Internalization of a Nerve Lengthening Device
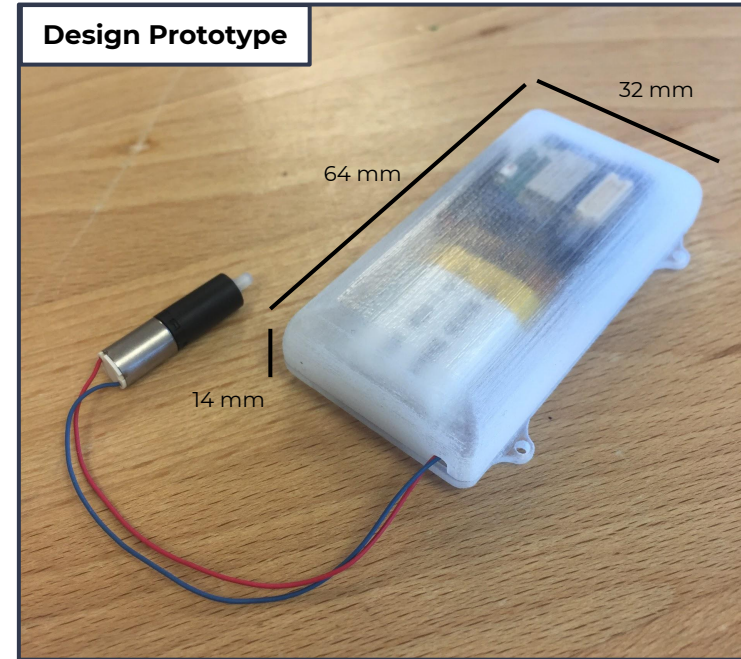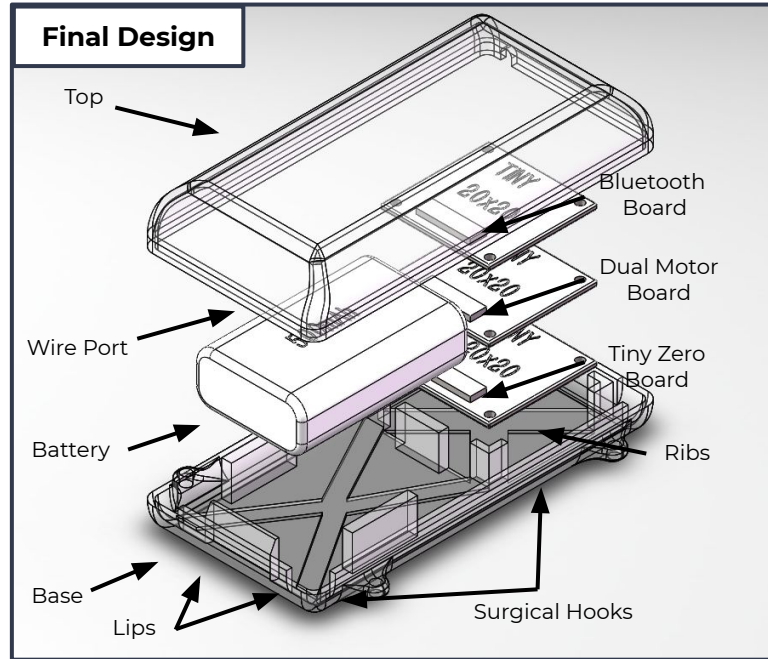
Sponsor: Professor Sameer Shah

