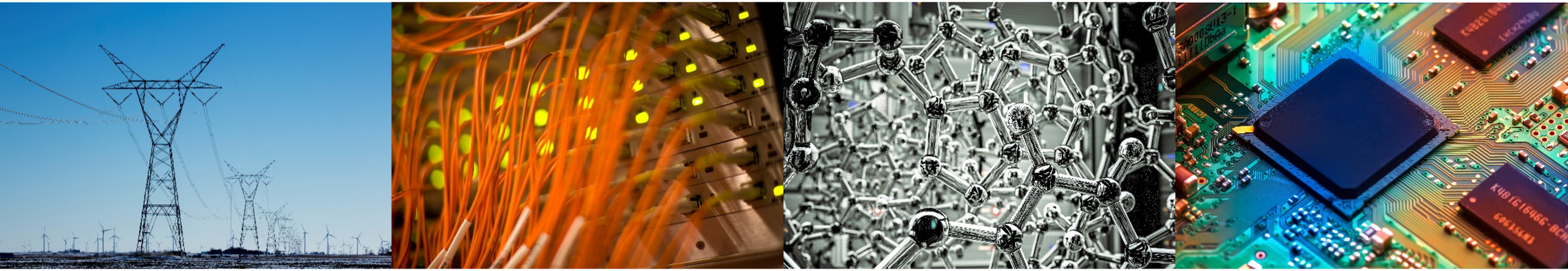
Team 25: Infinity Control Gauntlet

Chris Schodde, Ashish Pabba, Ramakrishna Kanungo



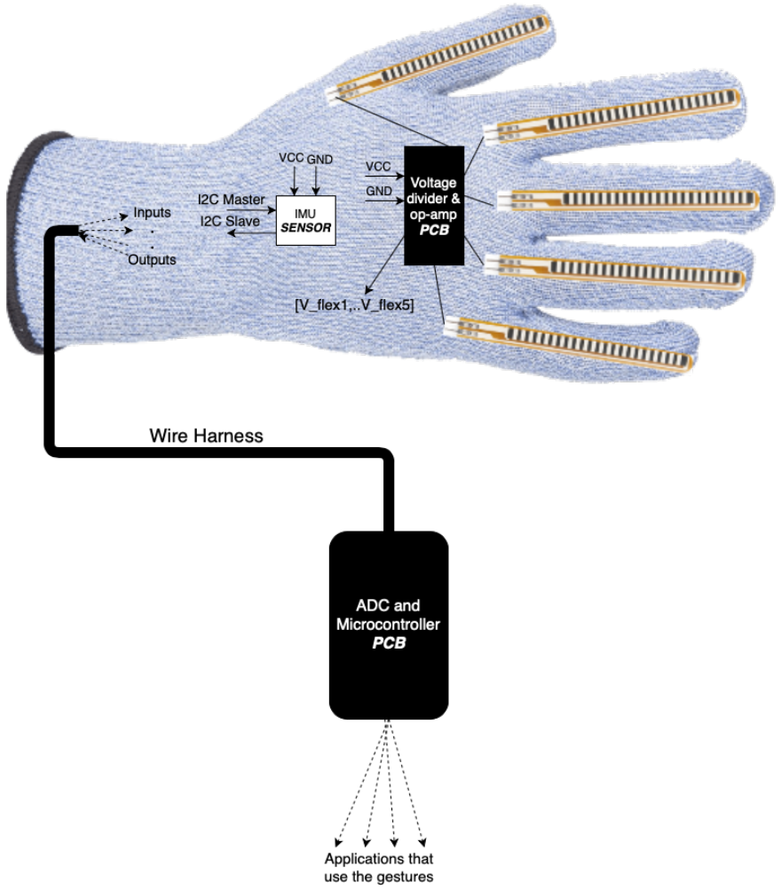
ILLINOIS
Electrical & Computer Engineering
GRAINGER COLLEGE OF ENGINEERING

Motivation

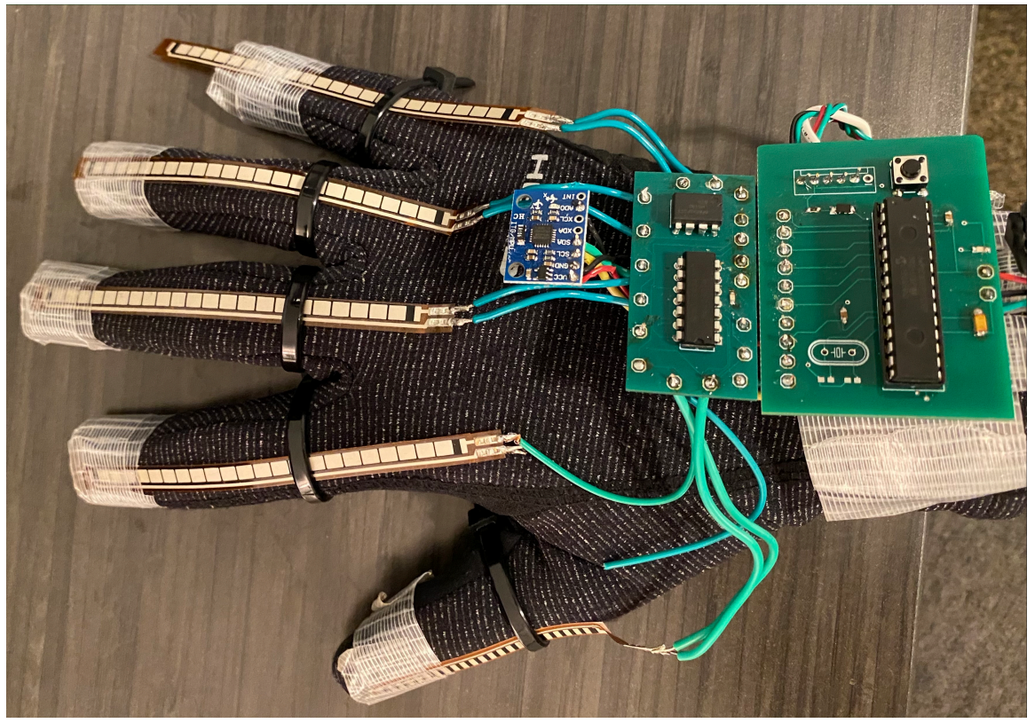
- CAD models can be clunky to manipulate
- Other input methods are unintuitive
- What form is the most convenient?

