## Engineering Requirements

The system must:

- Draw faster than four inches per second.
- Draw a ten inch straight line within a half inch error margin.
- Use a SCARA topology for the robotic arm, with two rotating joints to control arm actuation.
- Receive Gcode commands to control the robotic arm through a Matlab GUI.
- Not take more than 15 seconds for the operator to mount a writing utensil to the robotic arm.
- Use electromyography (EMG) sensors to determine muscle contraction with a delay of at most 500 milliseconds between muscle contraction and robotic arm movement.
- Use an accelerometer to determine the direction of the line drawing with fist up equal to 0 degrees, vertical equal to 180 degrees, and fist down equal to 360 degrees.

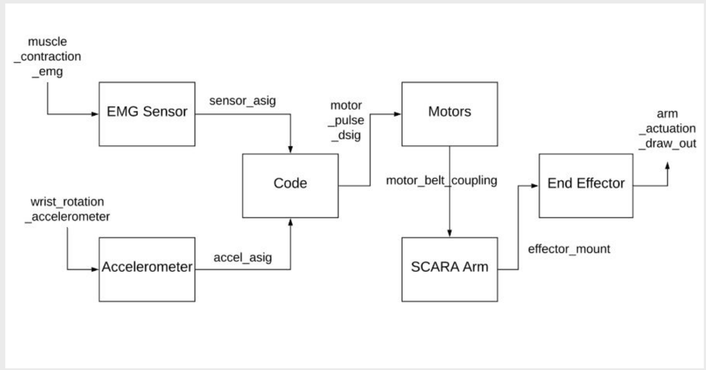
Oregon State University

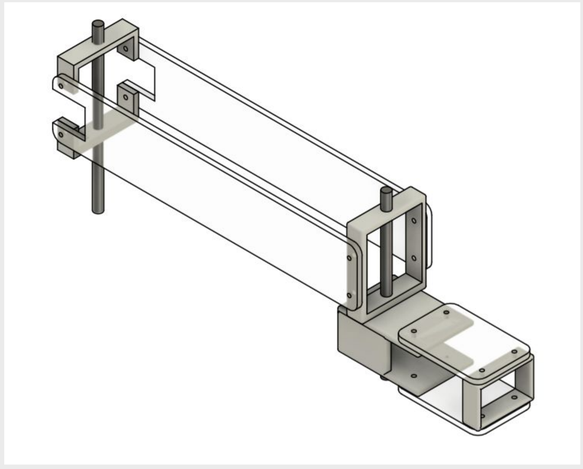
# Flex-a-Sketch

Robotic arm controlled by muscle flexing and hand movement

## Project Summary

The Flex-a-Sketch is a Selective Compliance Assembly Robot Arm (SCARA) that draws user-controlled drawings on paper. The arm is driven by the user's muscle contraction and hand movement.



## What is Electromyography? (EMG)

Electromyography is an electrodiagnostic medicine technique for evaluating and recording the electrical activity produced by skeletal muscles. EMG is performed using an instrument called an electromyograph to produce a record called an electromyogram.
Our project uses EMG sensors, which are placed directly on the user's arm to determine when the robotic arm will read input from the accelerometer.

## Mechanical Design

The robotic arm was designed in Fusion 360 with two pairs of acrylic plates connected to brackets to achieve the SCARA topology. This design is made up of a combination of laser cut and 3D printed parts, which allows the arm to be lightweight, achieve a full range of motion, and is inexpensive and manageable to reproduce. The steel dowels at each joint provide stability to the arm and enable the mounting of a system of belts and pulleys to control the arm's movement.

## Accelerometer Data

An accelerometer is a device that measures proper acceleration and the collected data will show as voltages and accelerations from the X, Y, and Z axis. When the user's hand is perfectly still and lays flat, the accelerometer data should show a downward gravitational force on the Z axis and zero for all other axes.
For our project, the user wears an accelerometer on their wrist to drive the direction in which the robotic arm draws.

## What We Have Learned

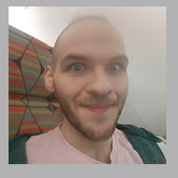
Each team member was delegated multiple tasks and learned new technical skills. We learned that setting smaller deadlines ahead of the hard deadlines helps keep the team on track, and that defining specific interfaces between each delegated part is key for a successful final product.

## Next Steps...

- Adding a third axis to allow more degrees of motion in the vertical direction.
- Developing additional mounts for more types of writing utensils.
- Wireless communication capabilities to remove the need for buses between the user and the robotic arm.
- Design a cage mount that allows for additional modularity on the robotic arm.

## The Team


**Victoria Vásquez**
Mechanical Design



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Robotics Control

**Ranyu Shi**
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