Thesis Topic

Design of a Novel, Non Invasive Computer Brain Interface For The Intuitive And Proprioceptive Control of Prosthetics And Other Robotic Systems

Project Overview And Current Status

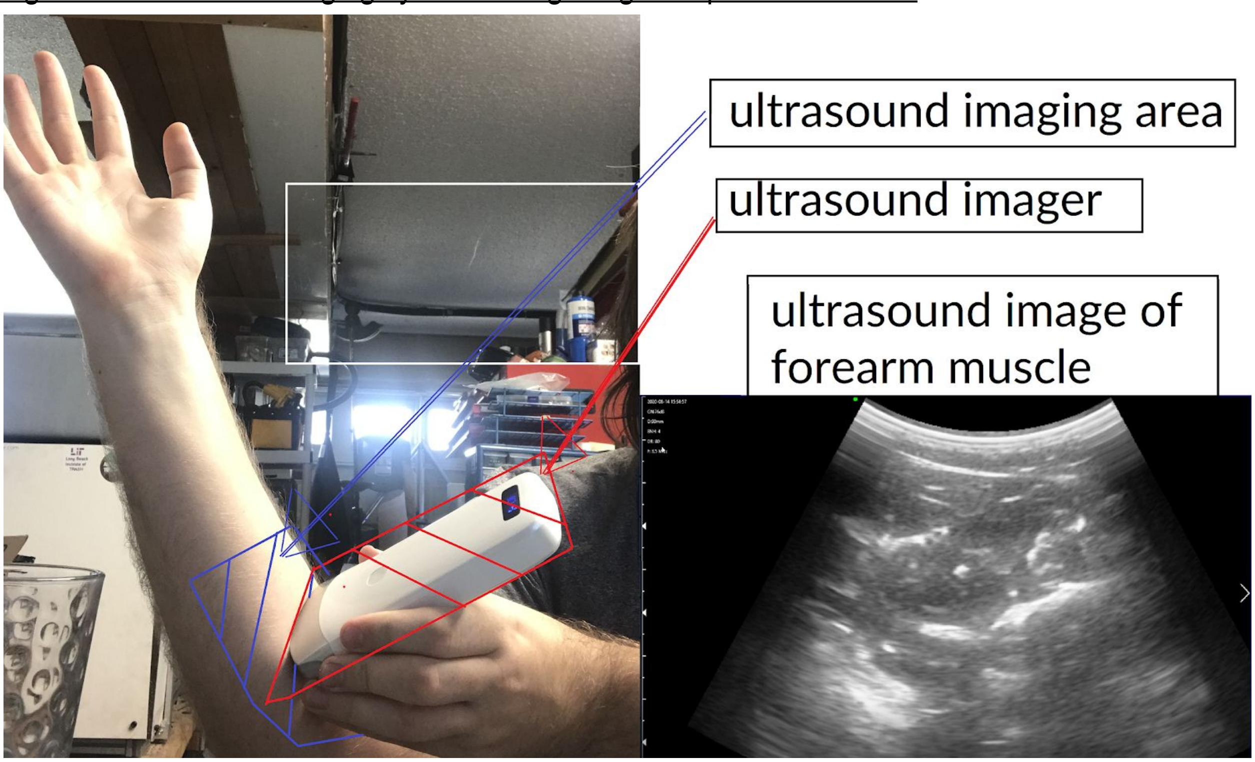
Non-invasive Computer Brain interface:

Control System

This control system will consist of an ultrasound scanner and a computer to process the images from the ultrasound scanner and turn them into position commands for a robotic system. (figure 1)

Example: Patient with this system forms a closed fist with their hand, the ultrasound imaging system will transmit an image of their forearm muscles to a computer with a preprogrammed neural network on board. This computer will then use a neural network to determine that the patient's hand is closed, and then signal the robotic prosthetic to close its fingers.

Figure 1: Ultrasound imaging system taking images of patients forearm



Current Progress: I have sourced an low cost ultrasound imaging system and I have used it to generate sets of images for training a neural network to classify ultrasound images of my forearm muscles into two groups: open hand, or closed hand

Our neural network has been successful at identifying between open and closed hand images (figure 2). We are now working on implementing this system to perform real time pose estimation between 100 different poses vs the current two that we have had success with.