Pictorial Overview

Vision



Prototype



Outline

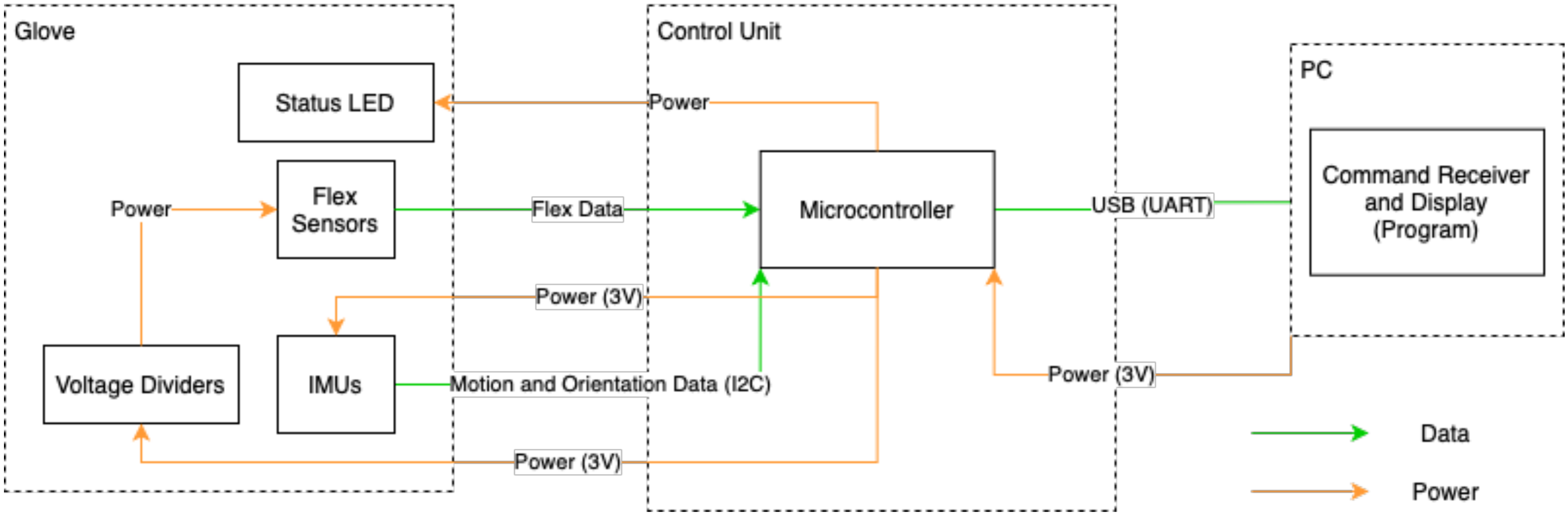
- Goals
- Block Diagram
- Subsystem
  - Glove Subsystem
  - Control Subsystem
- Gesture Recognition and Results
- Future HW and SW improvements

Goals

The glove should:

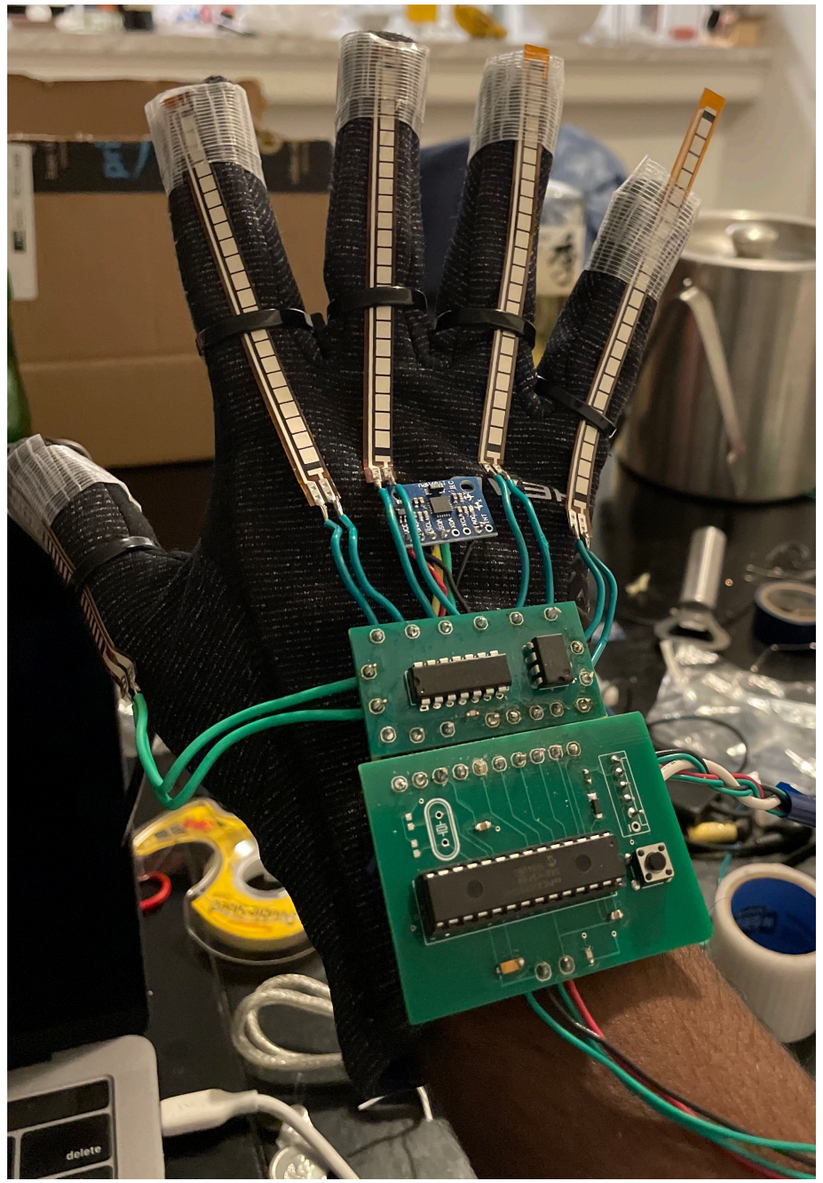
- Capture hand orientation
- Capture finger position
- Recognize the zoom, move right, move left, mode change and thumbs up gestures

