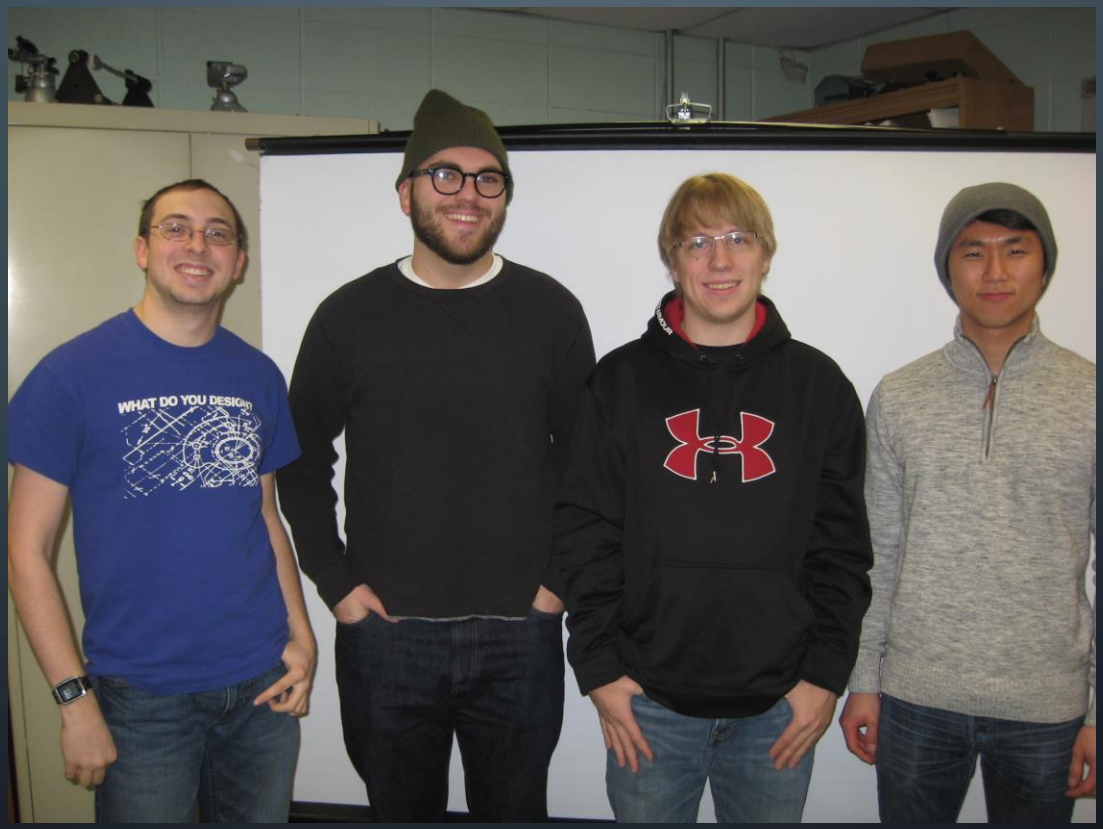
ECE 477 DESIGN REVIEW TEAM 4 – SPRING 2015



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OUTLINE

- Project overview
- Project-specific success criteria
- Block diagram
- Component selection rationale
- Packaging design
- Schematic and theory of operation
- PCB layout
- Software design/development status
- Project completion timeline
- Questions / discussion