Figure 2: Neural Network Classifying Images Between Open And Closed Hand
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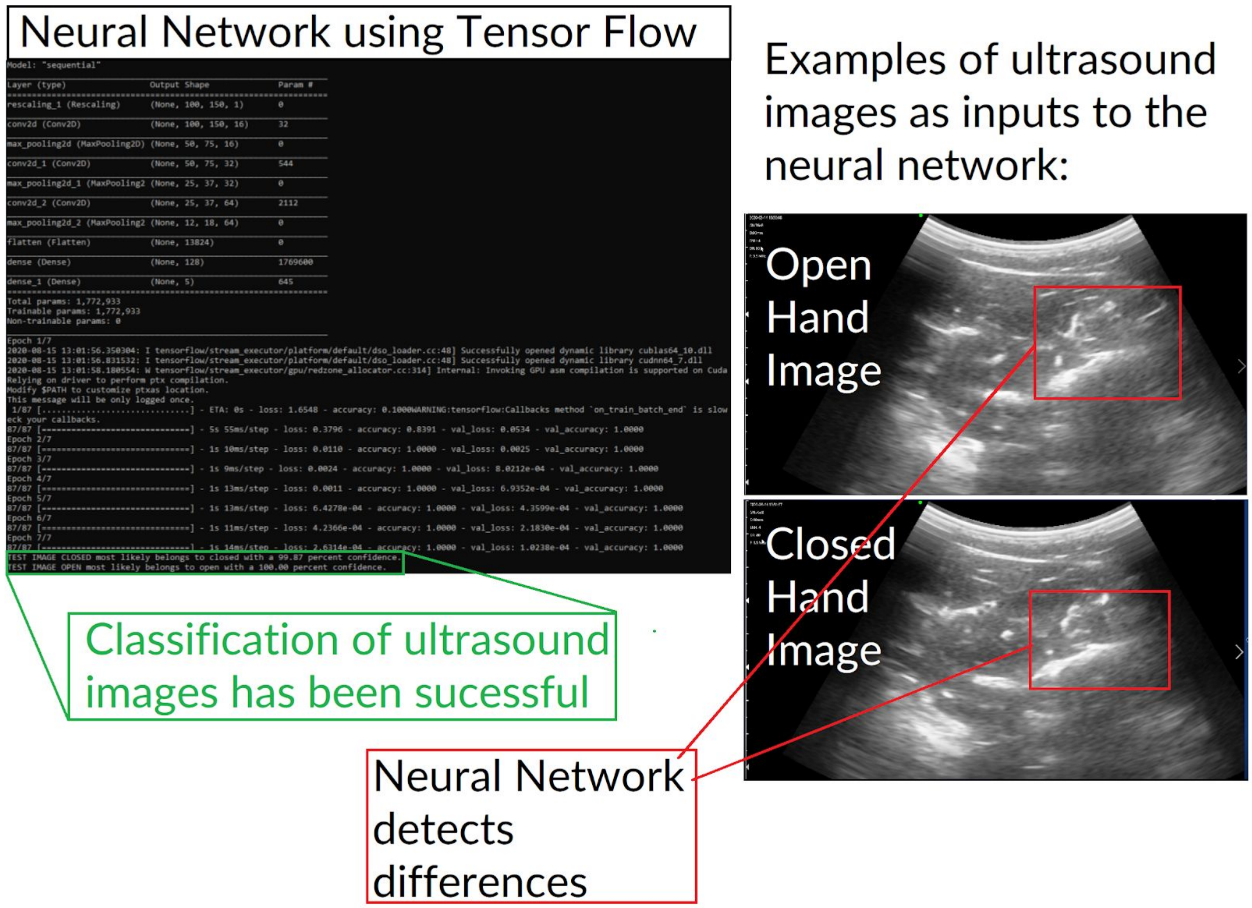
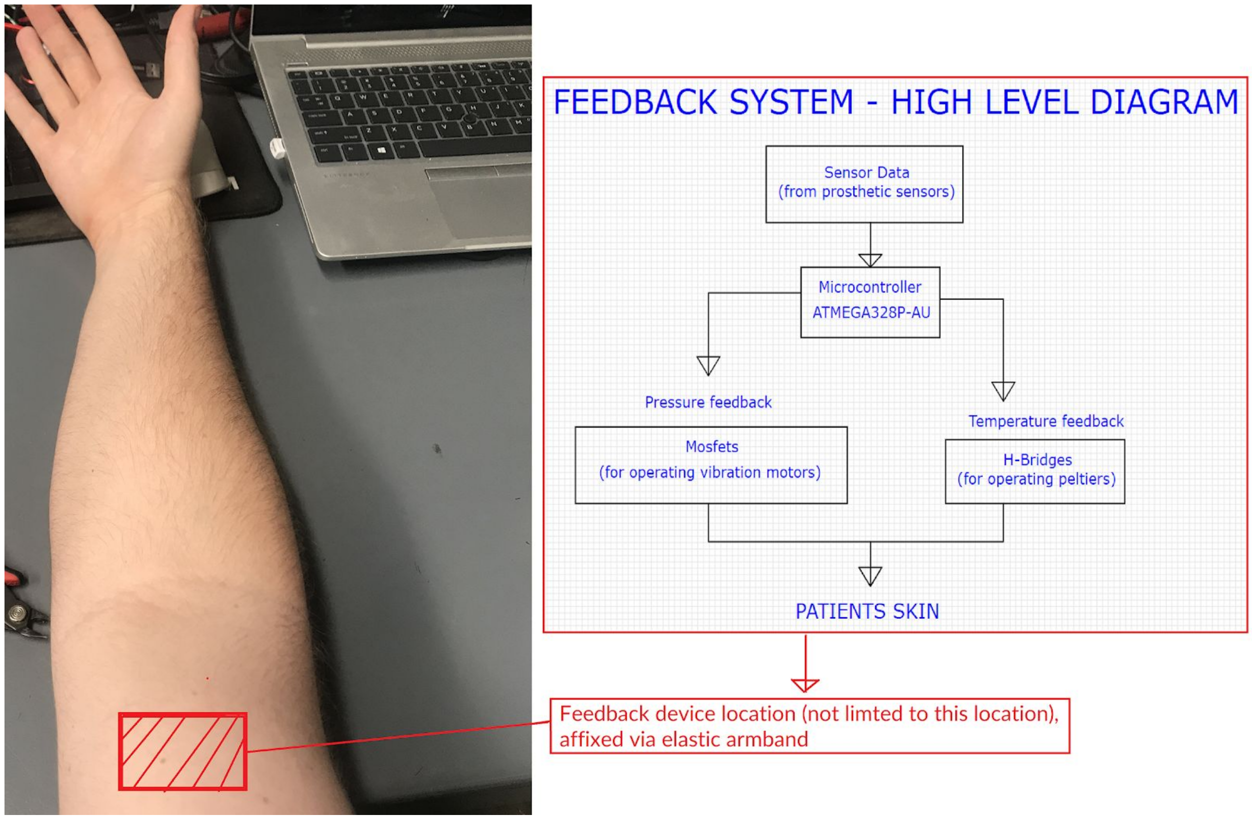


Feedback:
This feedback system is placed on the top of the patient's skin (preferable on their arm, but not limited to that location) and is used to transmit data from the prosthetic to the person.

Example one: The prosthetic finger touches a hot stove --> The patient feels a hot sensation on their skin that lets them know their prosthetic is touching a hot object. Example two: The prosthetic finger is pressing very hard against the surface of a table ---> The patient will feel a strong vibration (haptic feedback) on their skin indicating they are pressing hard on the surface. A high level diagram of the function of the device that will provide feedback to the human can be seen here in figure 3.

Figure 3: High Level Representation of Feedback System



Robotic Prosthetic hand (Our project needs a robotic system to be able to prove the computer brain interface works as designed)

This robotic prosthetic has already been constructed (figure 4) It is based of my previous work on robotic prosthetics that can be found here: https://ggalisky.weebly.com/biomimetic-hand.html

Upcoming tasks: Redesign fingertips to integrate pressure and temperature sensors.

Figure 4: Robotic Prosthetic Hand