Block Diagram



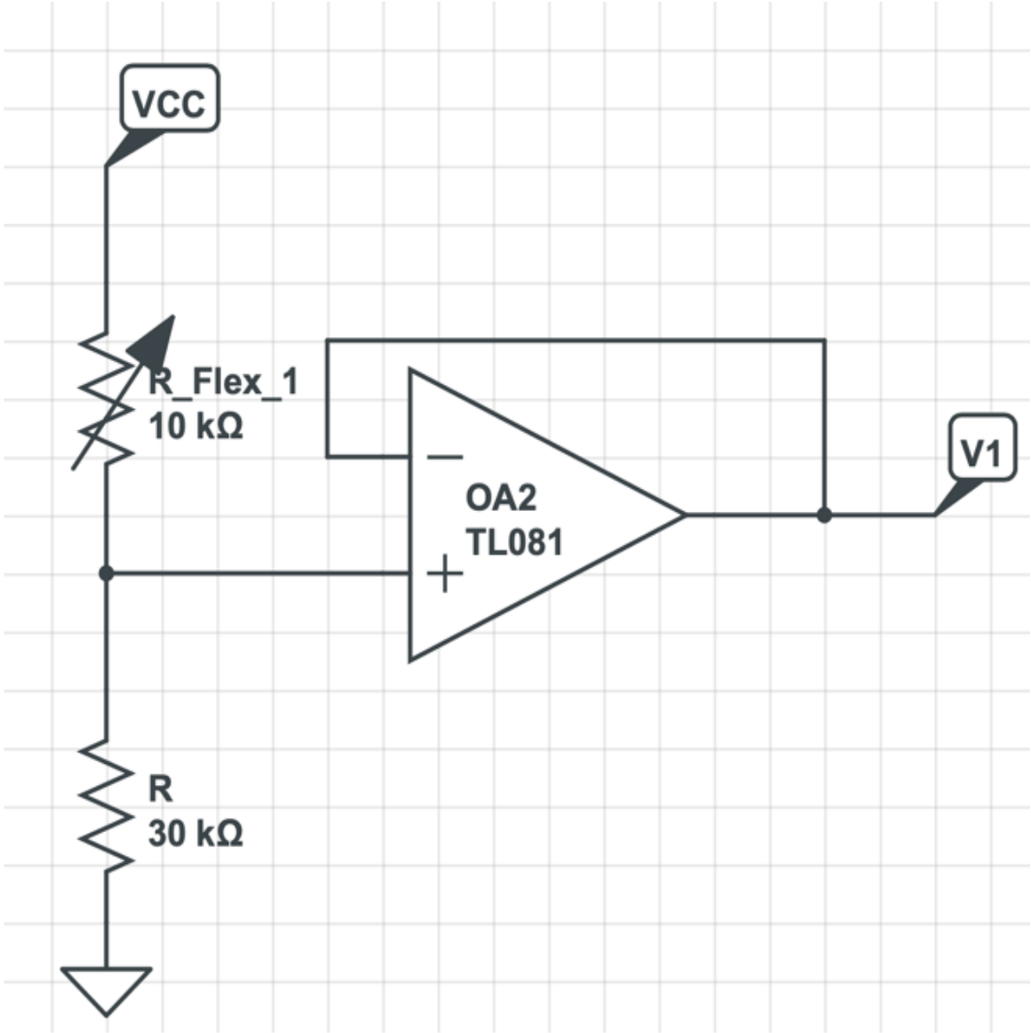
Glove Subsystem

- Flex Sensor PCB
- IMU

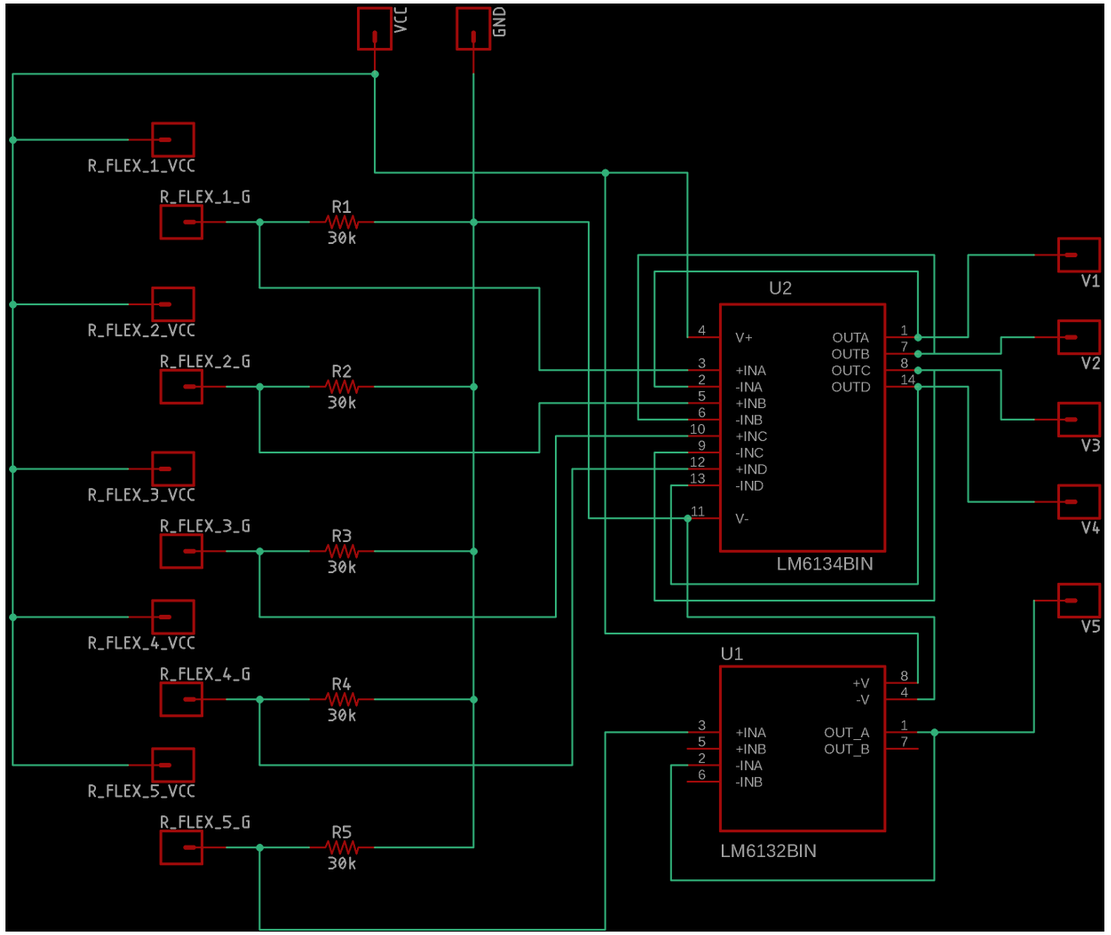


Flex Sensor PCB