Team 17:
Chikeng Dong
Ganesha Prawiraatmadja
Juan Maldonado
Pedro Cavalcanti

Our Problem: Exposed Wires

Nerve Lengthening Device

Early Prototype
Exposed Wires
Limited Space

Ganesha
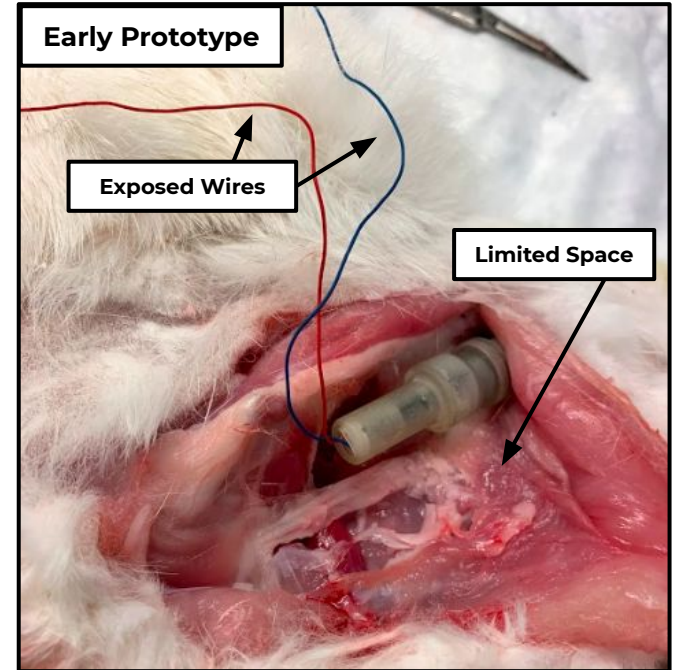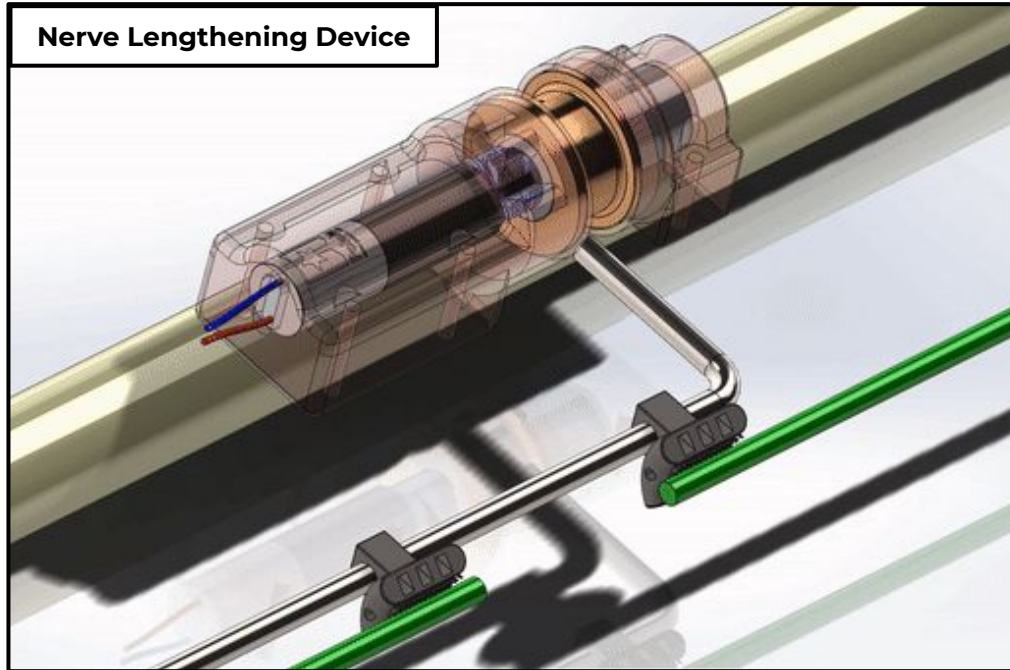
Our Solution: Implantable Motor Controller

Final Design

- Top
- Bluetooth Board
- Dual Motor Board
- Wire Port
- Tiny Zero Board
- Battery
- Ribs
- Base
- Lips
- Surgical Hooks

Design Prototype

- 32 mm
- 64 mm
- 14 mm

Ganesha

Enclosure Design

- Designed for subcutaneous implantation
  - Dimensions: 32 x 64 x 14 mm
  - No sharp edges

- Features:
  - Side Ribs: to secure components
  - Lips: to join top and bottom
  - Base Ribs: to strengthen base
 - Surgical Holes: to sow into

- 3D printed using ABS plastic.

