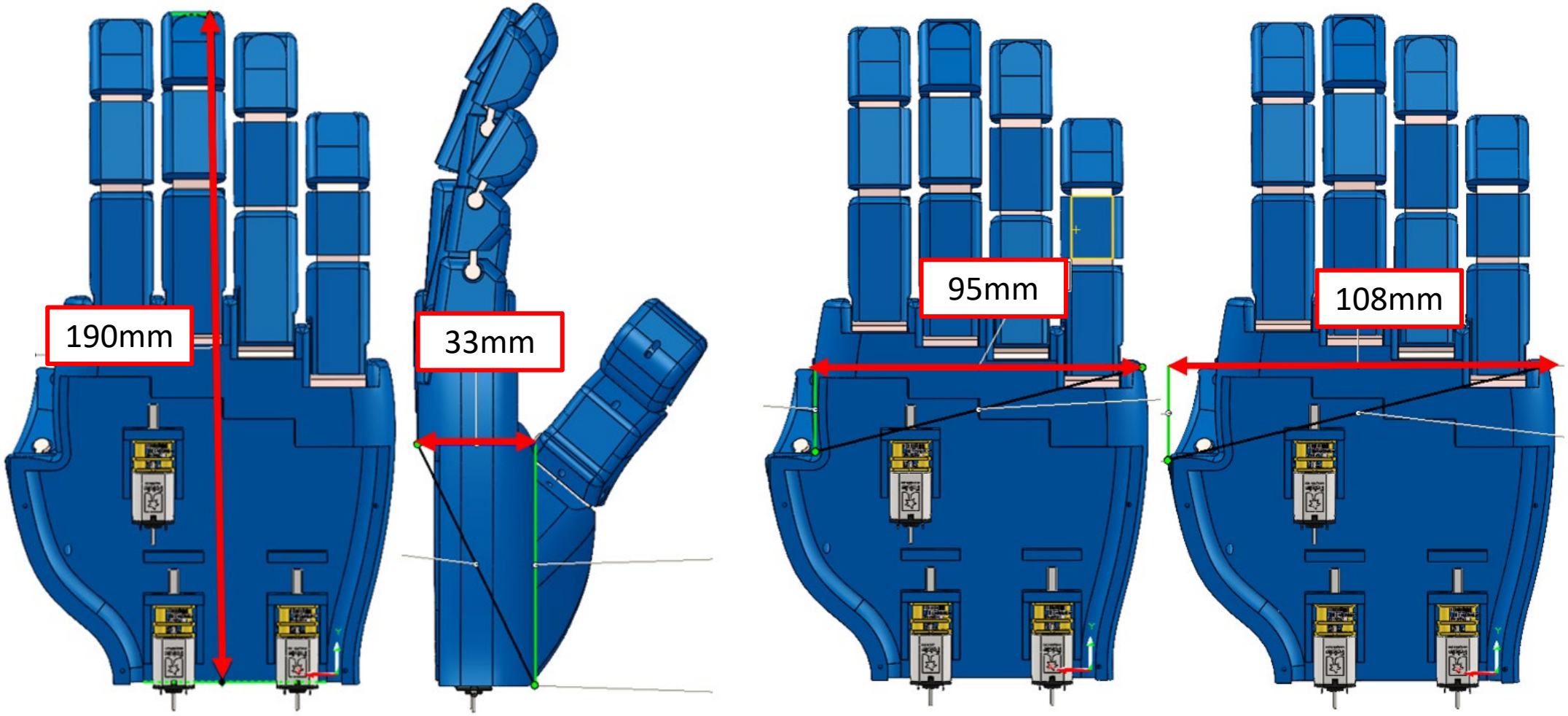
Objectives

- **Design** the **anthropomorphic prosthesis** with 3 degrees of freedom.
- **Design** the **electronic system** of the prosthesis.
- **Develop** the **control system** of the prosthesis using myoelectric signal classification.
- **Build the prototype** of the upper limb prosthesis from the designed components.
- Functionally **validate** the implemented **prosthesis**.

