Preliminary Design Review

S.H.A.R.C.

Simulated Hand and Arm Remote Control

Team 6

Connor Pope, Daniel Sheridan, Derek Caudill, Harrison Shecter

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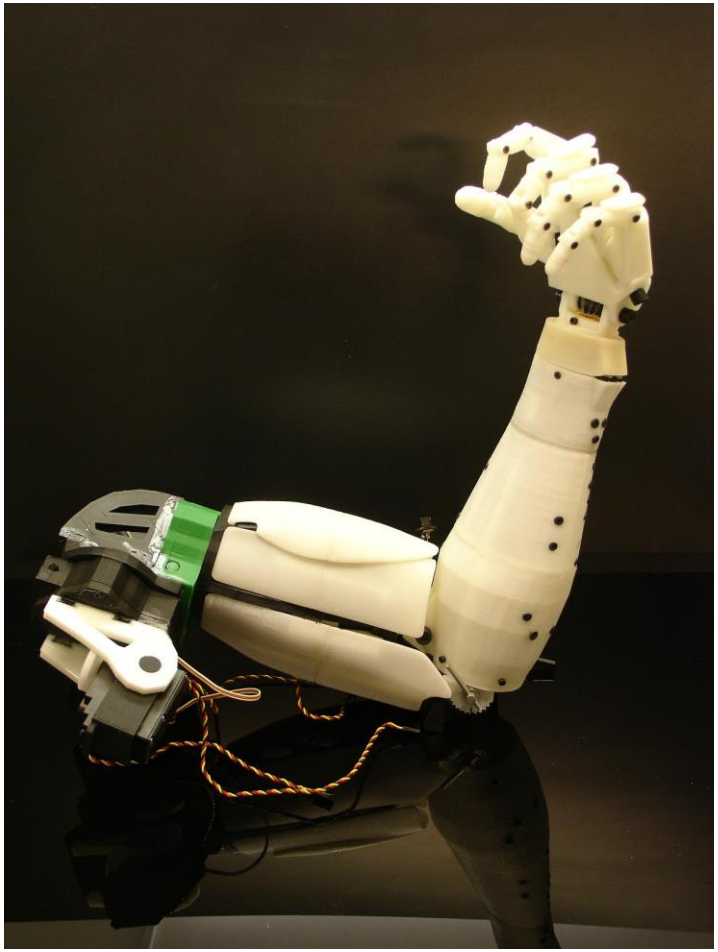
Project Description

- Our SDP team is going to design and build a system that controls a robotic arm wirelessly using wearable sensors.
- The robot arm is an open-source 3D printed design in order to focus our efforts on designing and building the controller

The Arm

- InMoov Robot Project
  - Open source
  - Directions on how to assemble the arm are provided
  - All parts and 3D models are given



Significance and Societal Impacts

- Bomb Defusal
  - Animatronic control -> Better accuracy + more intuitive control = Safer and more efficient defusal
- Medical Surgeries
  - Animatronic control maps to surgeon muscle memory
  - Scaled robotics leads to scaled surgeries
- Quality of Life
  - Robot arm + drone = Reaching the unreachable
- Manufacturing
  - 100 Robot arms + 1 glove/sleeve
- Defense
  - Non-autonomous and unmanned weapons

Alternatives Approaches

	Joystick Controller	Electrode Based System	Visual Tracking
Advantages	- Simplest design - Inexpensive to produce	- Allows control of limbs that aren't necessarily there (i.e. for use in prosthetics)	- Precise optical mapping from user's image
Disadvantages	- Lacks intuitive control - High learning curve	- Requires background in bio - Expensive - Noise from small signals	- Design requires high resolution optical sensors - Very CPU intensive