Enclosure Design (Iteration 12)

Chikeng
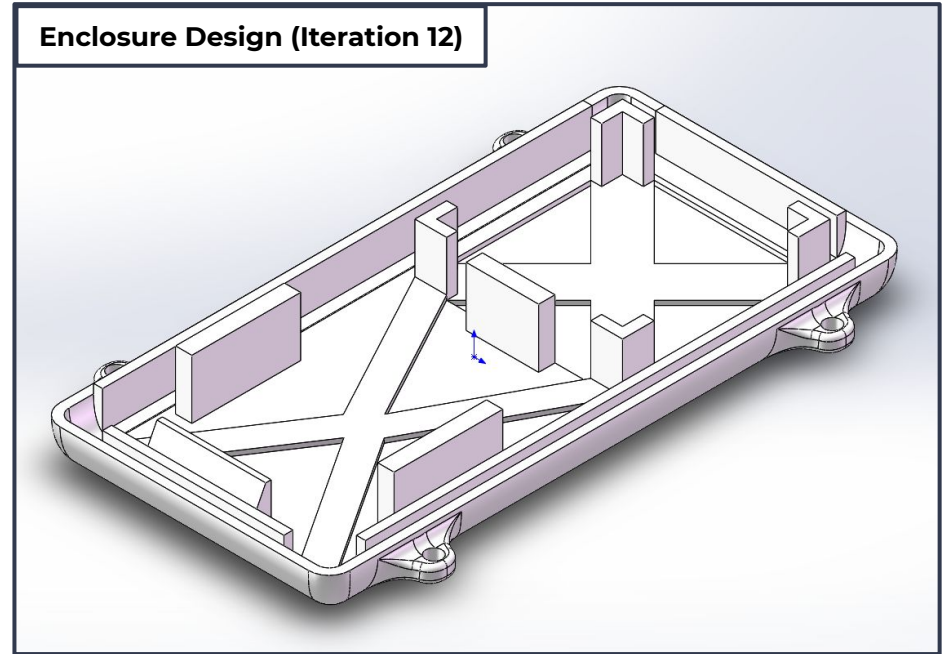
Enclosure Implantation Results

Subcutaneous Implantation

Layer of Skin

Muscle Under Skin

Subcutaneous Implantation

Resulting Bump

Chikeng
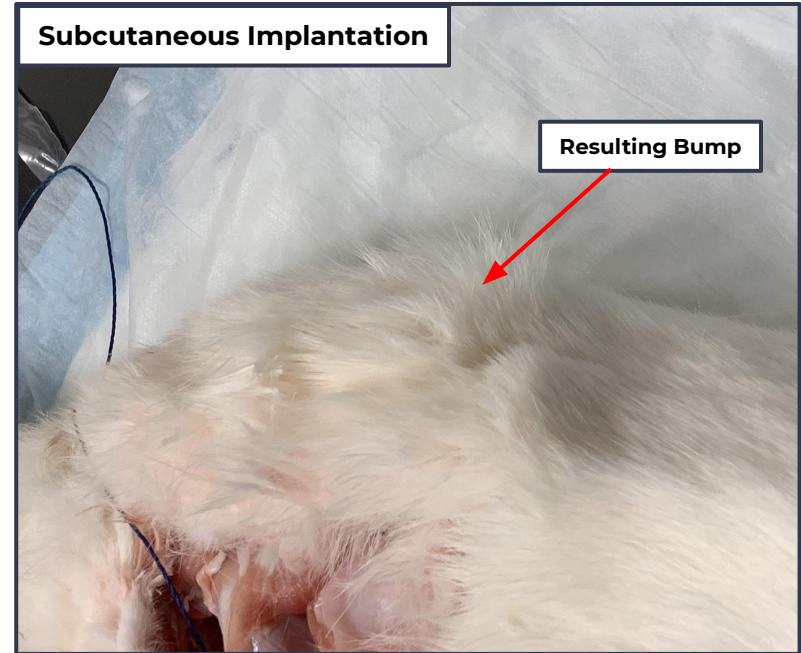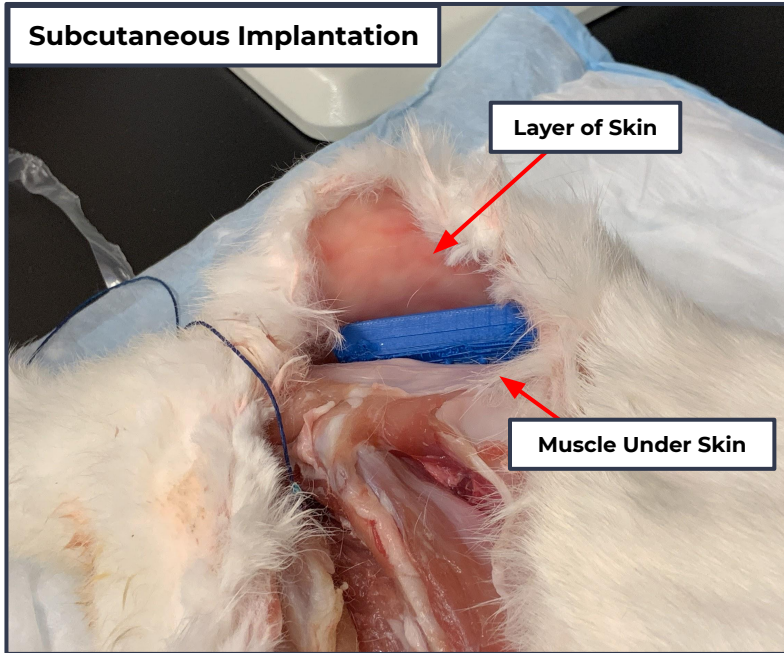
Motor Controller

