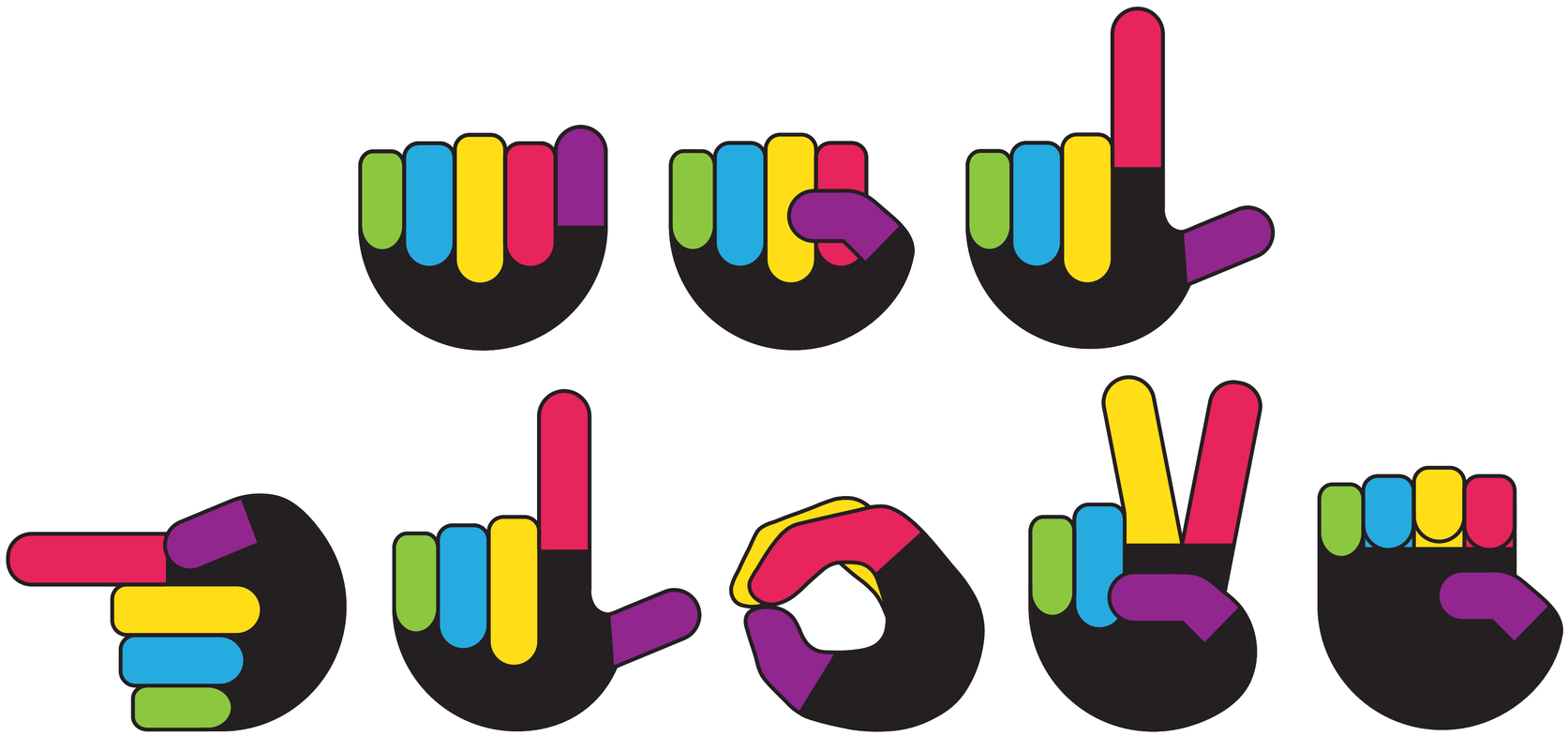
A Wearable Tool for Translating American Sign Language (ASL)

Project 3: ASL Glove 2.0
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DESN30146: IO & E
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(ASL GLOVE)

VERSION 2.0

DESIGN STATEMENT

The ASL Glove, once an interactive tool for learning the American Sign Language (ASL) alphabet, has been repurposed to include ASL translation functionality. This added functionality allows the glove to not only teach accessibility and communication, but to put it into practice. We feel this tool would be beneficial for anyone who communicates primarily with ASL in a world where ASL is an uncommonly used form of communication.



