technical proof of concept

Fall 2014

Intuitive Control & Feedback Prosthetic

Role: Electrical Engineering Lead

Responsibilities/ Skills:
battery selection, sensor selection, noise control, finite state controller, Arduino C, system integration, scrum

Website:
www.olinpoeprojects.wix.com/icfprosthetics

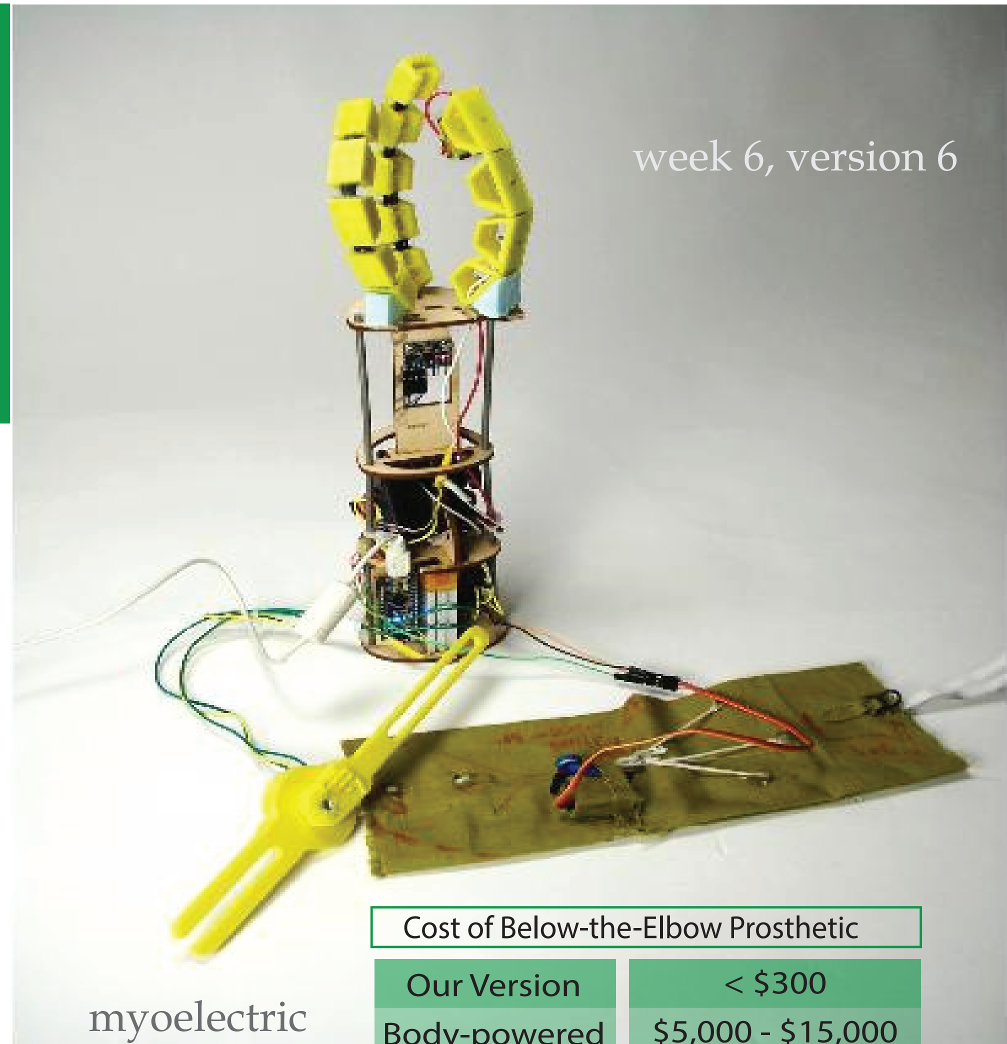
As a half-semester course project, our team of four challenged the price-intuitiveness trade-off in below-the-elbow prostheses. Our goal is to create a prosthetic arm with a more intuitive experience than a body-actuated prosthesis, without the expensive technology of a myoelectric prosthesis.

Our design and user experience has three components:

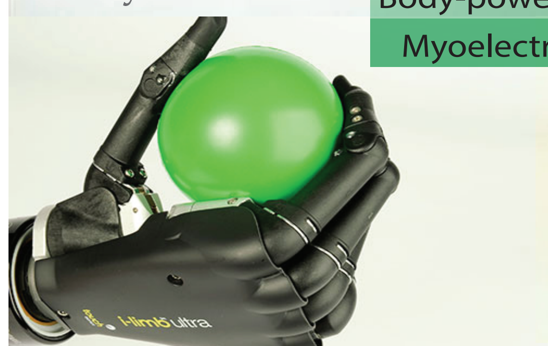
1. Sensors -- potentiometer reads angle of elbow
accelerometer reads arm position