- Selected Motor Controller:

  Dual Motor TinyShield

- Controllable Parameters:
  - Speed
 - Operation time
  - Direction

Juan
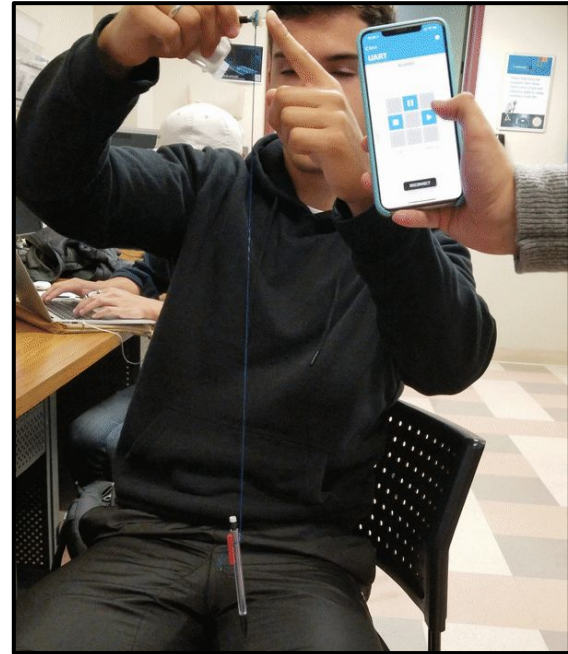
Bluetooth Connectivity

- Enables actuation of device using an external device via bluetooth

- Availability of bluetooth programed to be active for certain periods of time

- Signal of bluetooth board is strong enough to pass through layers of skin and tissue
 - The signal is reliable within a 5 feet radius

