

## Project Proposal

### Basis:

Ergonomic robotics are oftentimes very useful in daily life. Unfortunately, they can also be extremely difficult to use and program for the average user. This project aims to simplify that gap by integrating two distinct modes, for voice-control and gesture-control respectively, with a robotic arm platform to make it easier on end-users to control and make practical use of the arm.

### Problem-Solving Approach:

The approach will use a microphone for voice processing and web camera for hand tracking. The microphone data will be processed through the Google Speech API, whereas local color/blob detection will be performed on a dynamically calibrated reference tag to simulate tracking a hand. The Python code will take this data and output either a newly detected mode (from voice) or normalized hand coordinates in the arm's reference frame (from computer vision) to a socket, which is read in by a MATLAB script to then perform the specified actions with the arm.

### Subdivision:

The project is mainly composed of three parts.

1. Voice Control: This part of the project involves streaming data to Google Speech API, matching those words in a bank, filtering out the differences between modes and poses, and (if applicable) translating poses through a socket for the arm to interpret.

2. Hand Recognition: This part of the project involves color/blob detection using OpenCV and a ton of trigonometry. It will threshold based on color, use the known pixel to area ratio of the tag to simulate depth data, then use the tag's center coordinates to control the robotic arm.
3. Robotic Arm Manipulation and Integration: The finer details of the specific motion tracking profile will be done by studying kinematics and understanding how to output my specific gesture-interpreted angles/controls to the arm. Through normalization, these commands will be easily transformed to the robot arm's frame and allow the arm to be run by running two scripts.

The problems will be solved in this order, in increasing complexity. It is also organized this way to get more familiarity with the specific topics, as I am most familiar with voice control, then computer vision, and finally kinematics.

#### External Tech:

This project will utilize the following libraries:

1. OpenCV
2. HEBI Manipulator Optimization Libraries
3. Threading
4. Socket
5. PyAudio
6. Speech Recognition