Gesture Recognizing Robotic Hand

Term Project

ENSC 424 -Multimedia Communications Engineering

Jordan Lei | jla522 | 301303060
Victor Lance Luz | vluz | 301320949
Ramish Khan | ramishk | 301321100

Introduction

Affordable prosthetics has been a popular area of development as of the last few years, we would like to build onto this with our term project. Our team's ENSC 424 Multimedia Communications Engineering project will involve deep learning concepts to design a hand gesture recognition device that will perform commands based on the user's hand gestures. Hand gesture acts as a medium for nonvocal communication to express meaningful commands. Survey studies done on human-computer interaction have concluded that appearance-based gesture representations are preferred over 3D-based gesture representation due to their simplicity [1]. A technique that we will use for gesture recognition is using it in conjunction with an artificial neural network.

Project description

We are building a hand gesture recognition system and pairing it with a 3D printed robotic hand [2]. The reasoning for the hardware addition is for a more comprehensive and visual representation of our progress, and showing a real life application where our project would be needed. The prosthetic will be controlled via a microcontroller and the image recognition will be processed on our personal computers, with a wired serial communication between the two devices.

The end goal is to have a neural network which we have built and trained ourselves which can recognize a predetermined number of hand gestures, which will then be seen mirrored in real-time by the 3D printed prosthetic. With experience utilizing pre-trained models to control a small autonomous vehicle, we are confident we can complete this ambitious project. Should we run into issues we will move into either a pre-trained model or train an existing network.

The hardware will consist of the mechanical components such as the 3D printed parts, and strings, and electronic components such as the motors and microcontrollers. The hand is an open source design [3], and we are designing the mechanism in the forearm to control the fingers. We are near completion of the hardware and starting the software.

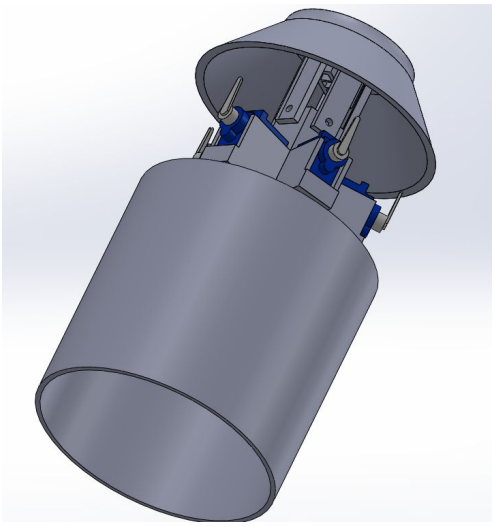
Project plan

Milestones

1. Project Proposal Due October 18, 2020
2. First hand model Due October 30, 2020
3. Functional robotic hand Due November 10, 2020
4. Completion of gesture mirroring robotic hand Due November 30, 2020
5. Project Presentation Due December 7, 2020
6. Final Project Due December 11, 2020

Partition

- Jordan Lei will be involved in the manufacture of the 3D-printed hand prototype, the hardware test validation, and assisting with the neural network development.
- Victor Luz will be involved in the neural network development using PyTorch library, and software test validation.
- Ramish Khan will be involved in the complexity analysis, and the development of the neural network.



Figures 1 & 2: Current progress photo [3] and Solidworks sketch of our design

References

[1] H. Hasan and S. Abdul-Kareem, “Human-computer interaction using vision-based hand gesture recognition systems: a survey, ” *Neural Computing and Applications,* vol. 48, p. 251-261, August 2014. [Accessed: October 16, 2020]
Available:
https://link-springer-com.proxy.lib.sfu.ca/article/10.1007/s00521-013-1481-0#citeas

[2] Mohammadi, A., Lavranos, J., Zhou, H., Mutlu, R., Alici, G., Tan, Y., . . . Oetomo, D. (2020, May 14). A practical 3D-printed soft robotic prosthetic hand with multi-articulating capabilities. [Accessed: October 18, 2020]
Available: https://journals.plos.org/plosone/article?id=10.1371%2Fjournal.pone.0232766

[3] Thingiverse.com, “Robotic Prosthetic Hand by grossrc,” *Thingiverse*. [Online]. [Accessed: 18-Oct-2020]
Available: https://www.thingiverse.com/thing:1691704