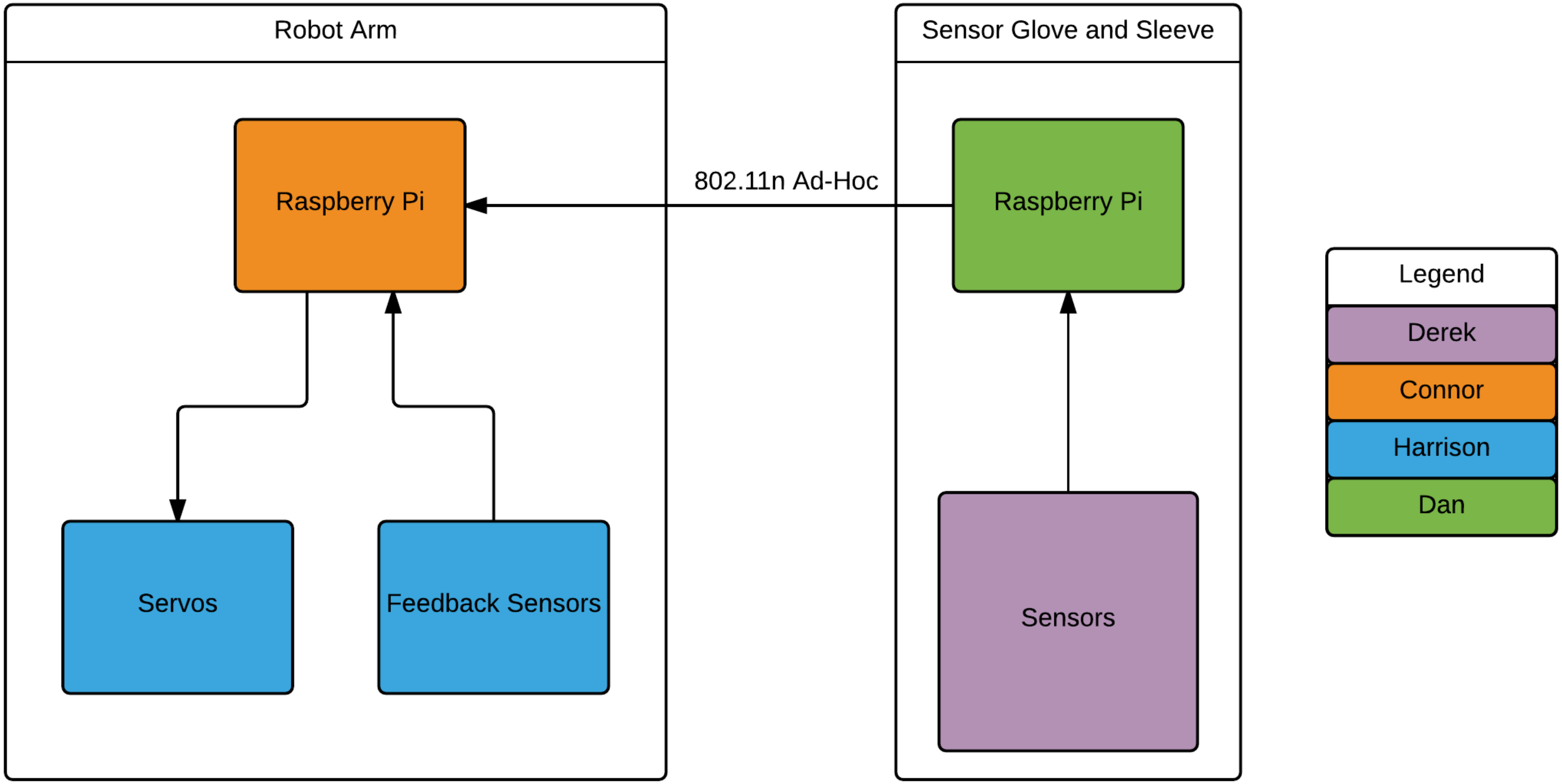
Requirements - Specifications

- Five degrees of freedom for arm movement
- Individual finger control
- Wireless communication between sensor glove/sleeve and robot arm
- Maximum latency of 500 ms
- Sensor glove/sleeve can be used by multiple users

Requirements – Input/Output

- Inputs
  - Accelerometer force data
  - Gyroscope orientation data
  - Flex sensor data
  - Feedback sensor data
- Outputs
  - Servo angle/rotation
    - Independent for each servo
  - Capture motion recording library