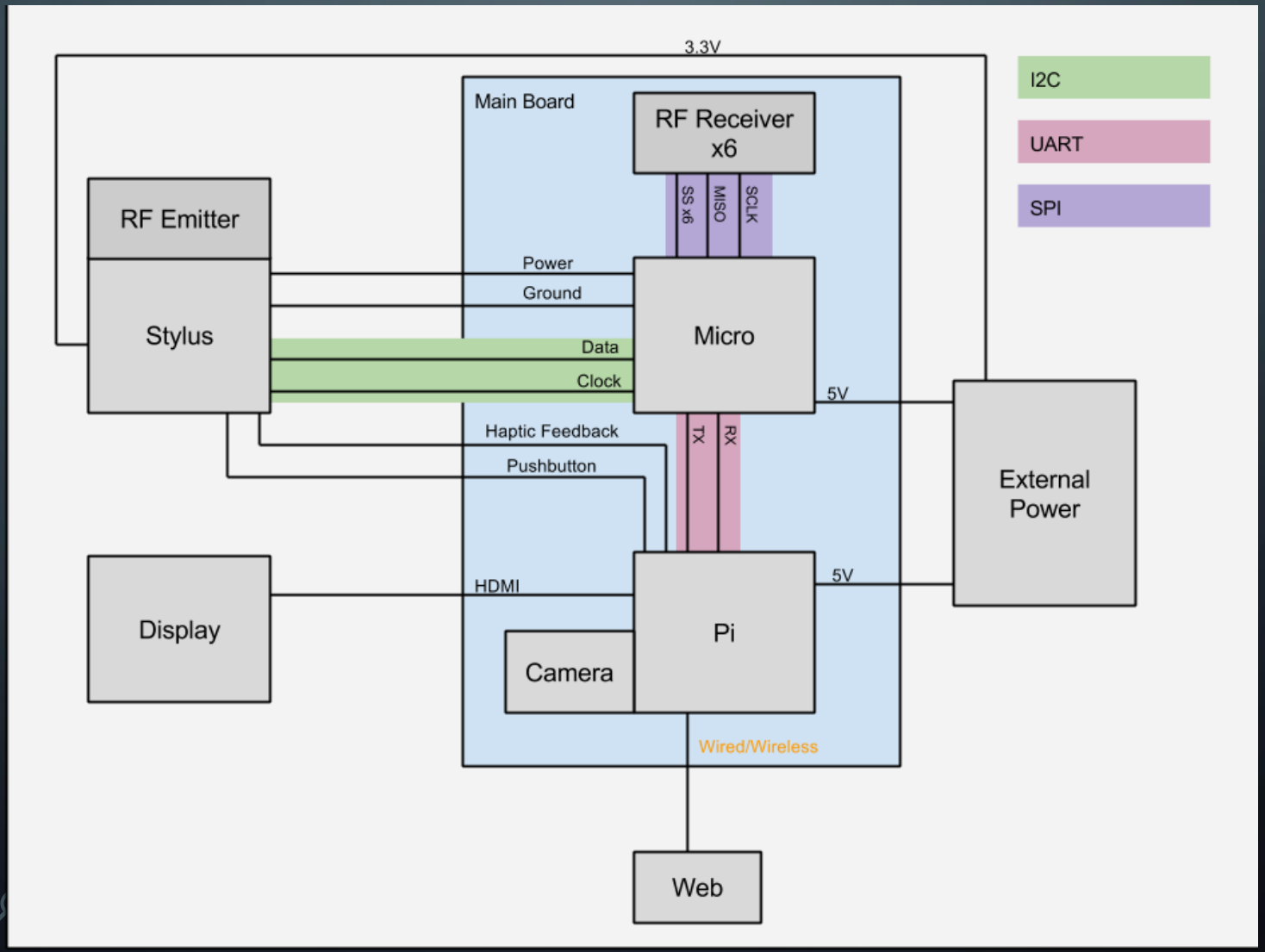
PROJECT OVERVIEW

- A system which allows the user to draw and manipulate objects in a virtual environment
- Utilizes a pen whose location in the 3D workspace is known to provide an intuitive, natural interface
- Environment can be viewed and settings modified remotely through a web interface

PROJECT-SPECIFIC SUCCESS CRITERIA

- An ability to remotely view the canvas as well as analytical data using a web or mobile interface.
- An ability to identify and communicate to the user (using some form of haptic feedback mechanism) when the stylus is in close proximity to a previously drawn object.
- An ability to assist the user in drawing straight lines and other primitive shapes using smoothing algorithms.
- An ability to determine the location of a point in 3D space based on wireless signal strength as measured from multiple locations.
- An ability to maintain reasonable (percentage TBD) accuracy locating the stylus regardless of its orientation.