THE CONCEPT

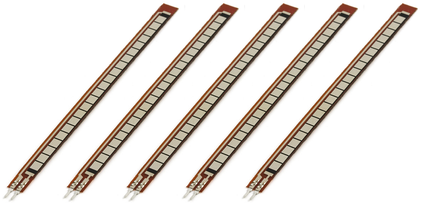
The ASL Glove concept came about when exploring how we could take the original ASL Glove one step further, by adding additional features. Since the original ASL Glove already recognized hand position to communicate the letters of the ASL alphabet, we realized that by simply adding motion detection, the glove could also be able to recognize full ASL words, which rely on specific hand motions.

In order to detect motion, we added an accelerometer to the glove. Once this technology proved successful, we decided to also downsize the wearable, by switching to an Arduino Pro Mini. This allowed us to remove the need for an armband and contain all the technology in the wrist portion of the glove. We also added a speaker to allow audible translation from ASL to English.



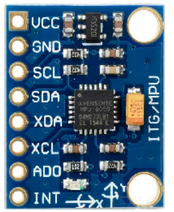
ASL Alphabet

+



Flex Sensors

+



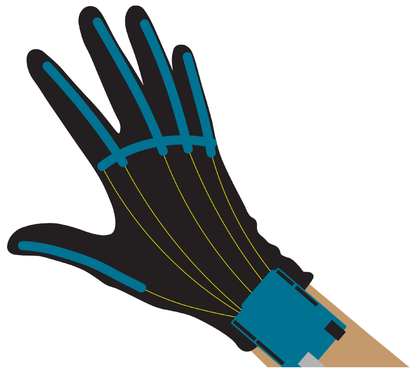
Accelerometer

+



Speaker

=



A Wearable Tool for Translating Simple ASL

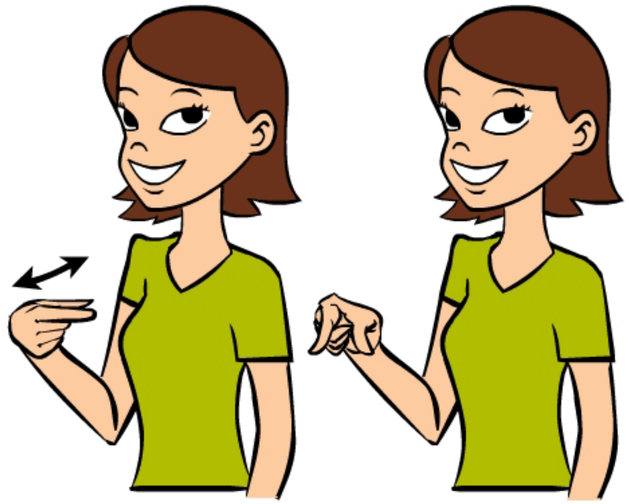
ASL GLOVE LIMITATIONS

The accelerometer used in the ASL Glove is an MPU-6050, a combined 3-axis accelerometer and gyroscope. Because of our lack of understanding of this complex technology, our opportunities were limited. As mentioned above, ASL words rely on hand positions combined with specific motions. While it is within the abilities of the MPU-6050 to recognize specific motions, we decided to focus only on simple ASL words that required a much less-specific type of motion. In particular, we focused on words that require a simple shake of the hand in any and all directions. This allowed us to use the MPU-6050 as a type of motion detector, sensing when the hand was in any type of significant motion.