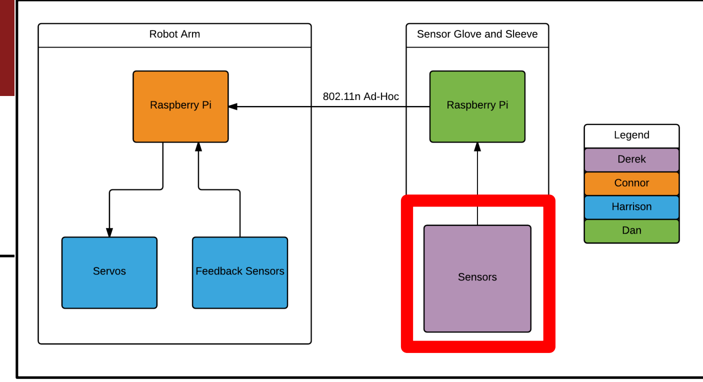
High Level Block Diagram

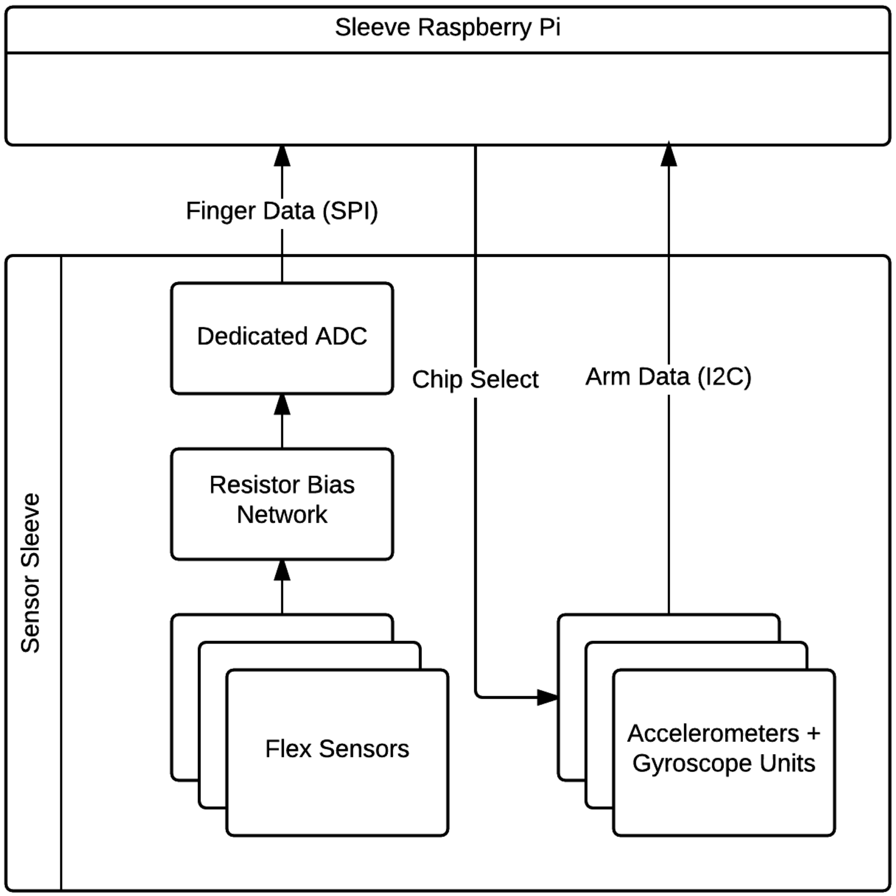


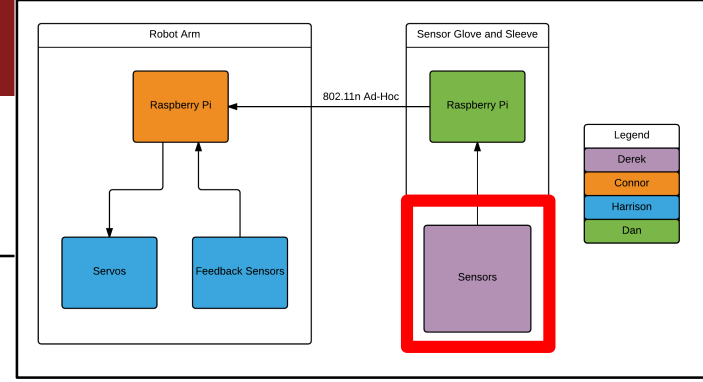
Distribution of Responsibilities

Connor	Derek	Harrison	Dan
- R Pi Robot Arm programming - Use sensor data to compute arm movements - 3D Printing of parts and assembly of 3D printed parts	- Sensor selection and placement on sleeve - Sleeve/glove assembly - Flex sensor bias network	- Calibrating and