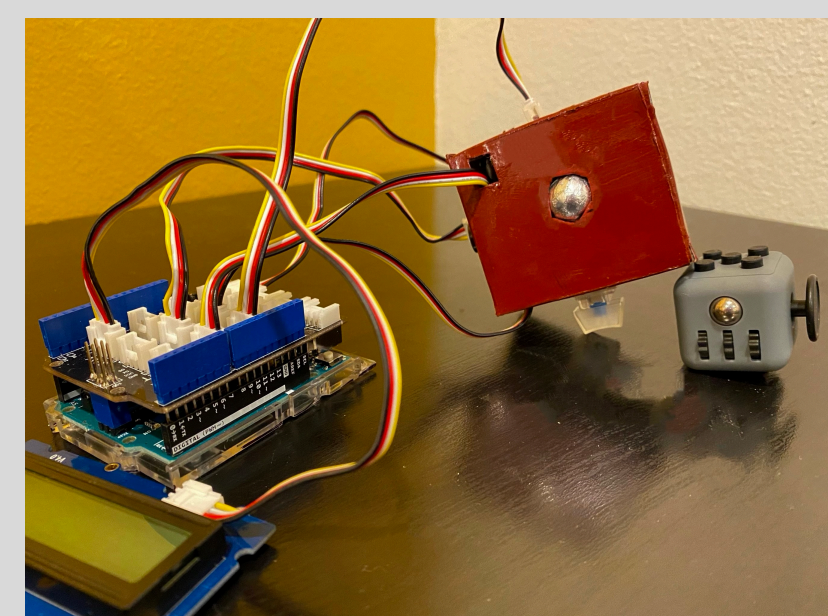


## Introduction

Haptics is becoming an increasingly important aspect of socially assistive robots. Professor Culbertson's Lab aims to research more about haptics and how it can play a role in responding to the lack of focus due to fidgeting. Throughout this summer, I created a fidget cube that can track the duration and intensity of a person's fidgeting at different stress levels.



*My Data-Collecting Fidget Cube  
PC: Smriti Wadhwa*

## Project Summary

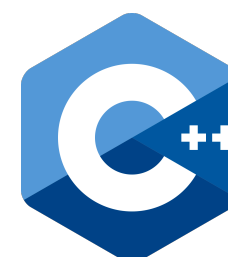
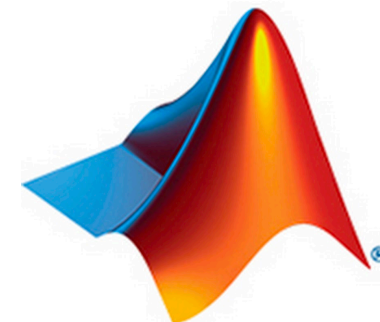
The creation of a robot always begins with data-collection. With the Arduino board, I embedded Grove sensors to each side, mimicking each element of a regular fidget cube. When connected to a computer, each motion is tracked and recorded.