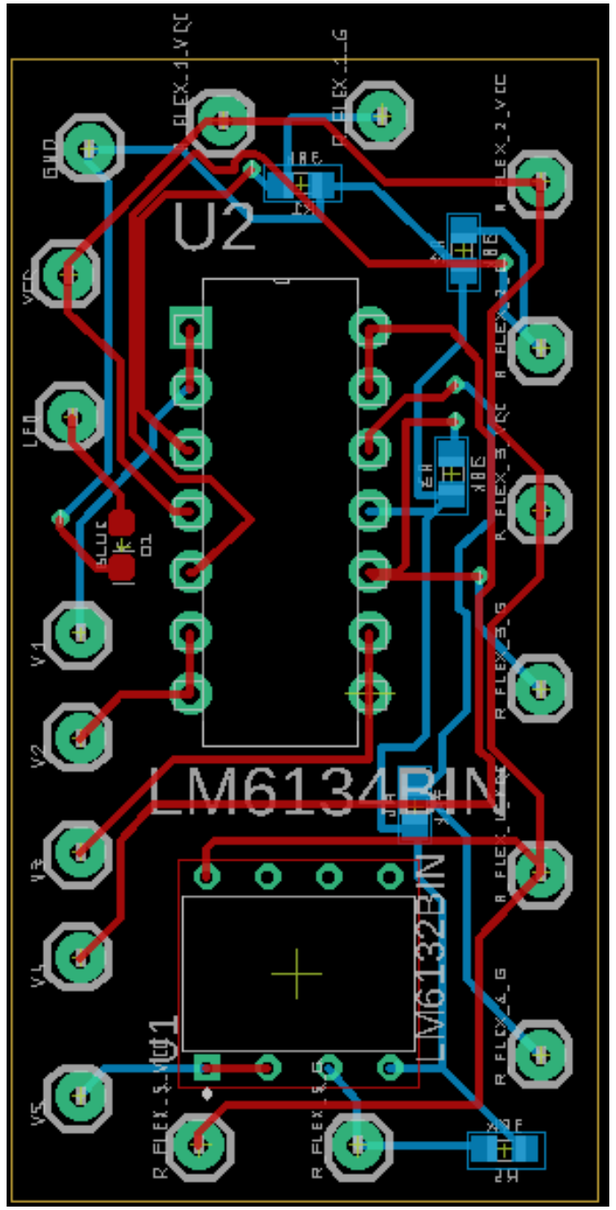
- Voltage divider circuit for flex sensor values
- Unity gain buffer implemented to avoid inaccuracies