testing servos - Sensor selection and placement for feedback - Power supply - Assembly of 3D printed parts	- R Pi Sleeve Programming - Receive data from Sleeve - Transmit data to robot arm - Communication architecture for Raspberry Pis

Sensor Glove + Sleeve - Derek







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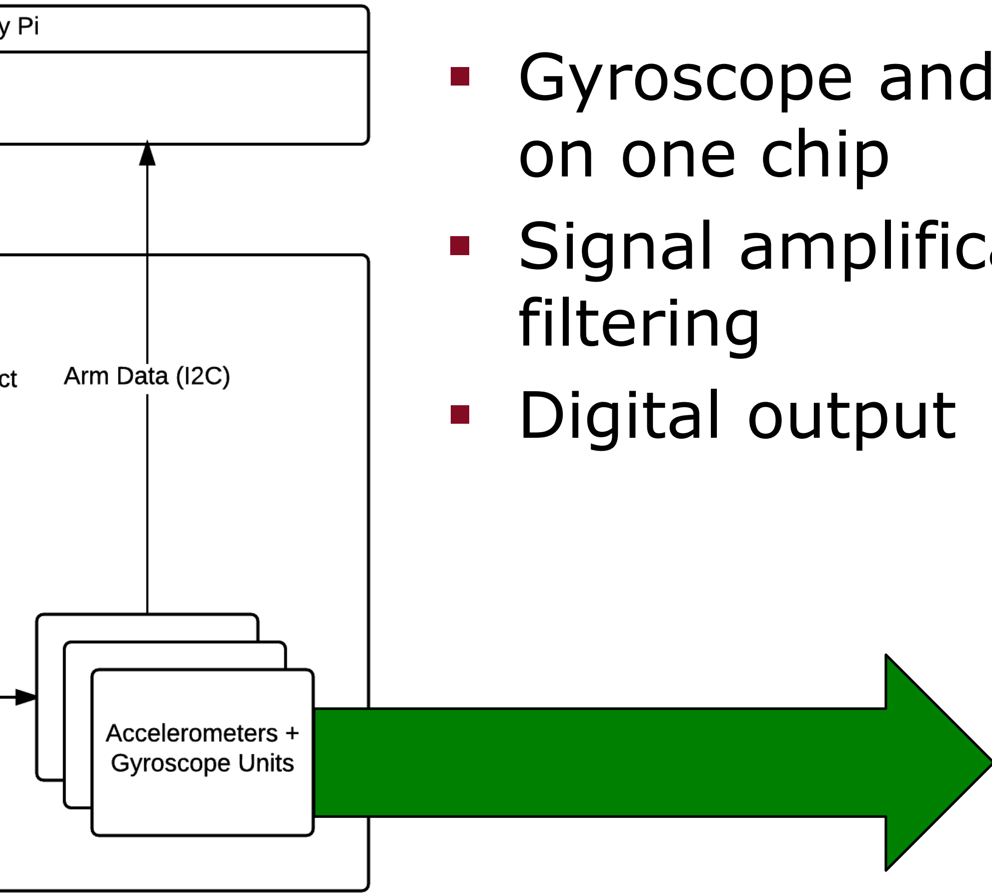
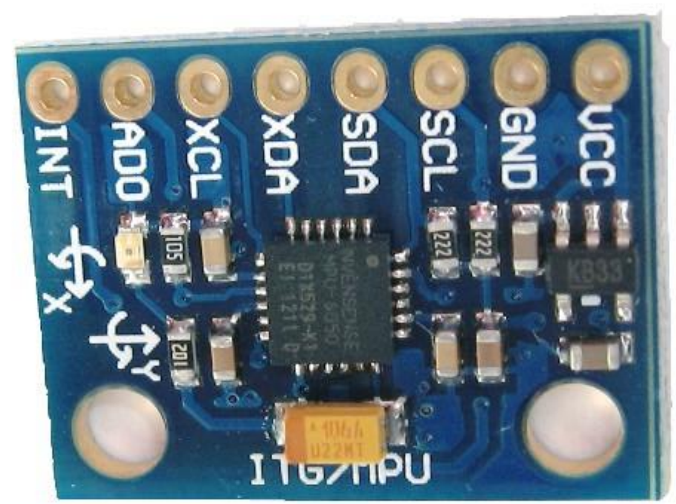
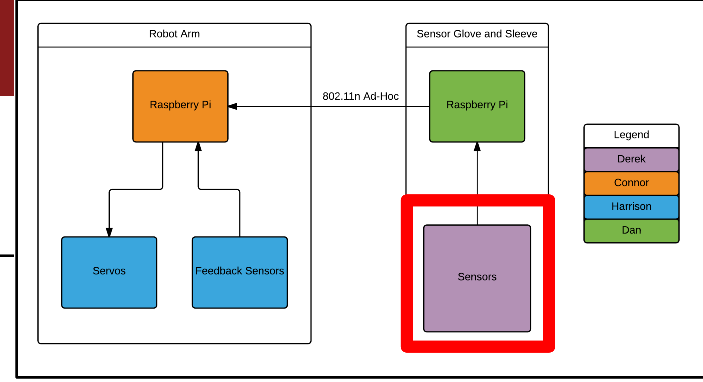


