Gesture Glove

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Use Case/Application Area
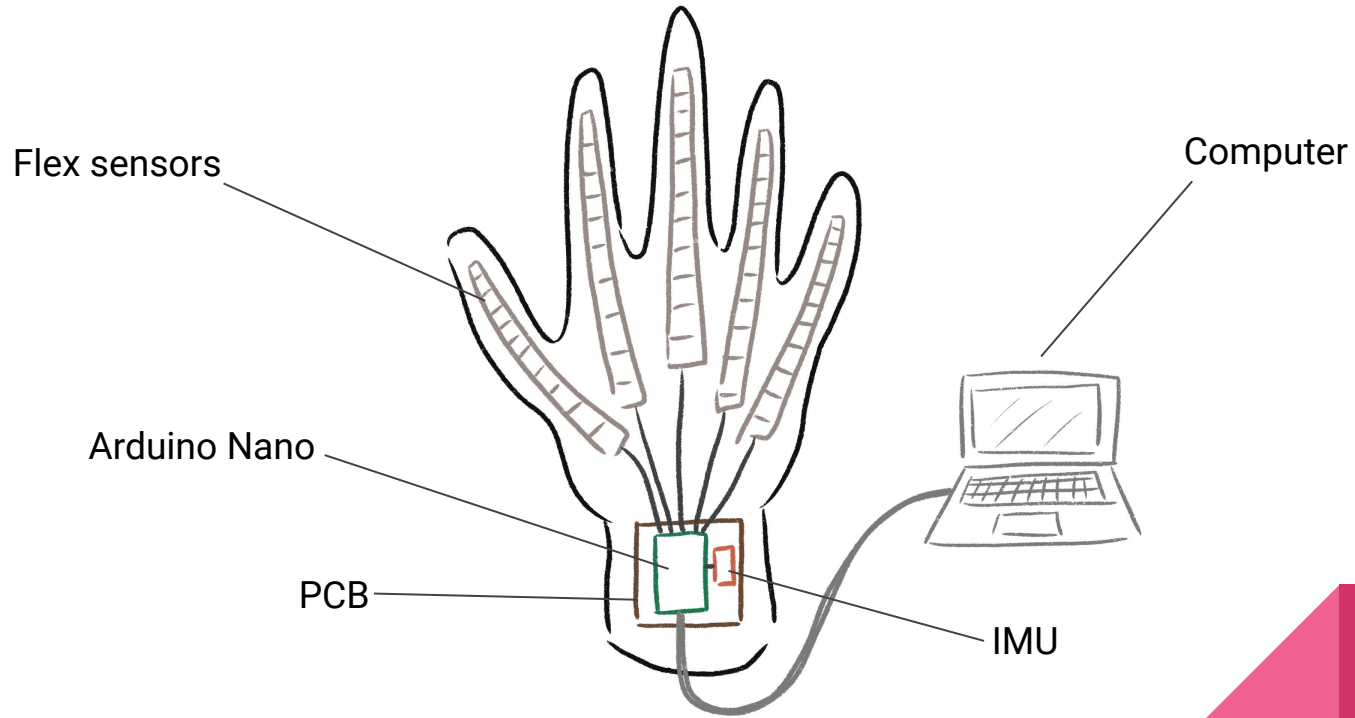
- Help people who sign ASL communicate with others who do not understand ASL
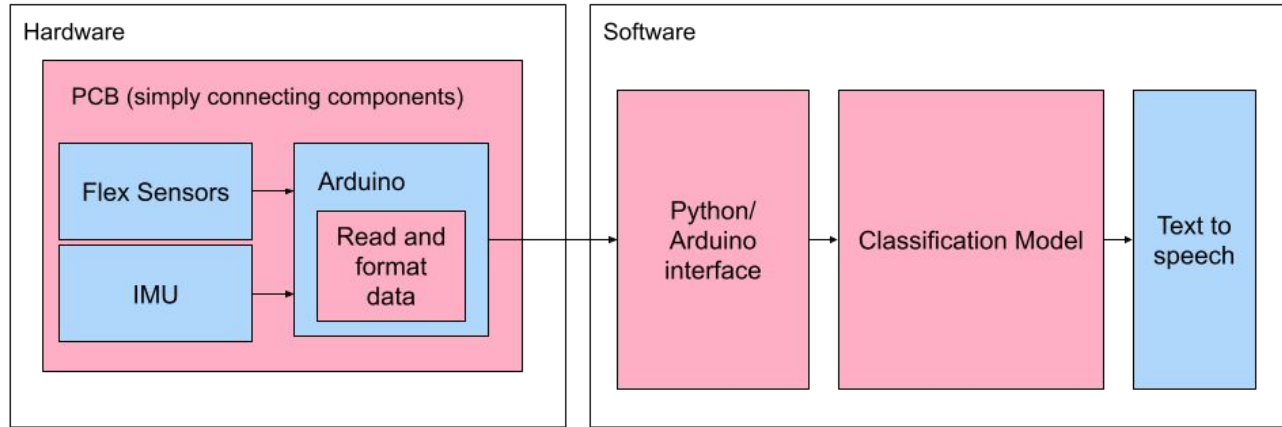- Recognizes gestures and hand directions
  - 26 ASL letters