Flex Sensor PCB



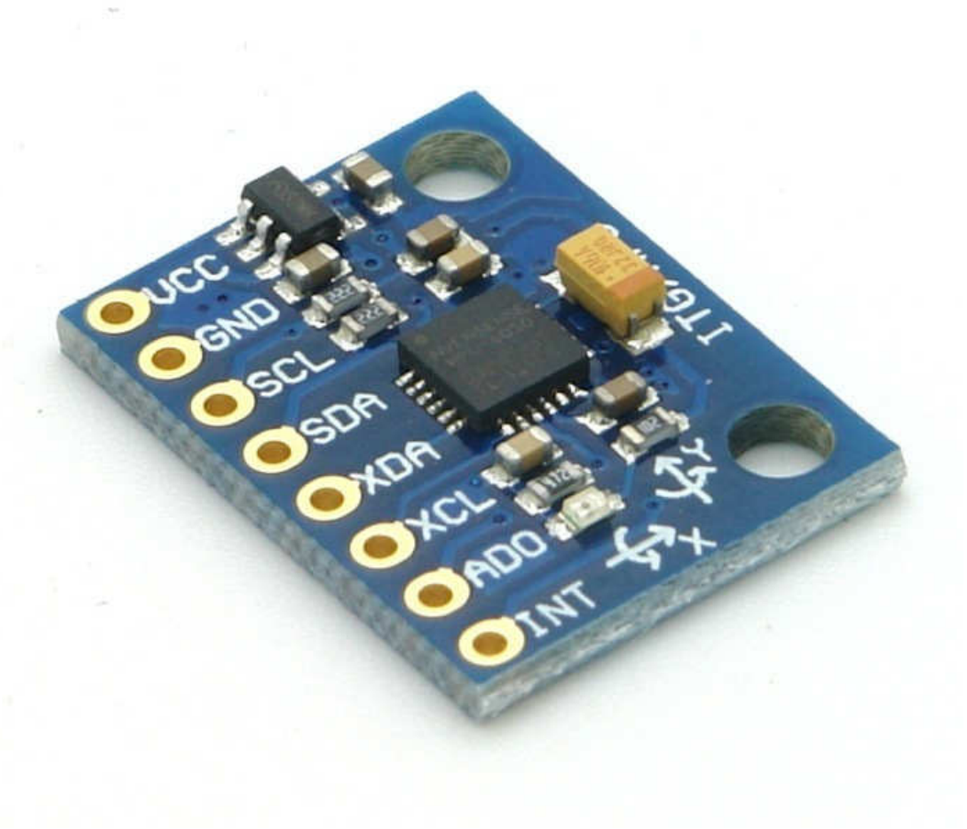
Schematic



Board

IMU

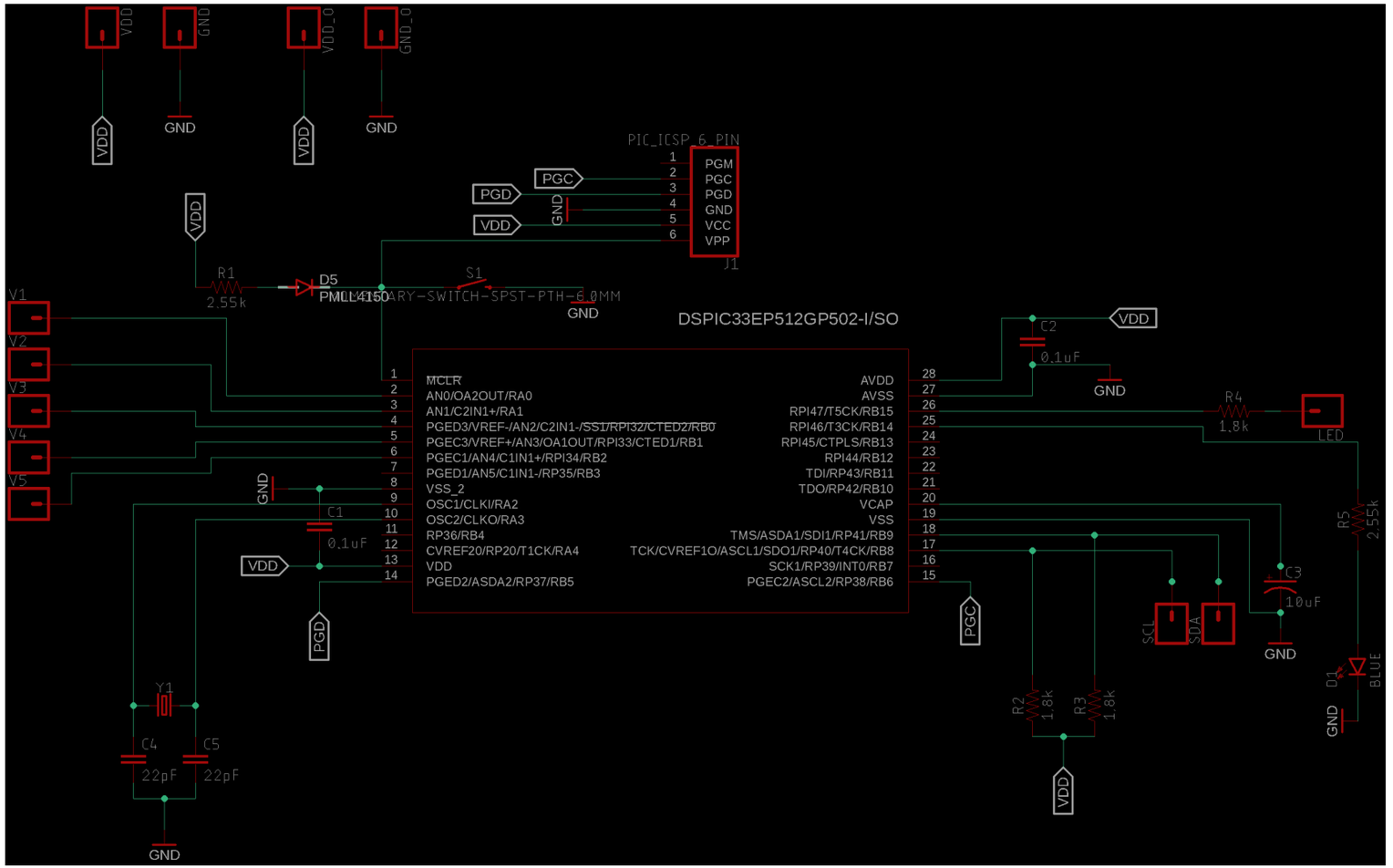
- Communication over I2C
- Orientation through linear/gravitational acceleration
- Zero error corrected during setup time