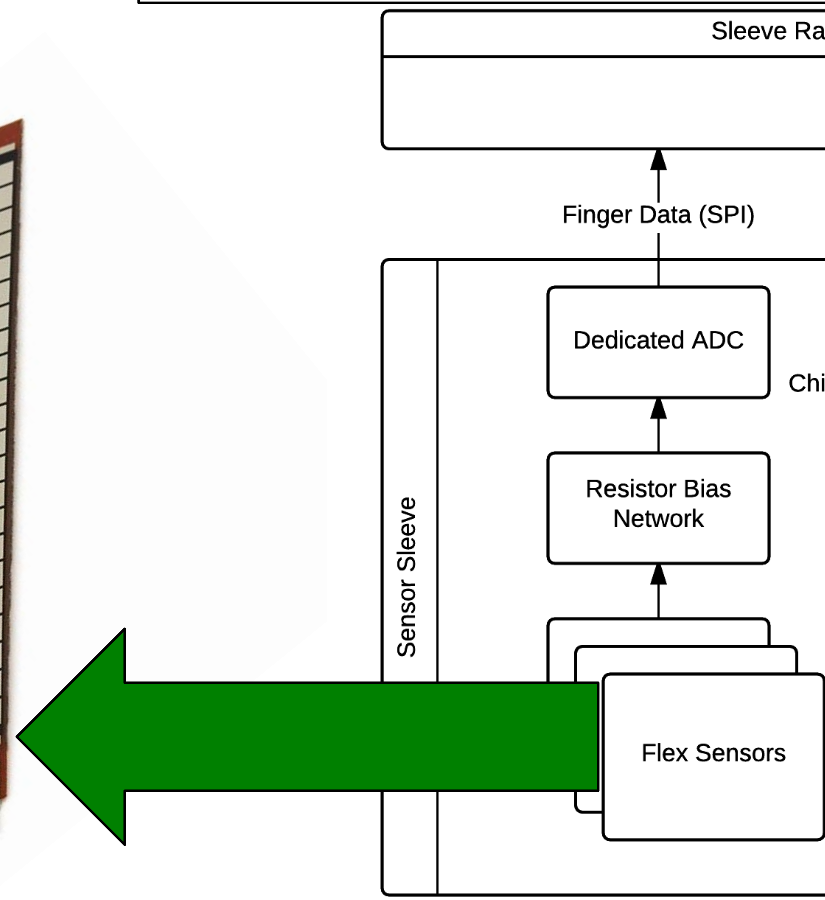
- Gyroscope and Accelerometer on one chip
- Signal amplification and filtering
- Digital output