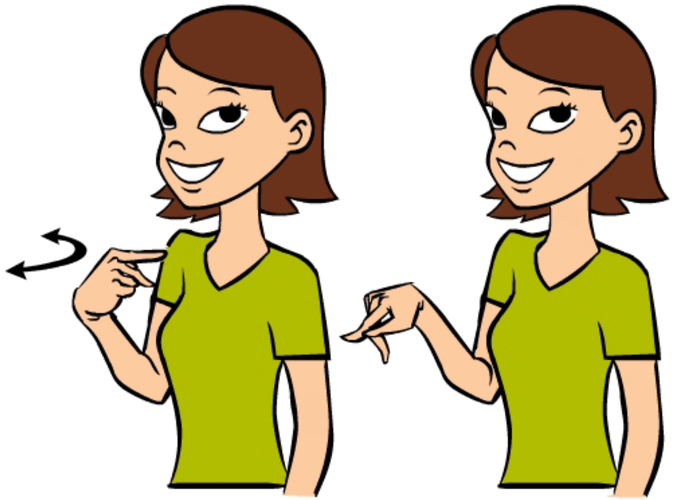
Currently, the glove can only translate up to two words, as the Arduino program memory is full.



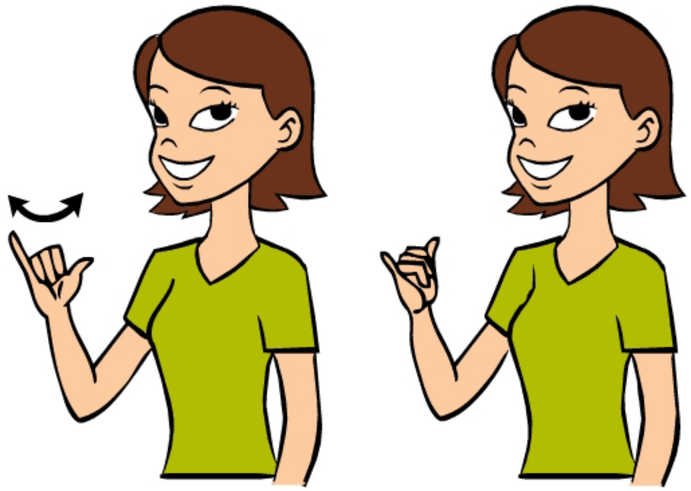
Blue



Green



Purple

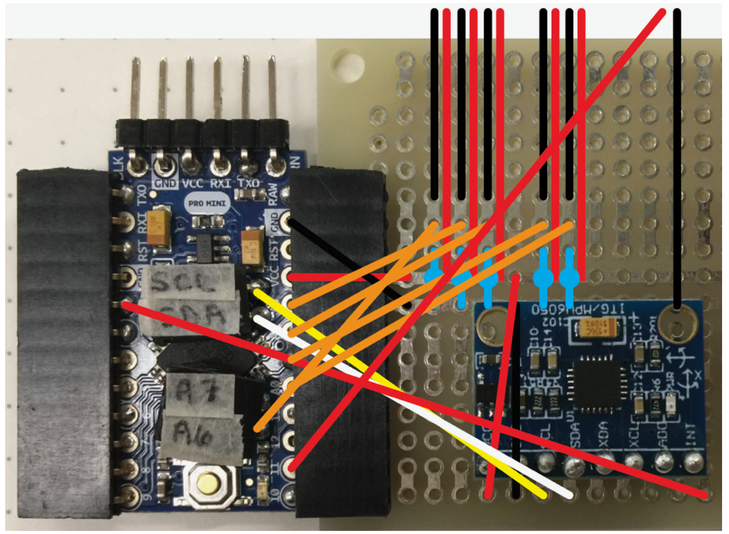


Yellow

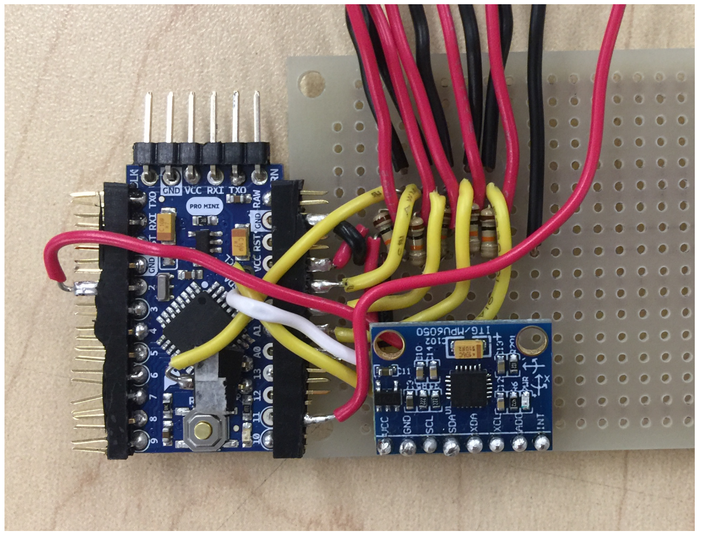
DOWNSIZING THE GLOVE

In order to downsize the extensive technology within the glove, we had to get creative in a number of different areas. Our biggest challenge was moving from our beloved mini breadboard to a PCB, which in the end allowed us much greater flexibility. In order to wire the PCB most efficiently, we had to do an extensive amount of planning.