Rabbit Skin Test

Pedro
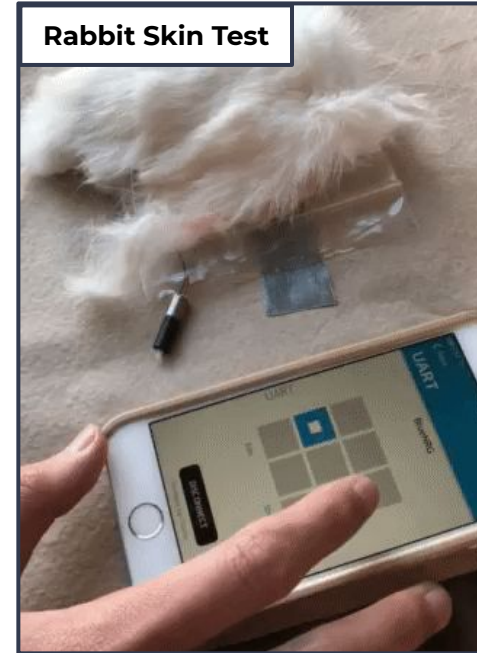
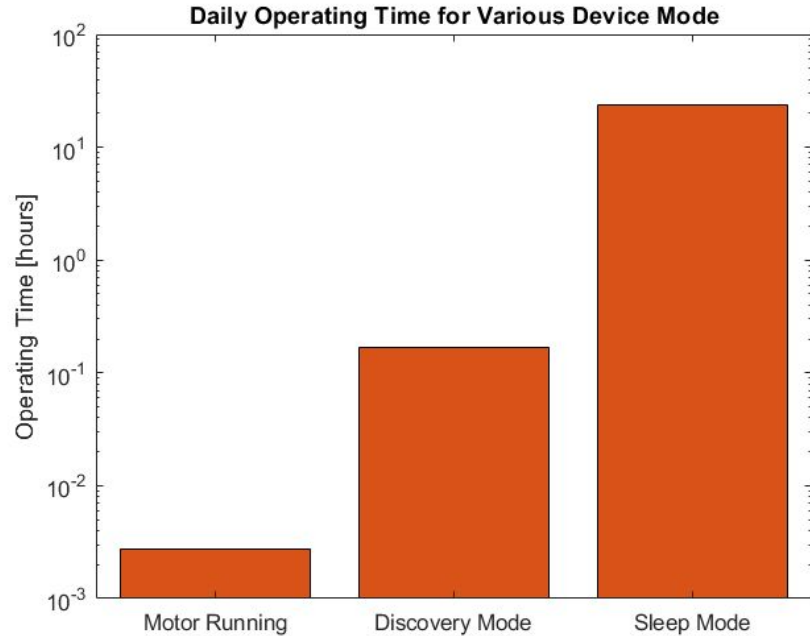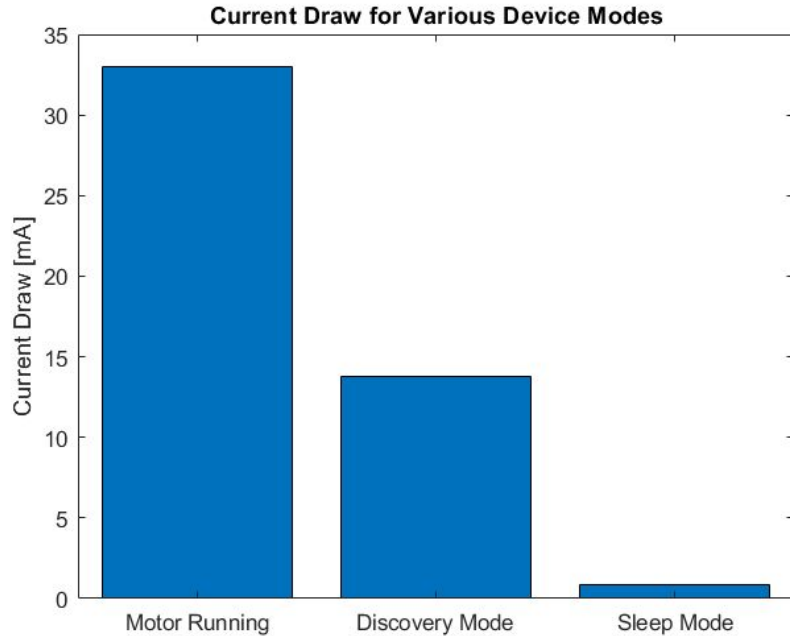# Bluetooth Connectivity Results