BLOCK DIAGRAM



COMPONENT SELECTION: *MICROCONTROLLER*

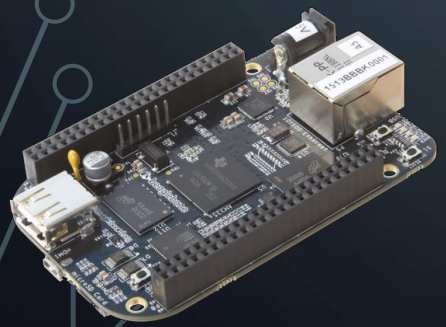
- Selection Criteria:
  - Performance
  - Community support and software tools
  - Power consumption

- Considerations: ATmega328p, TI MSP430, and PIC24FJ256DA206-I/PT

- Final Decision: ATmega328p for strong community

COMPONENT SELECTION: *CENTRAL COMPUTING DEVICE*

- Selection based on Cost and amount of I/O
- Decision between Beaglebone Black, Raspberry Pi, and Hummingboard
- Raspberry Pi was overall winner



COMPONENT SELECTION: *RF MODULE*

- Requirements
  - Operate in the unlicensed 433-444 MHz band
  - Release and experience minimal interference from system
  - Support RSSI (Received Signal Strength Indicator)

- Final Selection:
  - Link TRM-433 Transceiver IC

COMPONENT SELECTION: *ORIENTATION SENSOR*

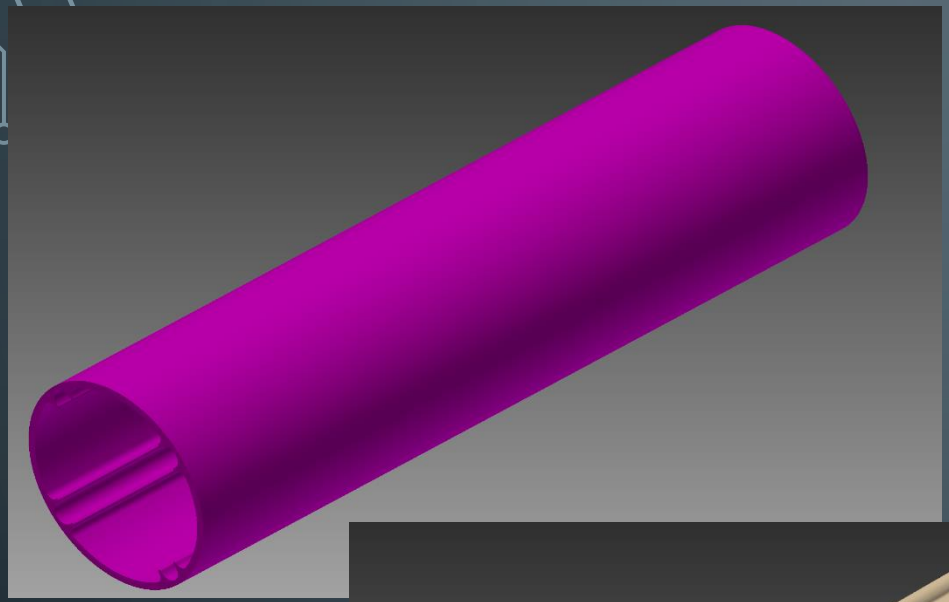
- Inertial Measurement Unit
  - Combines Accelerometer, Compass, Gyroscope
  - Allows device orientation to be determined with reasonable accuracy
- Contenders: Razor IMU & Sensor Stick
  - Sensor Stick similarly equipped while being smaller, less expensive