In the end, our hard work paid off, as the PCB fits perfectly in the wrist portion of the glove. While this solution is suitable for a prototype, we would eventually want to move to a custom PCB, which would be even smaller in size.



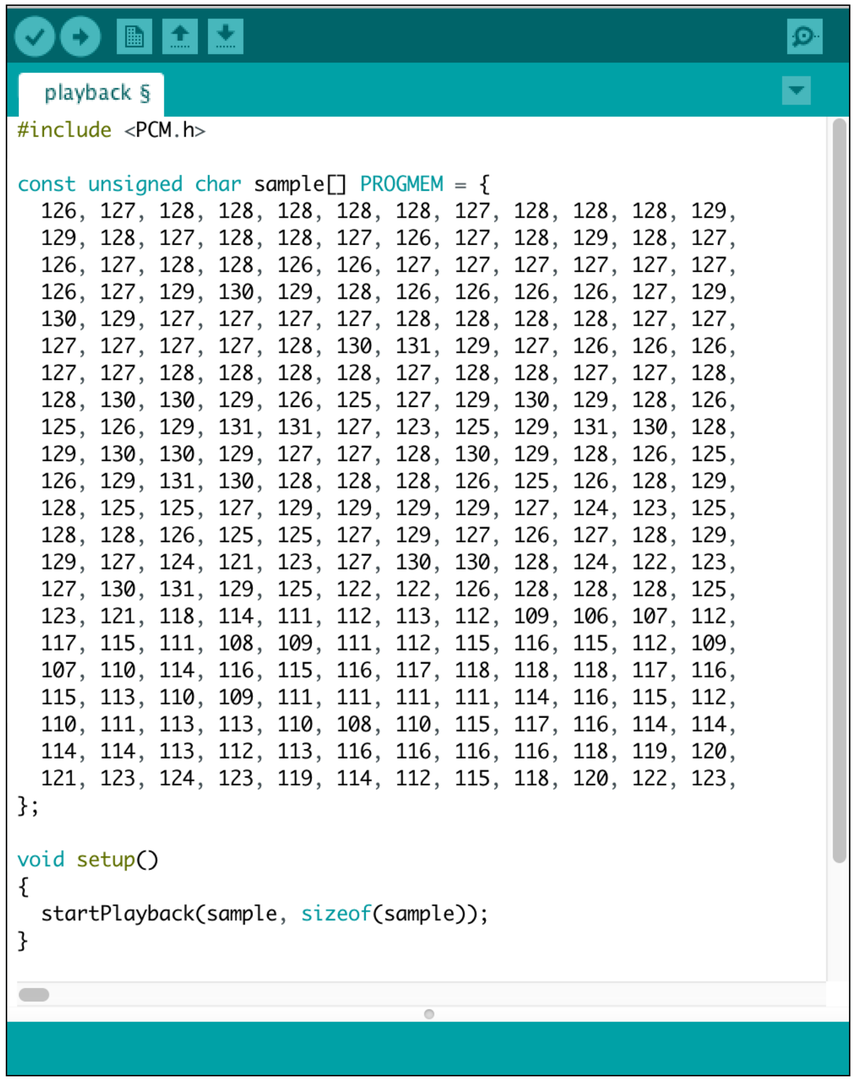
Planning the PCB layout in Illustrator



Completed PCB

ADDING THE AUDIO

In order to include audio functionality in the glove while still adhering to our size limitations, we added a flat, round speaker to the back of the glove. Since adding an MP3 shield with an SD card reader would be too large, we had to translate all audio clips into sound data that the Arduino would use to generate PWN output. In essence, this sound data is a series of numbers in an array, that tells the speaker what sounds to produce.