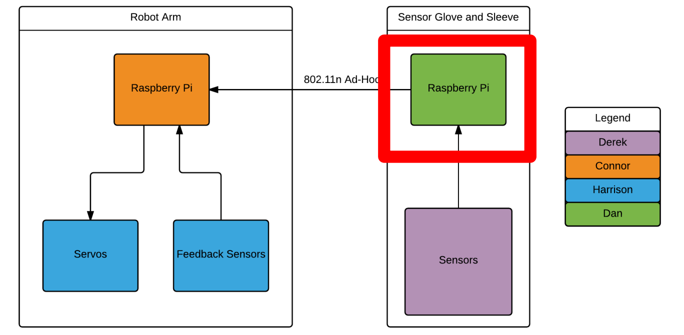
Sensor Glove + Sleeve - Derek

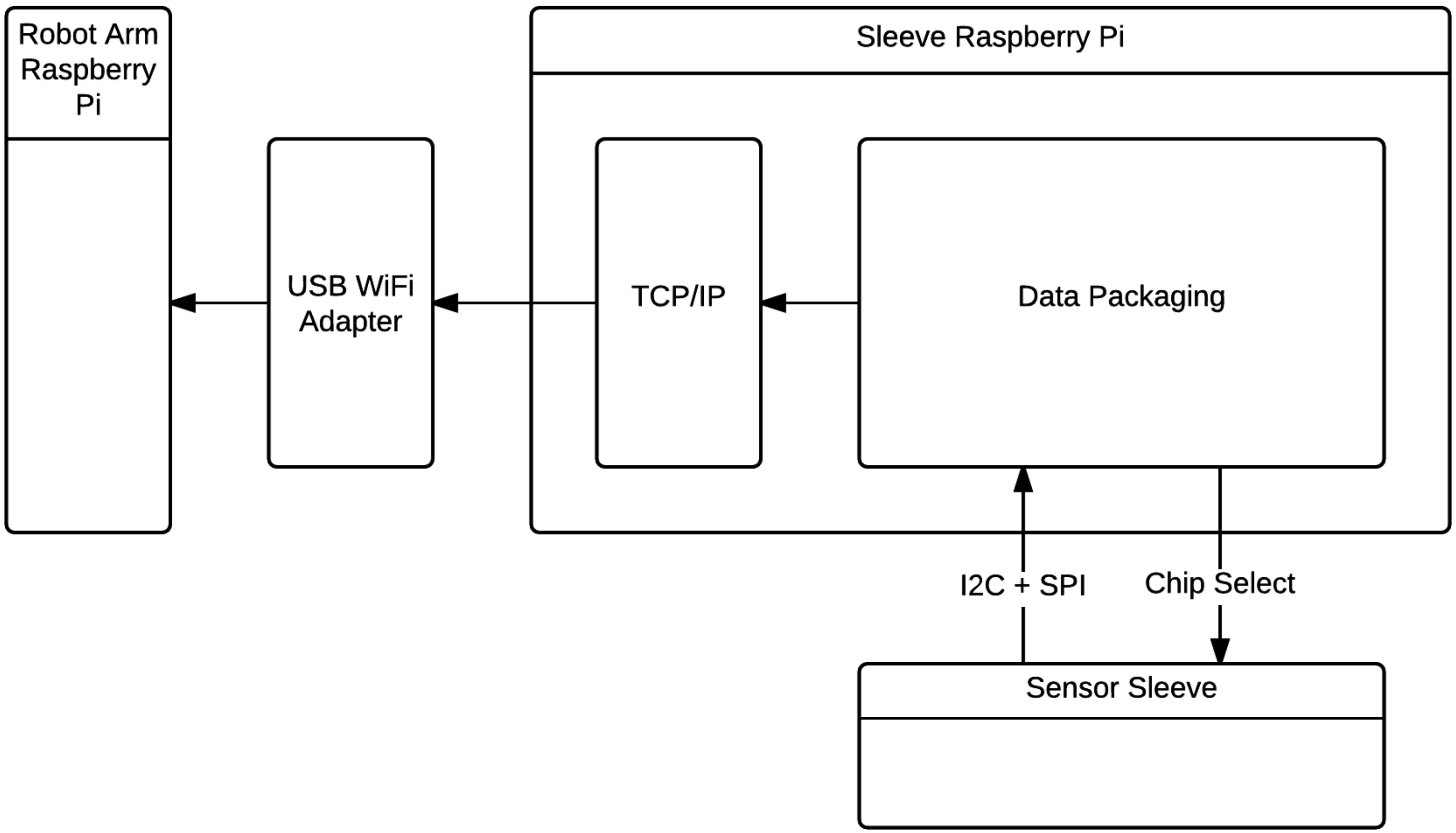


- Flex sensor
  - Variable resistance based of bend of strip
- Voltage divider with flex sensor to measure finger movement