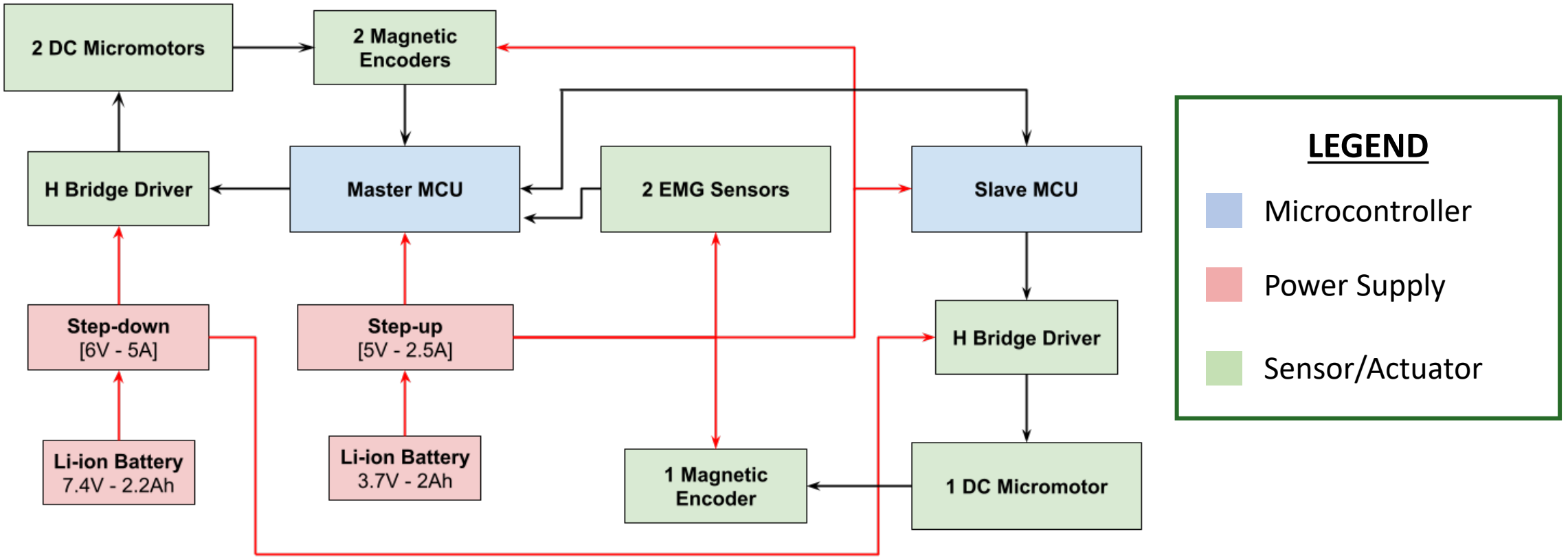
Mechanical design: SolidWorks assembly



Mechanical design: based on anthropometric data

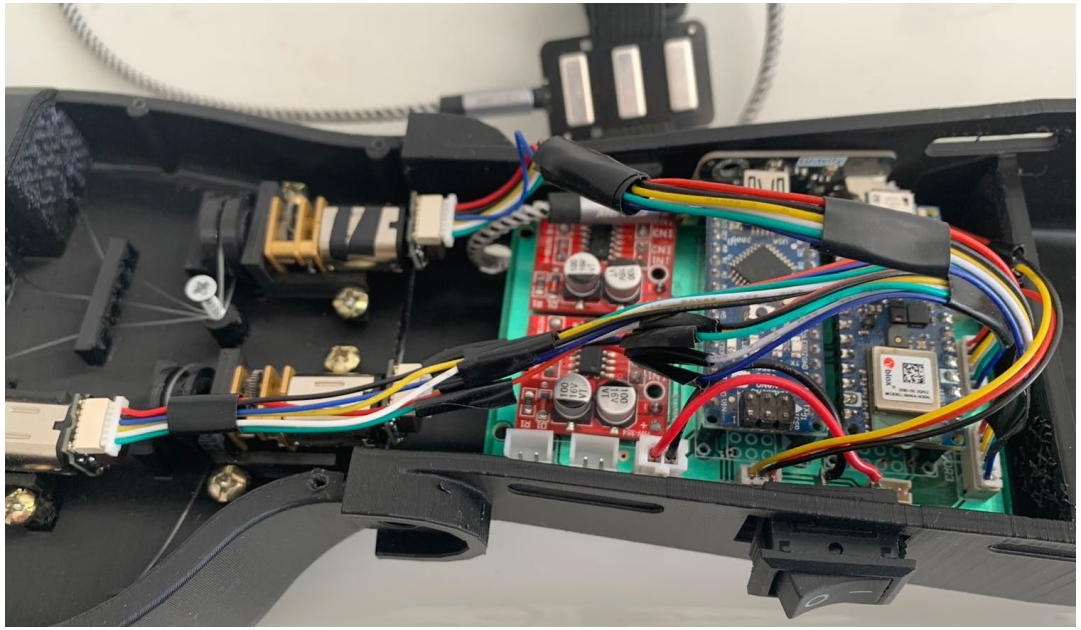


Electronic system: circuit diagram

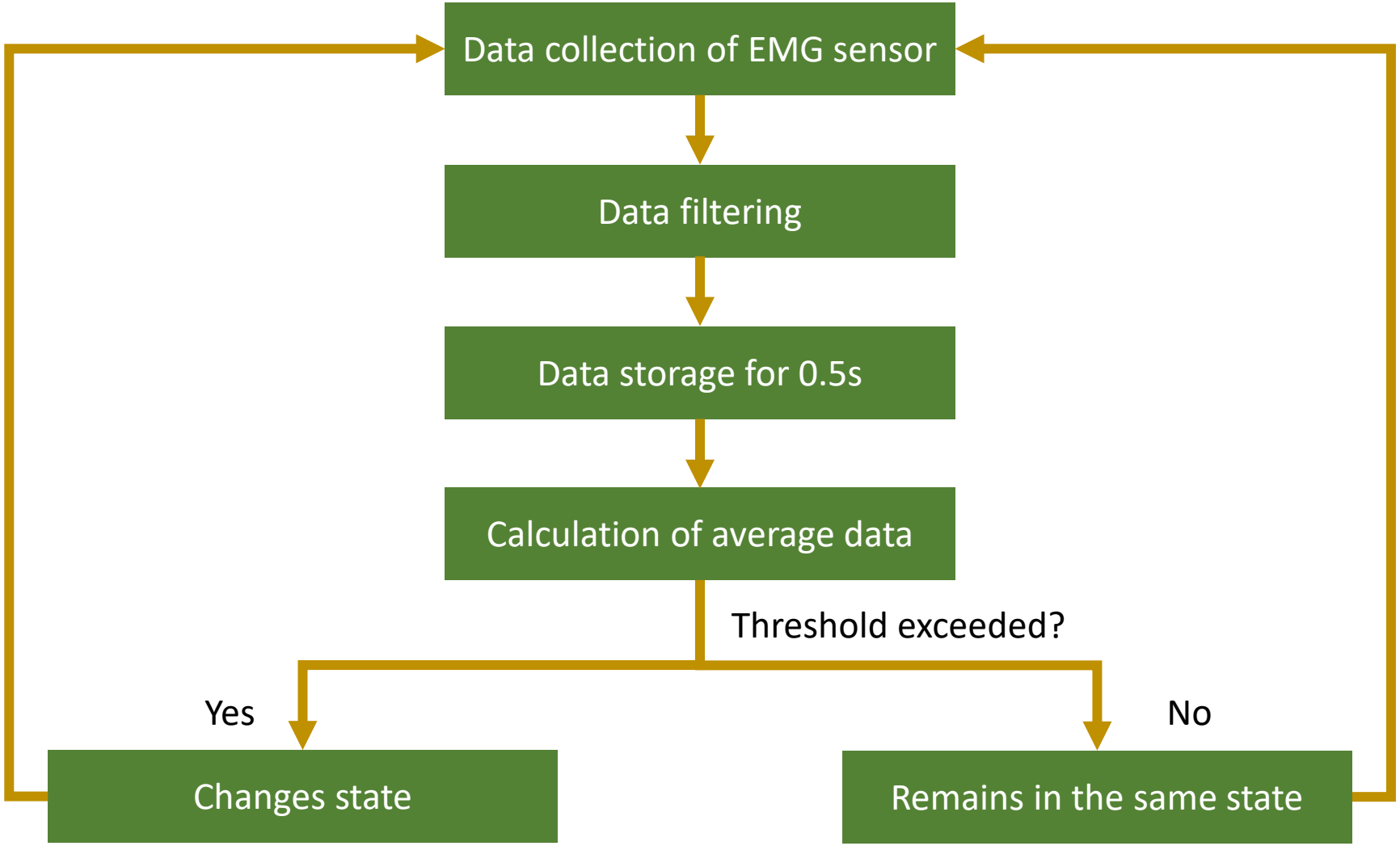


Electronic system: final circuit

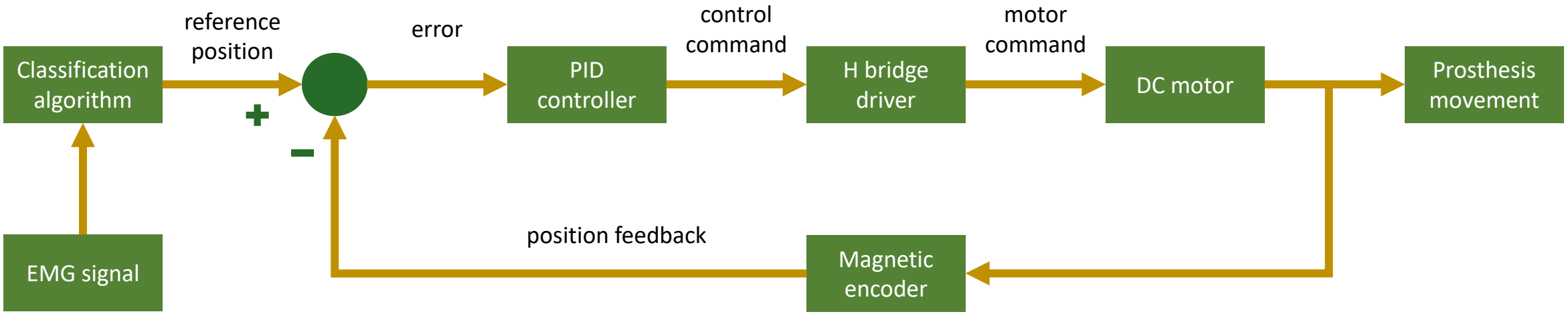
Printed circuit board (PCB) assembly results:



EMG signal: Processing Algorithm