2. Actuation -- Arduino processes data to determine
desired hand position/ begin gripping

3. Feedback to User -- piezoresistive sensors read grip
strength and Arduino tightens
arm cuff to match pressure



Cost of Below-the-Elbow Prosthetic	
Our Version	< $300
Body-powered	$5,000 - $15,000
Myoelectric	$15,000 - $80,000



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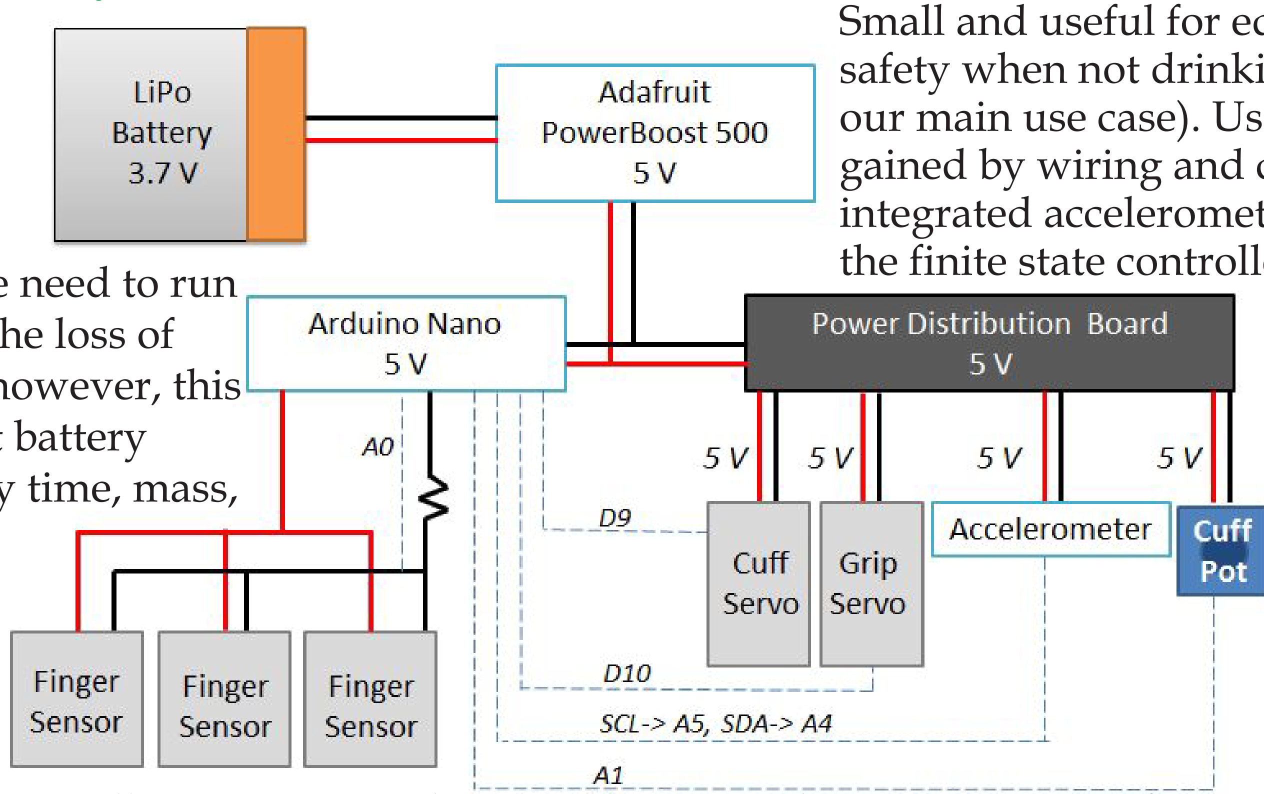
As electrical engineering lead, my main concerns for sensor and battery selection are price, portability (physical size, mass, power efficiency/ battery lifetime), and safety (including sensor reliability). The microcontroller (Nano) and accelerometer also became opportunities to delve into software.

Rechargeable 3-Cell LiPo Hybrid

Mass: 110 grams
Cost: $28
Capacity: 6000 mAh
Size: 19 x 54 x 60 mm
This battery gives less than the voltage we need to run the system. Even with the loss of power boosting to 5V, however, this battery gave us the best battery capacity for the delivery time, mass, volume and price.

Accelerometer (MPU6050) & Gyroscope

Price: $6
Small and useful for edge cases (for safety when not drinking from a cup, our main use case). Using familiarity gained by wiring and calibrating, I integrated accelerometer readings into the finite state controller.



Piezoresistive Sensors

Price: $15
Area: 4″x 6″
This kit uses a more durable version of Velostat, allowing us to make sensitive paper-thin piezoresistive finger pads in any desired shape.

The sensors were more sensitive than was useful, which we addressed through smoothing filters in software. Issues with creep and hysteresis were a concern, but were not critical for our purposes. Twisting the wires around each other cancelled out interference from sensors in close proximity to each other.