Pedro
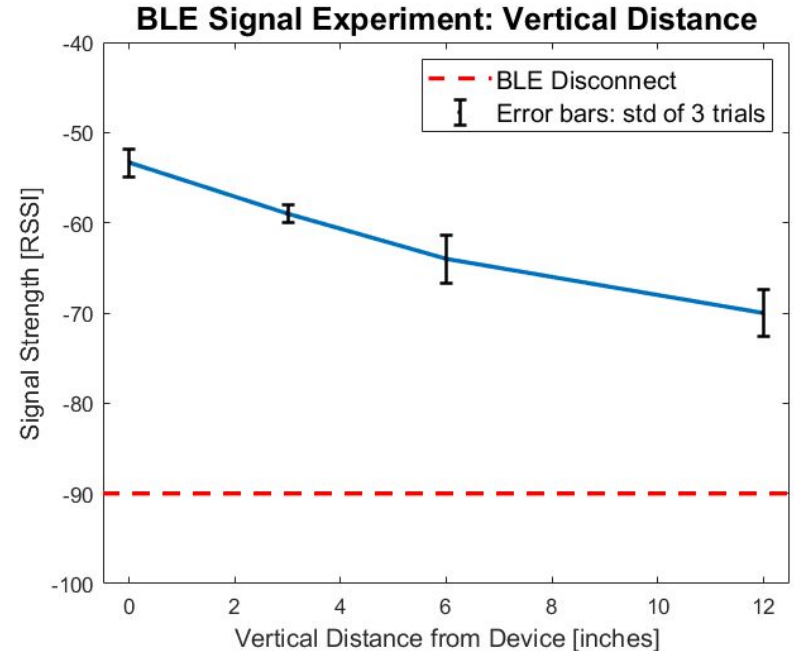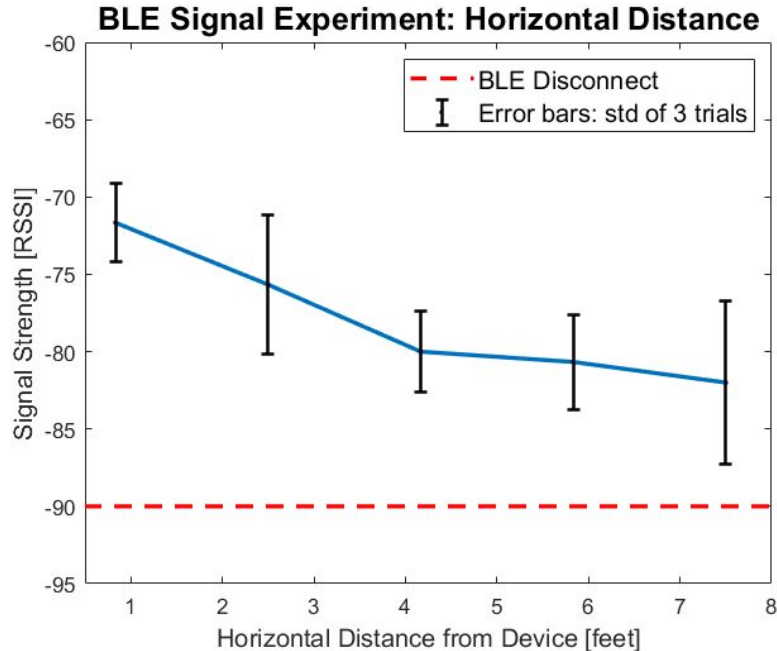
Power Consumption

- Power Consumption Analysis
  - Battery Capacity: 500 mAh
  - Procedure Duration: 14 days
  - Total Power Required: 313.06 mAh
  - Factor of Safety: 1.6