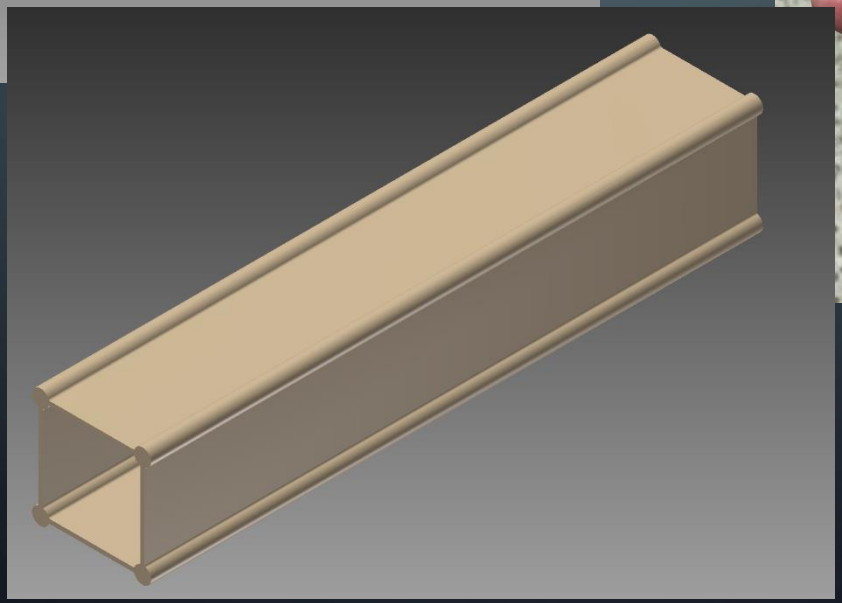
PACKAGING DESIGN - STYLUS

Two piece, 3D printed construction comprised of outer body and inner core to which PCBs are attached

- Modular
- Inexpensive to manufacture
- Easy to swap in different grip designs for testing