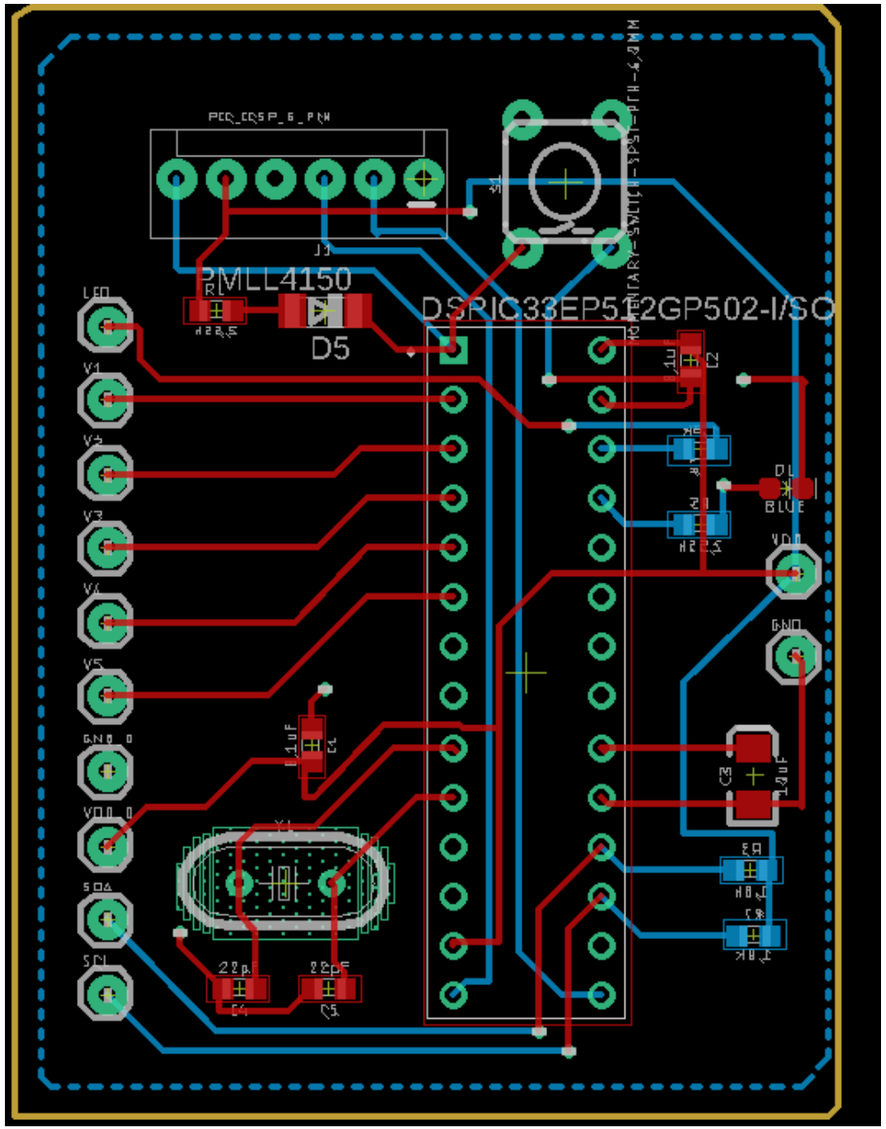
Control Subsystem

- Control Unit PCB
- Software
  - Control Loop Overview
  - Data Acquisition

Control Unit PCB

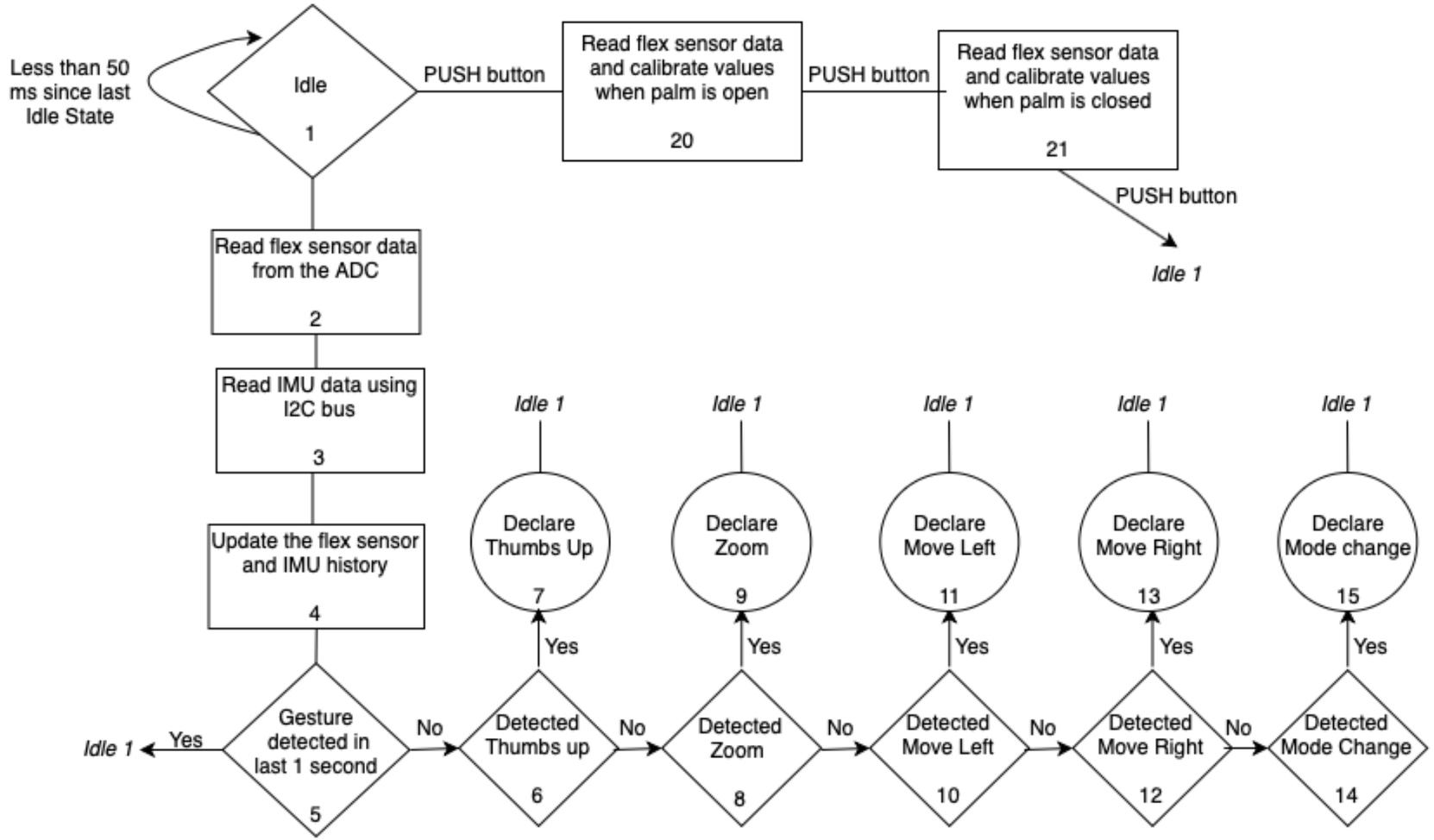


Schematic



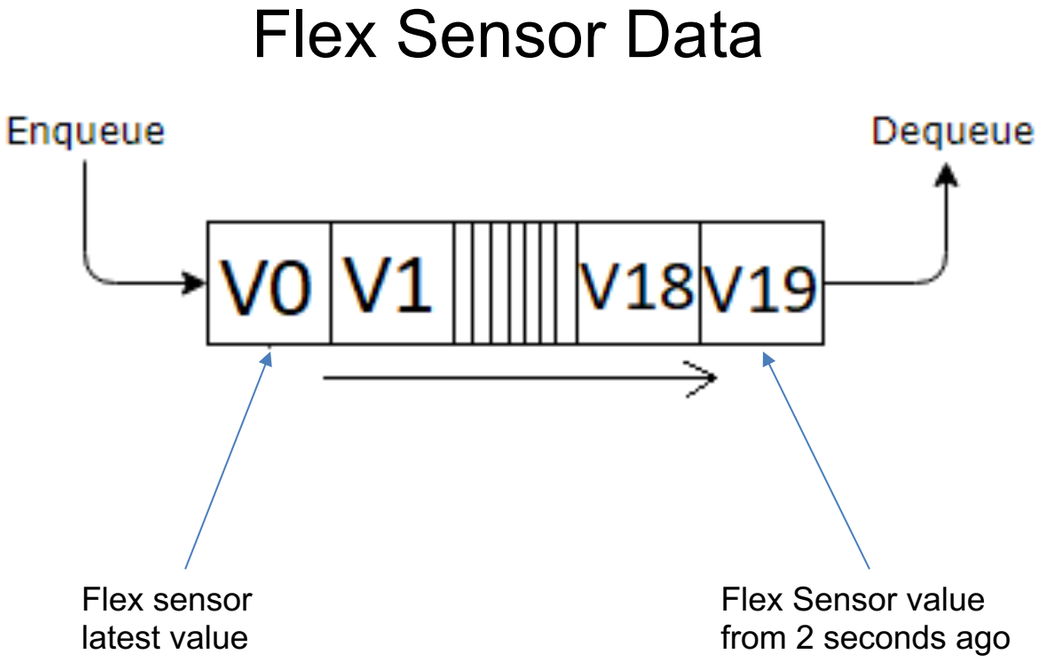
Board

Control Loop Overview



Flex Sensor Data

- FIFO queue created from array to store flex sensor data
- All data stored is 50 ms apart
- Latest 20 values of flex sensors stored at all points in time
- ADC set to 12-bit precision