A   S   L

Quantitative Requirements

Requirement	Measurement
Accuracy	90%
Latency	Less than 100ms
Frequency	.5 S per gesture
Craftsmanship	200 g

Solution Approach

Flex sensors

Computer

Arduino Nano

PCB

IMU

Block Diagram

System Specification

- Spectra Symbol Flex Sensors
- InvenSense ICM-20948 9-DoF IMU
- Arduino Nano
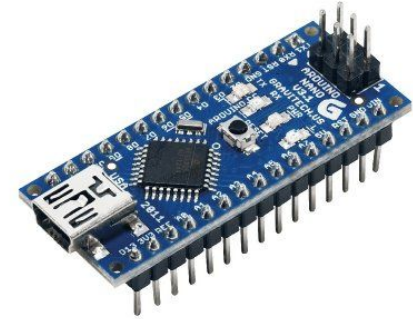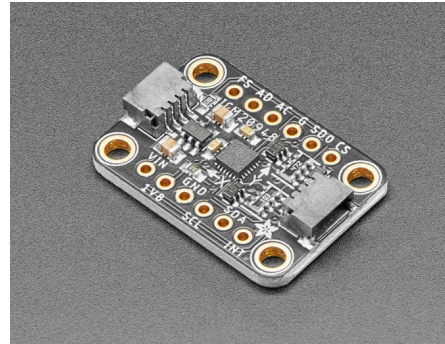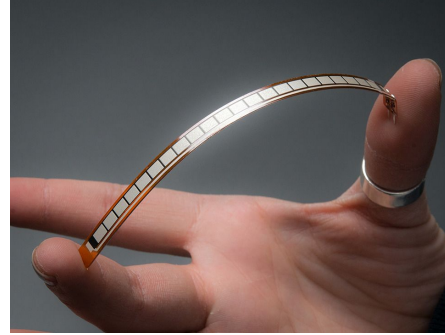
ML Models

- Support Vector Machines
- Perceptron
- KNN
- Random Forest
- Neural Network (scikitlearn default of two layers w/ 10 nodes per layer)

Generating Fake Data

- Normal distributed selection of angles for fingers
- Random choosing of accelerometer + gyroscope data since we are mostly looking at static poses
- Magnetometer selected from a range based on directions
- Sample data:
  [42.42 23.83 15.07 18.95 15.84 1.62 0.92 0.02 4.84 4.02 2.67]
  Flex sensors, accelerometer, gyroscope, magnetometer,