PACKAGING DESIGN - STYLUS

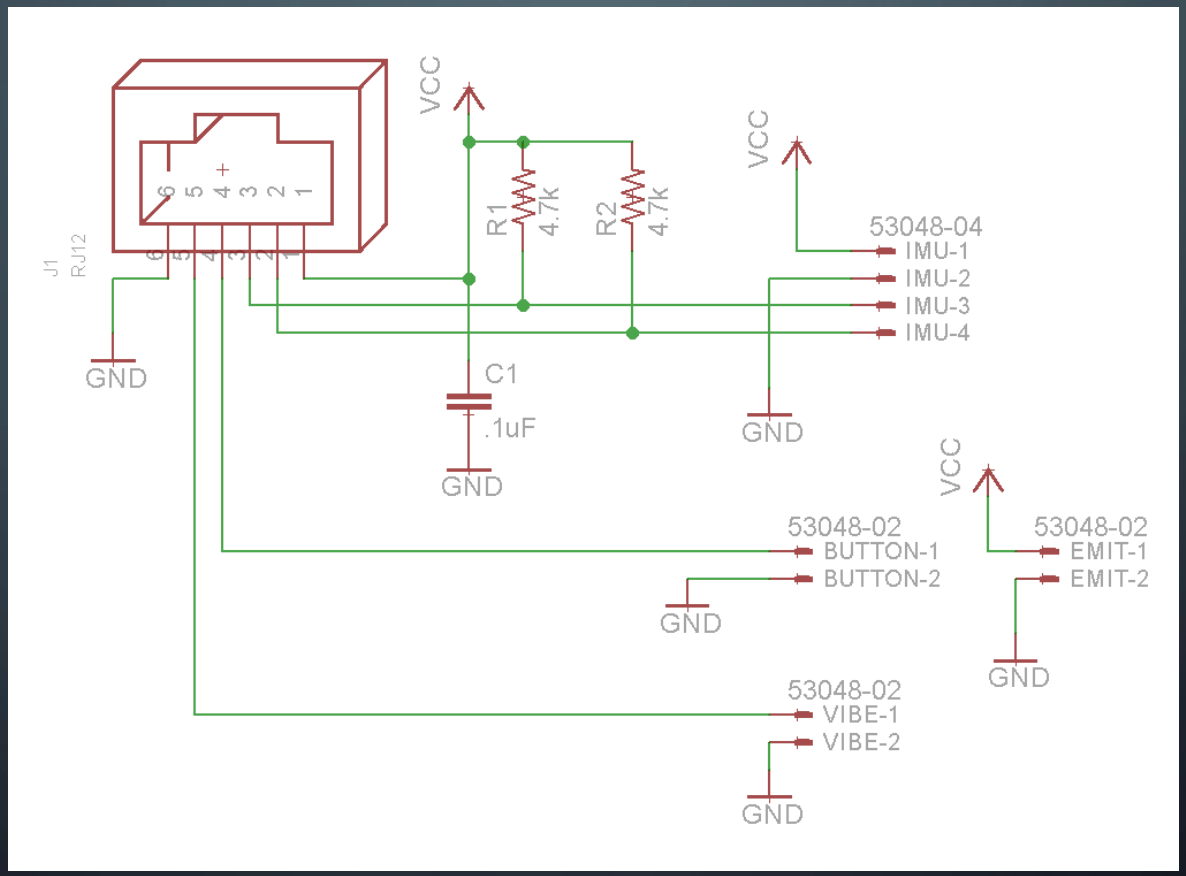




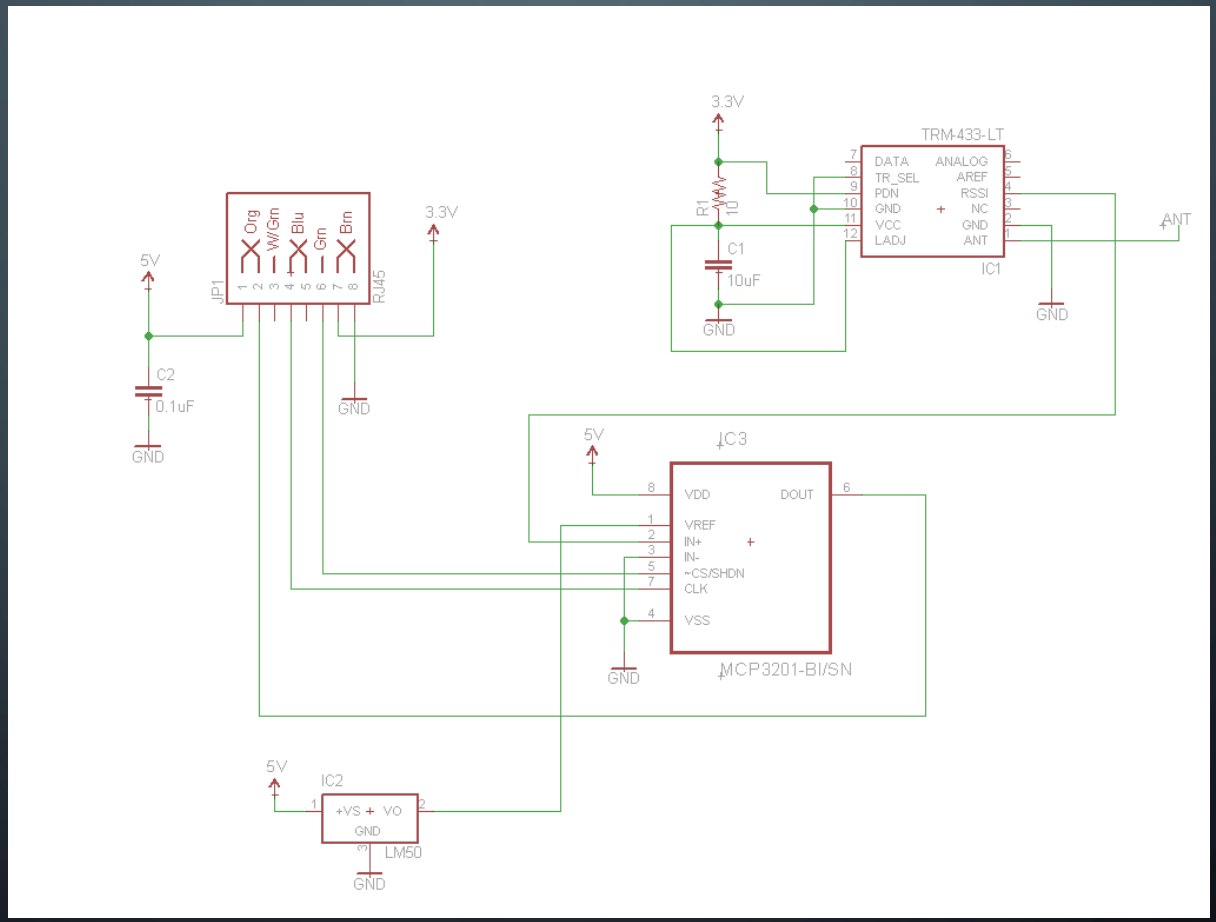
PACKAGING DESIGN: *MAIN BOARD & RECEIVERS*