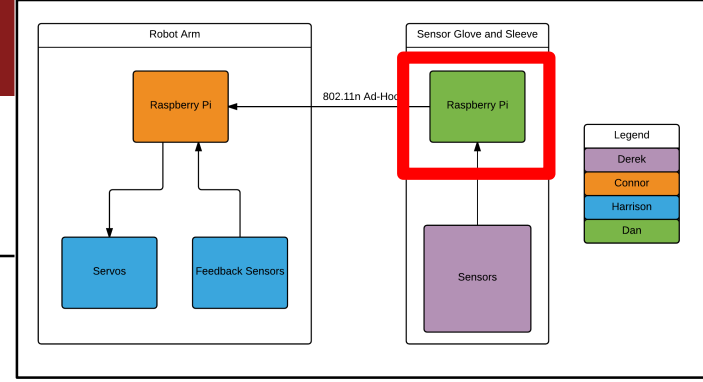


Sleeve R Pi - Dan

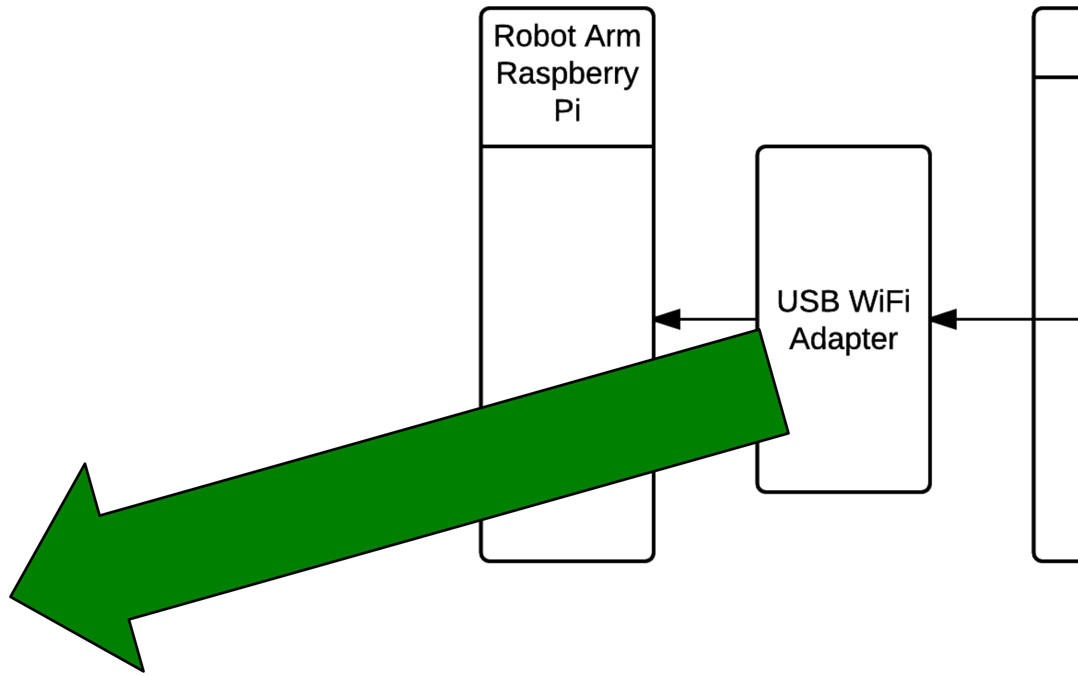




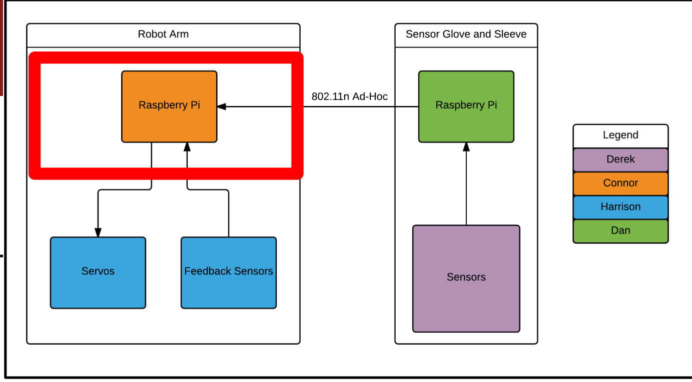
Sleeve R Pi - Dan

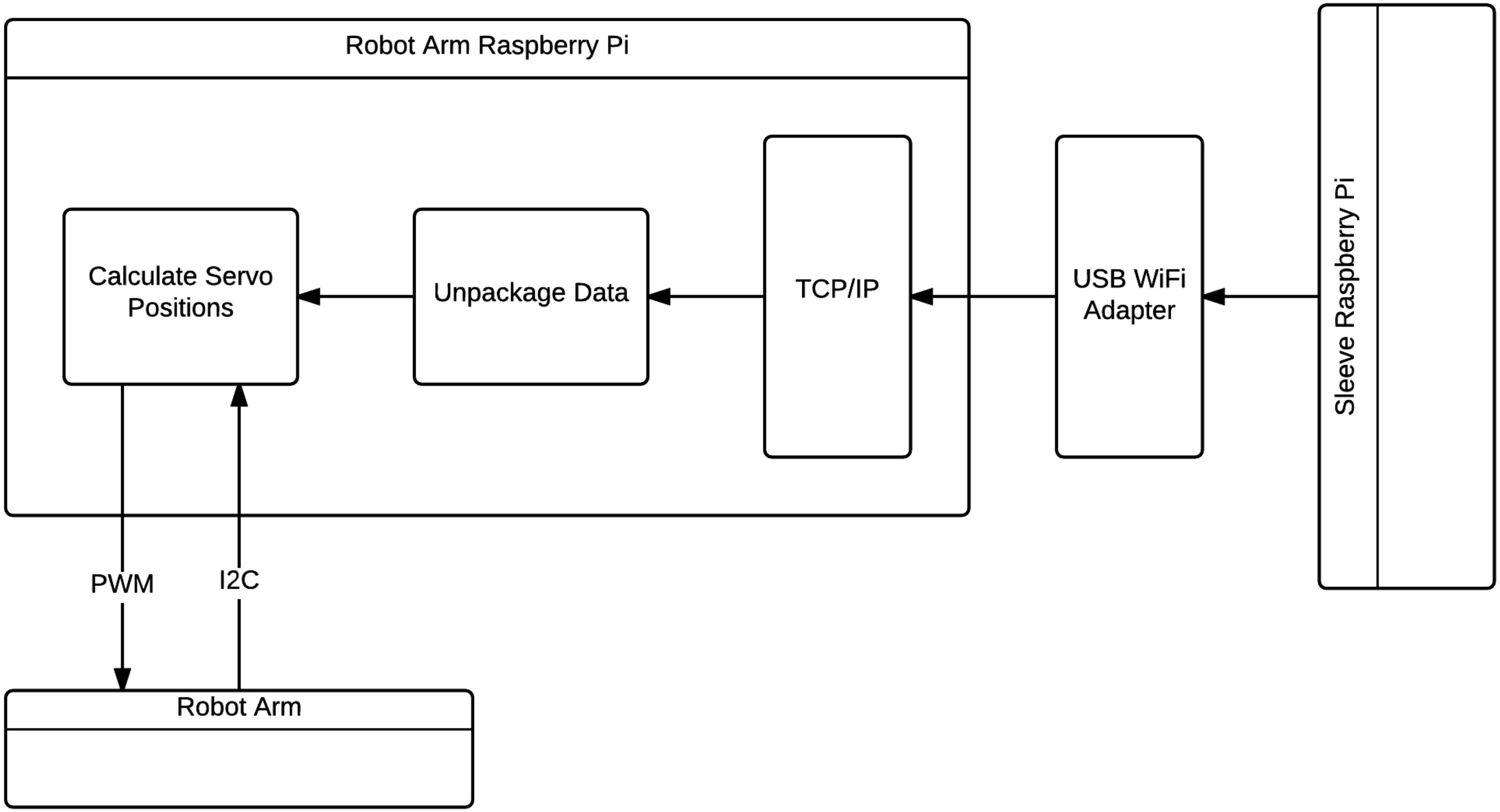


- Chosen WiFi Adapter is the Edimax EW-7811Un
- Supports 802.11n
- Cheap
- Compatible with R Pi