- No re-charging or battery replacement is required

- Potential to reduce power required even further
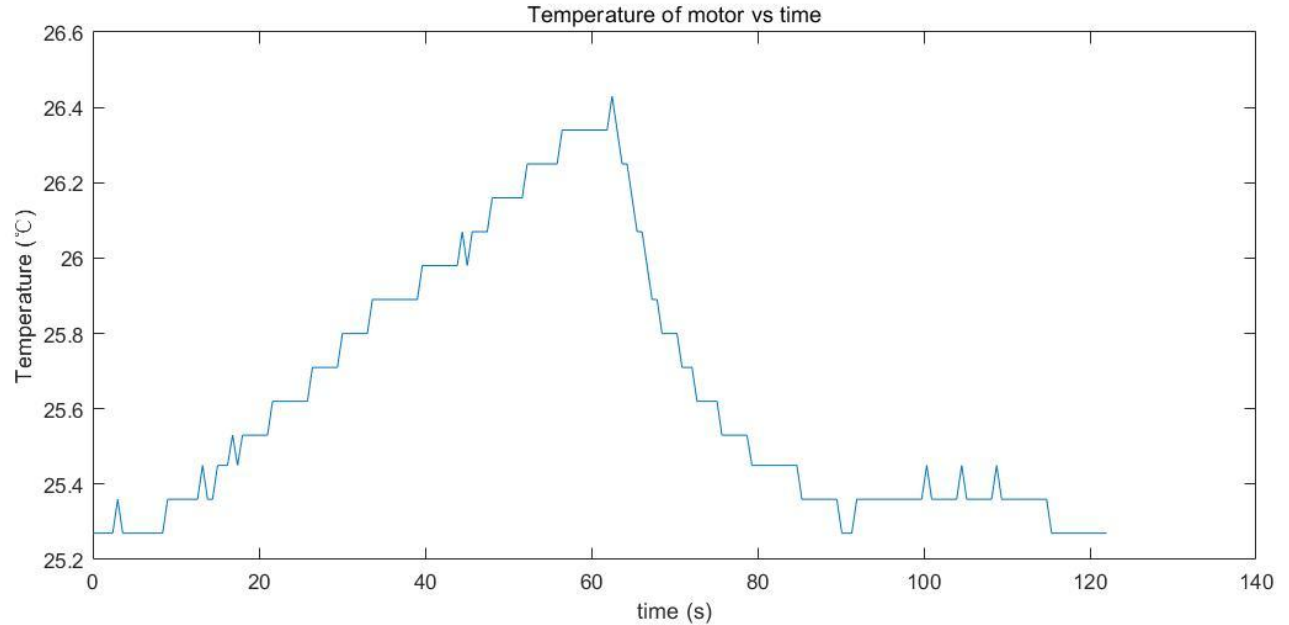

Power Testing

Juan
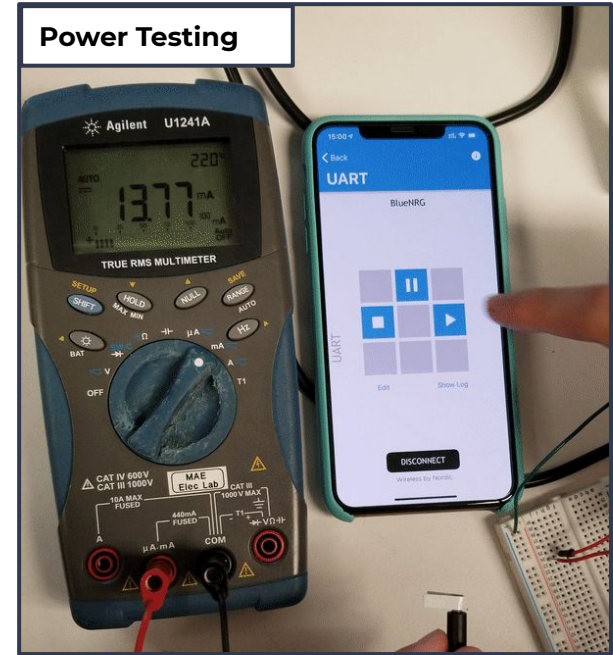
Power Consumption Results

Juan

Heat Generation Test

- Negligible change from boards

- Negligible change in temperature for short actuation periods

- Change in Temperature:

  1.1 °C / min

Temperature of motor vs time

Chikeng

Next Steps For Human Implantation

- Silicone conformal coating on internal components
  - Glue everything in place
  - Waterproof electronics

- Parylene coating on all external faces
  - Biocompatible protection from external environment

- High quality stepper motor
  - Provides more control of the strain rate
  - Requires new motor housing and arduino code

- External controller tablet with bluetooth connection
  - Requires graphical user interface

Ganesha