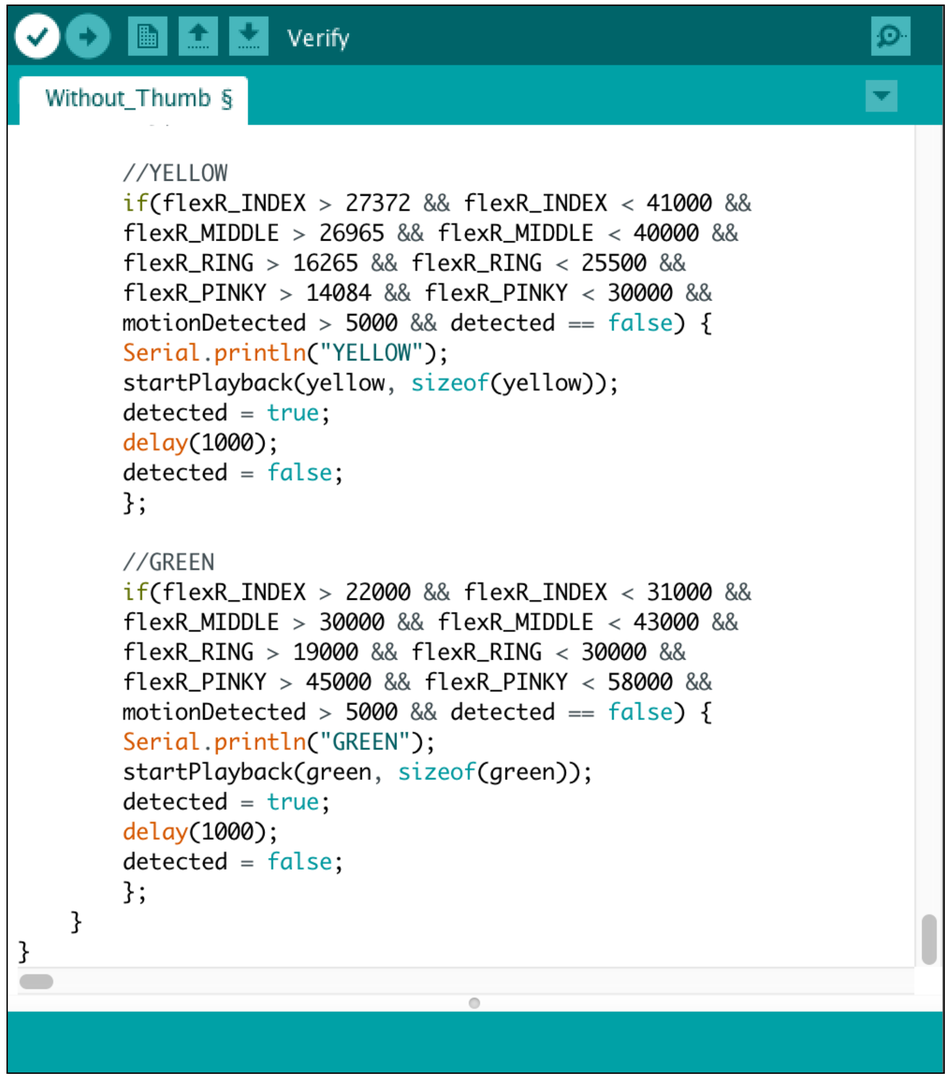


Translated audio clip for PWM output

ARDUINO CODE

The Arduino code is a combination of codes for the MPU-6050, the hand positions and the audio.

Essentially, every frame, the Arduino checks the values of each of the flex sensors, then sees if the combination of values signifies a recognizable hand position. It also checks if there is significant motion by reading the values outputted by the MPU-6050. If a recognizable hand position and motion are detected, the Arduino plays the relevant sound data through the speaker.



Code for words Yellow and Green

THE GLOVE IN ACTION

The ASL glove is a success and can translate the words yellow and green, as showcased in this video (right).