Flex Sensor Boundary Values

- Flex sensor data was interpreted to have three states – flexed, straight and neither flexed nor straight
- Boundaries are set based on initial configure mode values with a 25% margin
- Eg:

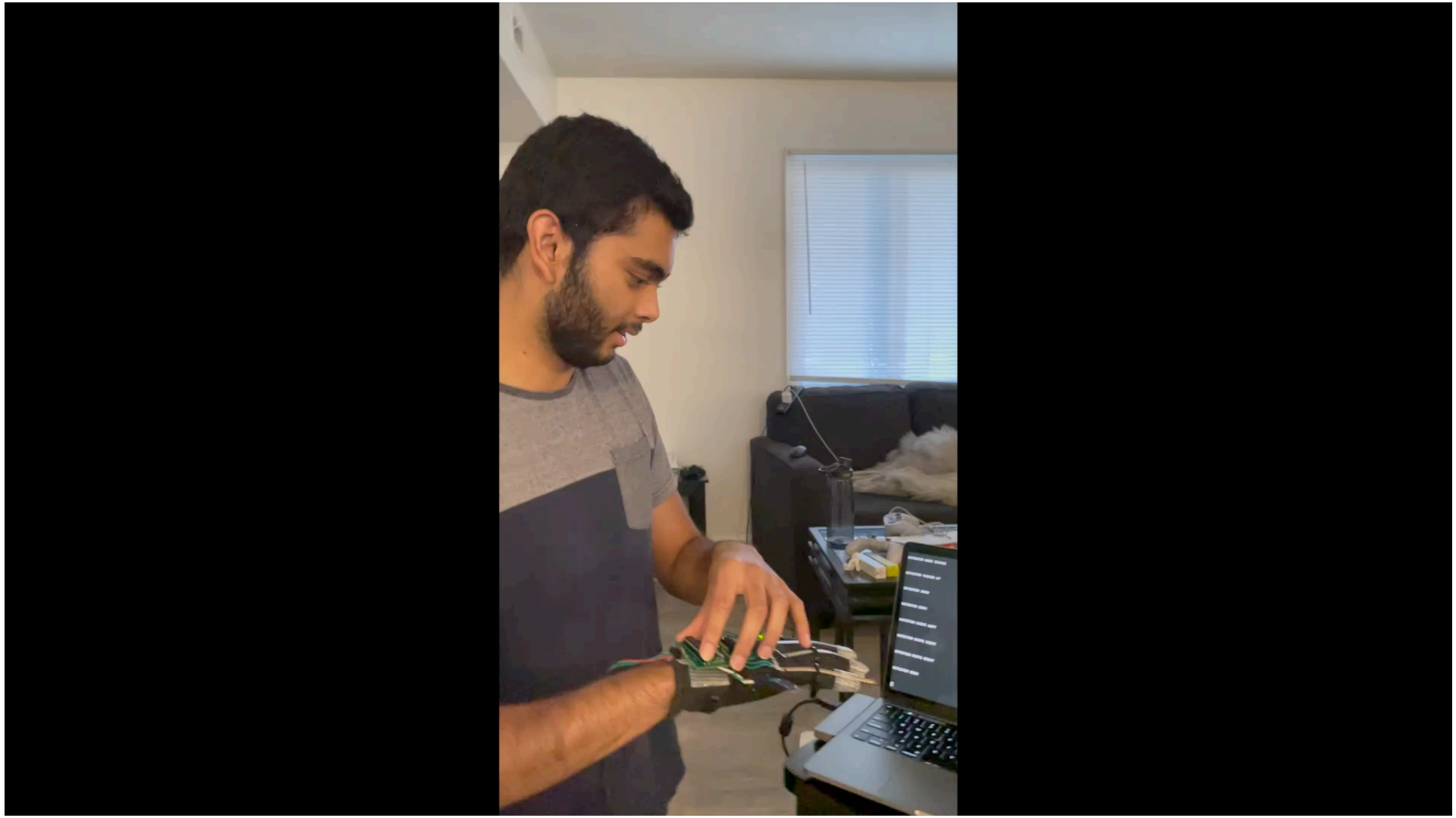
Straight Hand Flex Sensor Value	1.8 V
Flexed Hand Flex Sensor Value	1.2 V
Confidence interval of 25%	0.6V*0.25 = 0.15V
Boundary to declare straight hand	>1.65 V
Boundary to declare flexed hand	<1.35 V