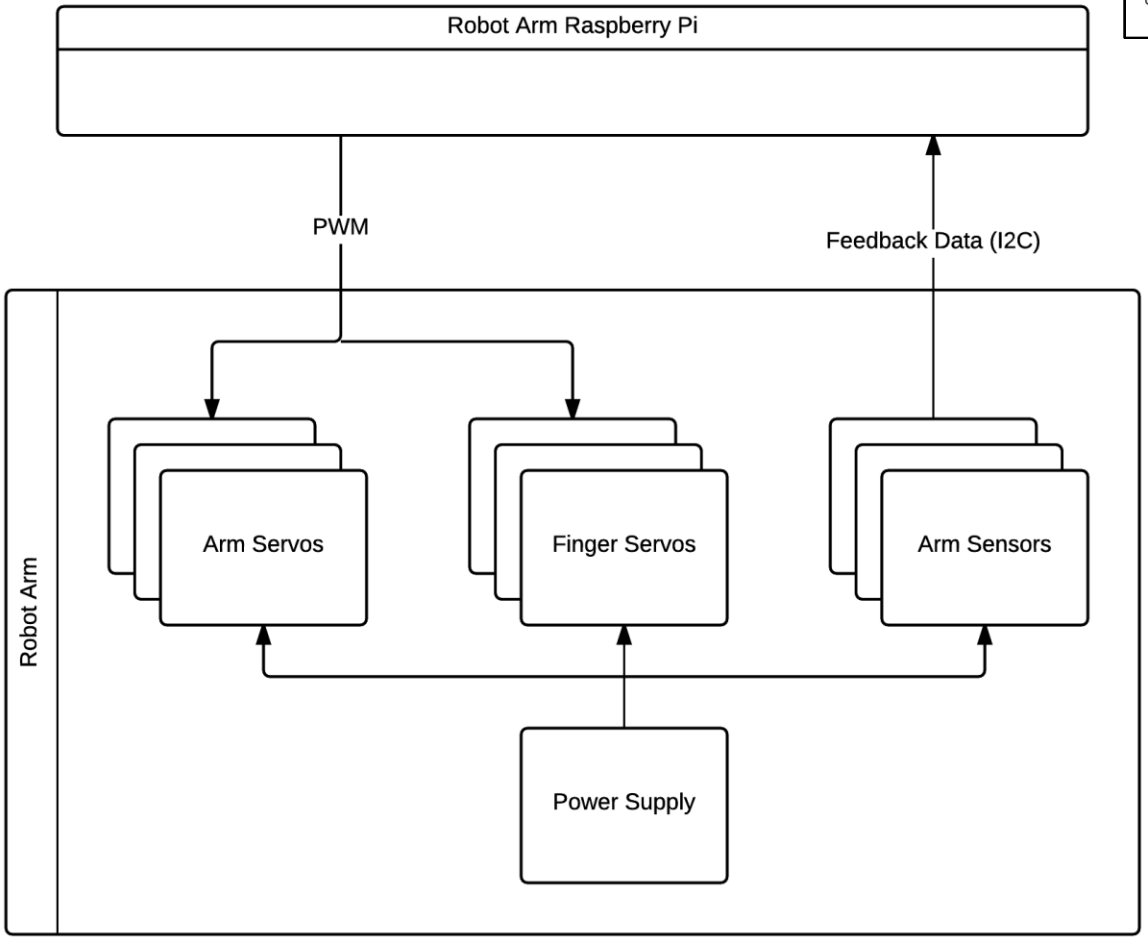


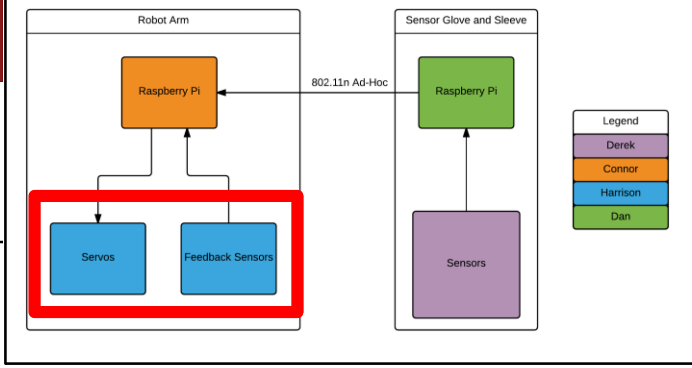
Robot Arm R Pi - Connor





Robot Arm - Harrison





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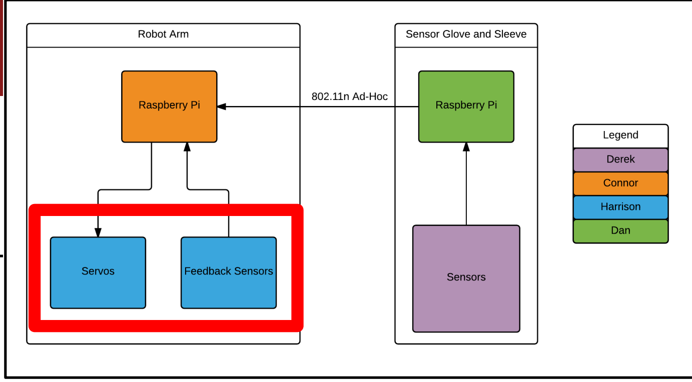
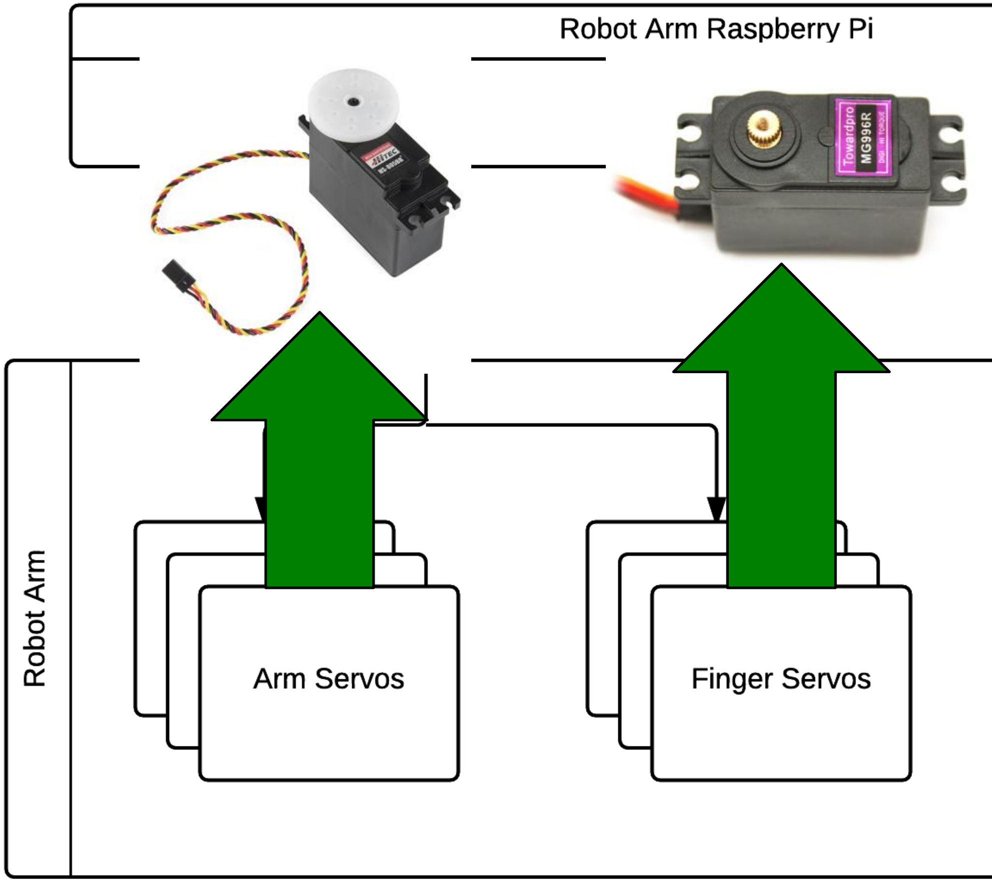
Robot Arm - Harrison



- Servo models provided by instructions for InMoov robot arm
  - HS-808BB for arm
  - MG996r for fingers



MDR Deliverables

- Functioning ad-hoc Wi-Fi communication between Raspberry Pi’s (Dan)
- Sensor glove complete and sending signals to Raspberry Pi (Derek)
- Raspberry Pi on robot arm sending control signals to finger servos (Connor)
- Servo power supply for fingers and assembly servo calibration (Harrison)

- 3D printed and assembled robot hand/arm (All)