## Objective & Impact of Professor's Research

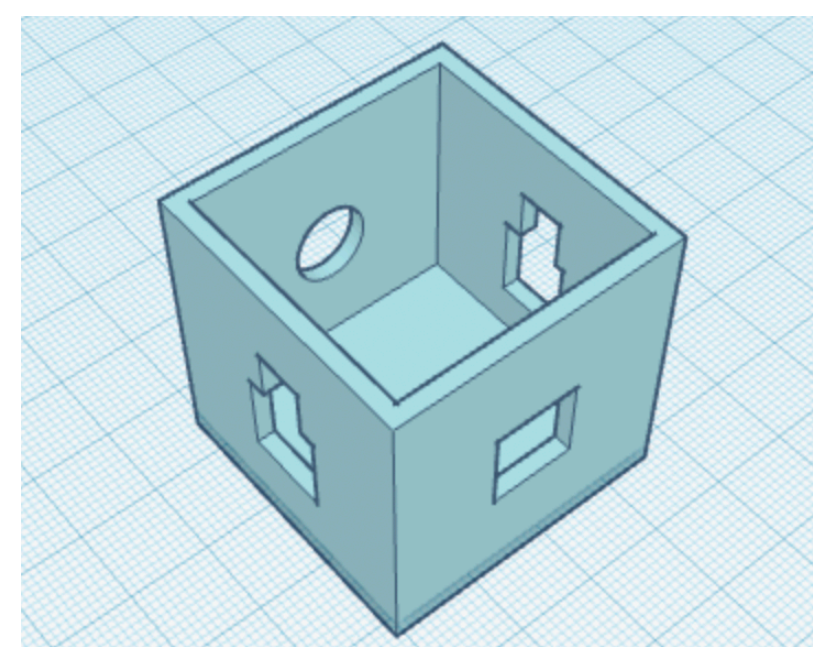
Professor Culbertson's lab researches haptics, which is the study of touch sensations. In robotics, it can provide a sense of realism but also create socially assistive robots. Since fidgeting can reduce stress but also interfere with productivity, the lab aims to design an assistive robot to respond to these behaviors and eventually help kids with Autism or ADHD.

## Skills Learned

- Learned MATLAB
  - graphing data
  - creating plots
  - data analyzation
- Learned to work with Arduino and Grove sensors
  - coded in C++ with additional functions and methods made for Arduino
  - built a working circuit that produces outputs with user-driven inputs
  - gained familiarity with the Arduino UNO board and the Grove Arduino shield and the basics of circuits



- Used 3D project planning tools to measure and execute a basic design for the cube
  - used digital and analog inputs and outputs for the button, buzzer, LCD Backlight, touch/marble, keycap, and potentiometer sensors.



*Project Measurements and Plan  
PC: Smriti Wadhwa*

- Debugging
  - the room for error created an environment where I debugged not only the circuit but the program
- Soft Skills
  - learned communication, public speaking, and the hierarchy of a university laboratory

## How This Relates to Your STEM Coursework

Robotics is often a culmination of mechanical engineering, electrical engineering, and computer science. Prior to SHINE, I had quite a bit of computer science experience, but very little of the other two.

Wiring each sensor to transmit data to my computer entailed electrical engineering, as I had to connect each component to a motherboard, then to an external element of the fidget cube.

These external elements had to be created from scratch as they needed to be about two times in size of the original. Creating heat-sensitive toggles and marble rotators that were also compatible with triggering a sensor required planning then executing my ideas (mechanical engineering). I used ordinary household materials to create each element for the prototype of the data collecting fidget cube.

Once the cube was assembled completely, it was time to program each sensor to collect data that included the duration and intensity of human usage over different stress levels (computer science). This data was then imported into excel, to later be plotted on MATLAB.

```
if (digitalRead(3)==HIGH)
{
    delay(100);
    counter++;
    lcd.clear();
    lcd.print(counter);
    digitalWrite(6, HIGH);
    delay(100);
    digitalWrite(6, LOW);
}
```

*C++ for the Arduino and sensors  
PC: Smriti Wadhwa*

## Next Steps

This project has a few more steps before it can be integrated into Professor Culbertson's larger project. First, each piece of data collected by the cube needs to be imported into MATLAB. From there, I can program the console to create a graph of the duration of fidgeting per each toggle on different stress levels. This graph can help study and understand the patterns of the way humans fidget. From there, we can test different ways to measure productivity under different levels of stress, as well as collect more cube data. Correlating the decline in productivity with the increase of fidgeting will eventually help me and the lab combat ways to help distraction in kids with autism and ADHD.

## Acknowledgements

I would like to thank Professor Culbertson and Dr. Mills for giving me the opportunity to work in a laboratory studying haptics. I would also like to thank Naghmeh Zamani and Cassandra Jeon for mentoring me through this project. Lastly, I thank Saamarth Sethi and the rest of the SHINE team who made this project possible.