B
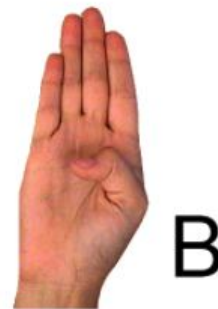
Comparing ML Models

Random Forest: 0.8177
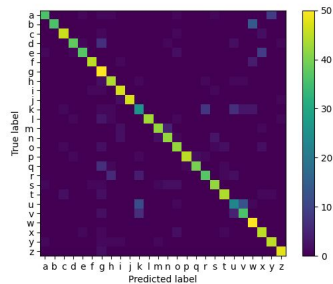
Neural Net: 0.7308

KNN: 0.7438
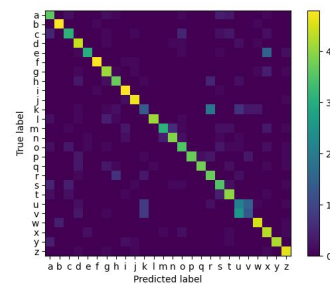
SVM: 0.7362
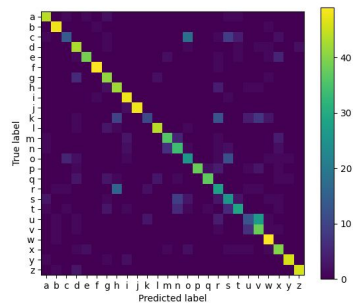
Perceptron: 0.6369
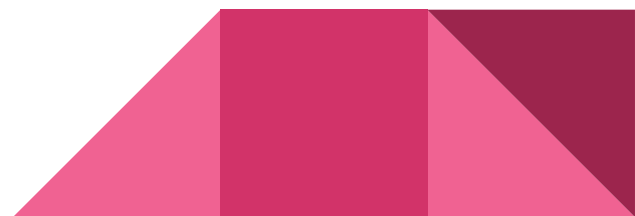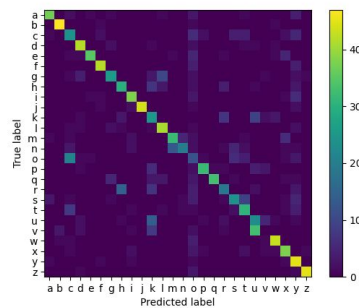
Metrics and Validation
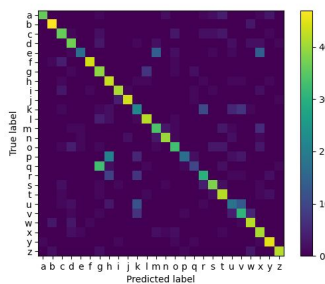
Requirement	Measurement	Testing Procedure
Accuracy	90%	Have 10 people make each gesture 3 times
Latency	Less than 100ms	Start a software timer beginning when the gesture is finished and end a timer when the algorithm outputs the gesture recognition
Frequency	.5 S per gesture	Glove should be able to detect two signs per second
Craftsmanship	200 g	Measure the weight of the glove after fabrication

Implementation Plan

Plan the construction

1

Design and order PCB; do some theoretical testing on potential ML models to eliminate the poorer performing models.

Build glove and train model

2

Build the glove once the components have arrived and begin training ML model on real data. A few models should be tested at this stage.

Test/survey and modify

3

Run tests on many people, collect feedback on user experience and adjust as needed.

Schedule

	9/13	9/20	9/27	10/4	10/11	10/18	10/25	11/1	11/8	11/15	11/22	11/28
Make proposal presentation + website												
Order parts (arrive by 9/27 - expedite shipping if necessary)												
Do proposal presentation												
Build and order PCB												
Write program for serial streaming												
Attach flex sensors												
Test that we get consistent data from flex sensors with each gesture												
Prepare design review												
Do design presentation												
Design report												
Install PCB onto glove												
Attach IMU												
Test that we get consistent data from IMU with each gesture												
Determine ML Model												
Integrate glove with Software side												
Collect data (for training and testing)												
Train model												
Test model ourselves												
Get other people to test (gather survey data)												
Make adjustments as needed from feedback												
Make final presentation												
Final presentation												
Final report												

everyone
sophia
stephanie
rachel
stephanie + rachel