Control System: Block diagram



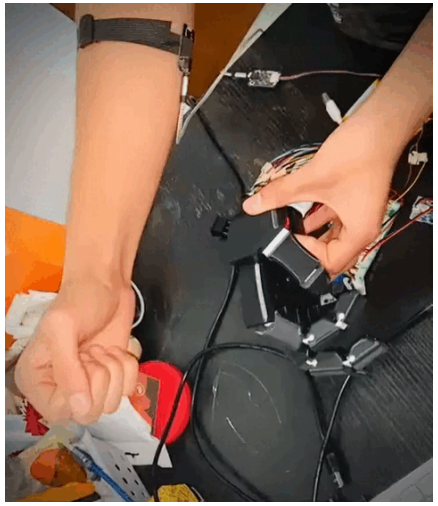
Fabrication: final cost of prosthesis

Service	Quantity	Unit Price	Cost
3D printing	65 hours	$ 2.00	$ 130.00
PCB printing	1 unit	$ 35.00	$ 35.00
		Total	**$ 165.00**

Material costs	$ 274.75
Service costs	$ 165.00
Total	**≈ $ 440.00**

Weight of the prosthesis

Prosthetic hand movement



Conclusion:

- CAD design of the anthropomorphic prosthesis with 3 degrees of freedom.
- Hand design similar to the average anthropometric measurements of the Latin American database.
- Prototyping: 3D Printing time of 65 hours.
- Final implementation cost for materials and service was $440.
- Total weight within the limits initially proposed: 716 grams.

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