Example Gesture Detection Code: Thumbs Up

- V0, V1,….V4, are queues with data for the five flex sensors
- V[20] and V[21] for each of the queues contains the upper and lower bound values for flexed and straight

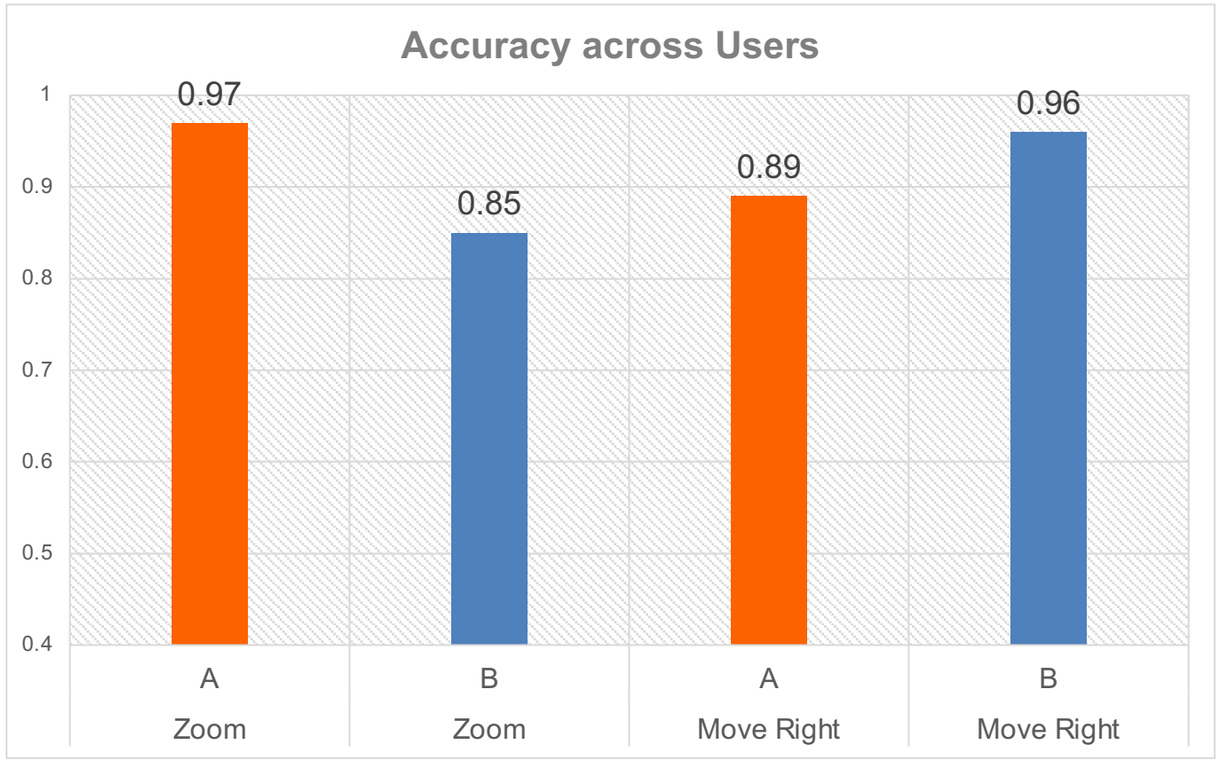
```
392
393 bool thumbsup(){
394     bool val = ((V0[0]<V0[21]) && (V1[0]<V1[21]) && (V2[0]<V2[21]) && (V3[0]<V3[21]) && (V4[0]>V4[20]));
395     return val;
396 }
```

Gestures



Results

- Significant variance in recognition across users
- Hardcoded thresholds vs. dynamically configured thresholds



Future Hardware Improvements

- Add magnetometer in conjunction with accelerometer and gyroscope for better orientation data
- Build quality (aesthetic and functional)

Future Software Improvements

- Custom gesture configuration
- Driver to allow glove to actually be used as an input device
- Improve precision and accuracy of gesture recognition
- Granularity in existing gestures

Conclusion

- High level requirements satisfied
- Significant scope for further developments