- Main Board:
  - Simple combination of two sheets of Polycarbonate/Acrylic with board attached in the middle to protect it from damage
- Receivers:
  - Dependent on results of experiments once boards have been produced and assembled

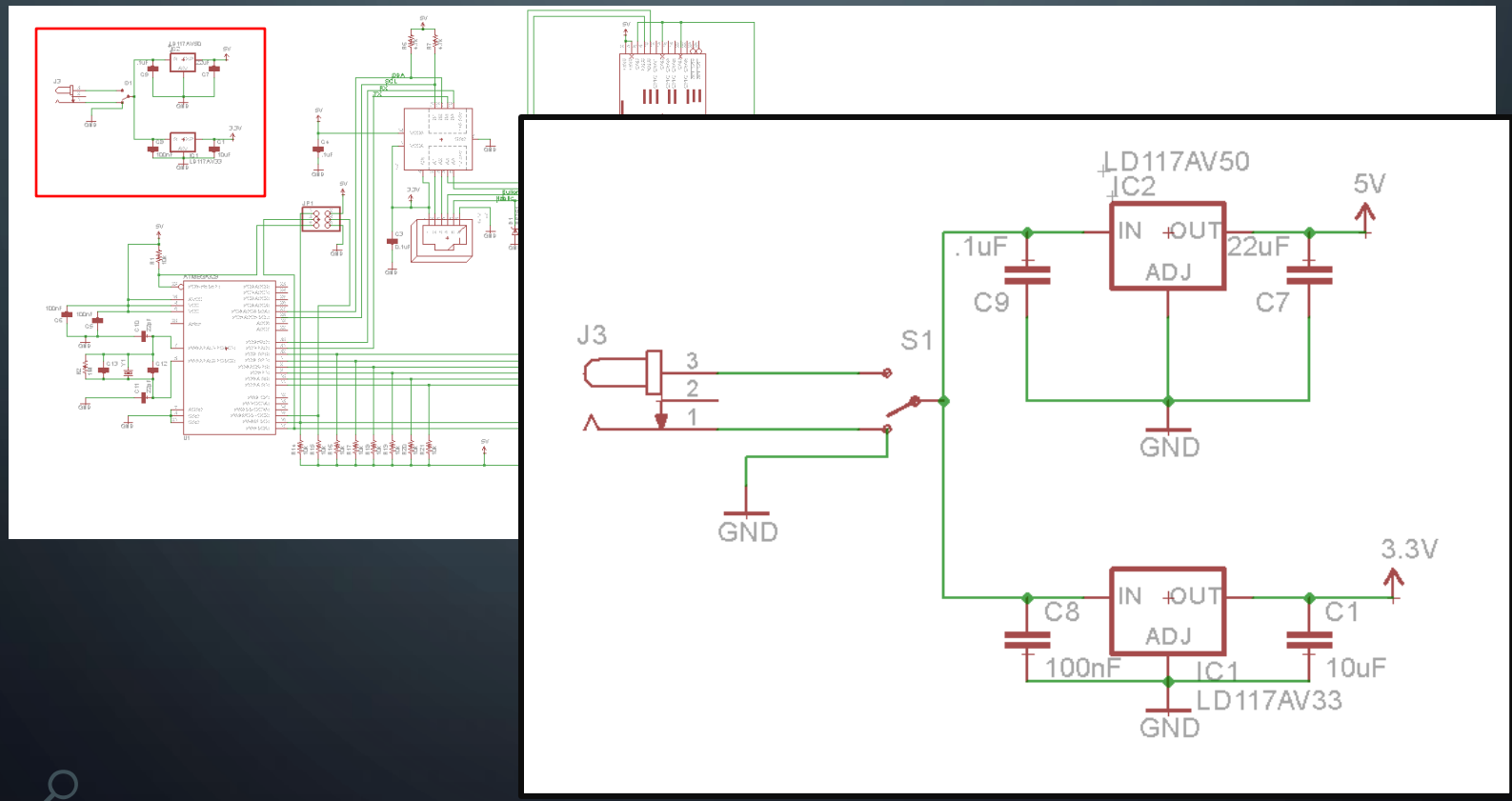
SCHEMATIC/THEORY OF OPERATION: *STYLUS*



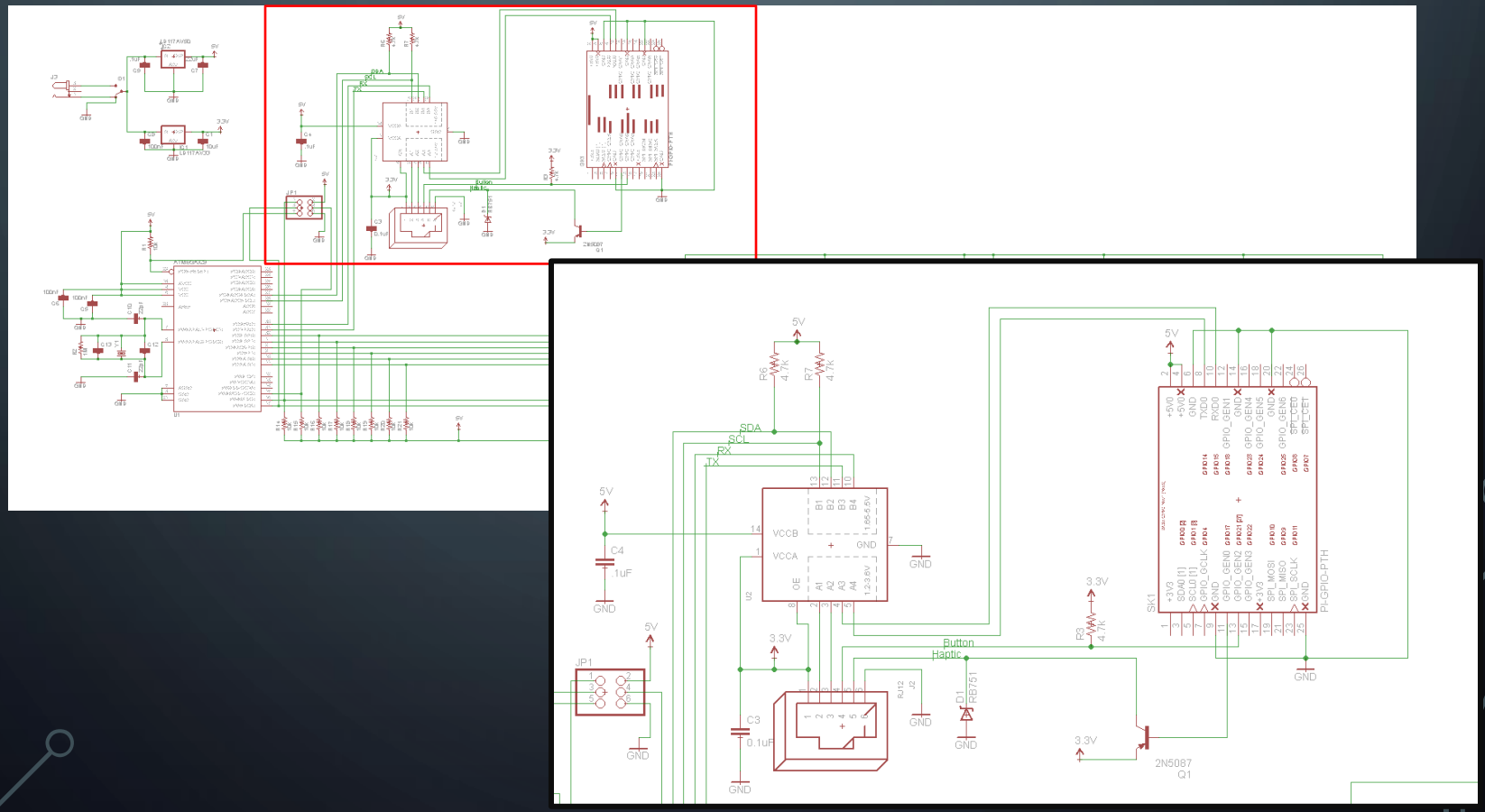
SCHEMATIC/THEORY OF OPERATION: *RECEIVER*



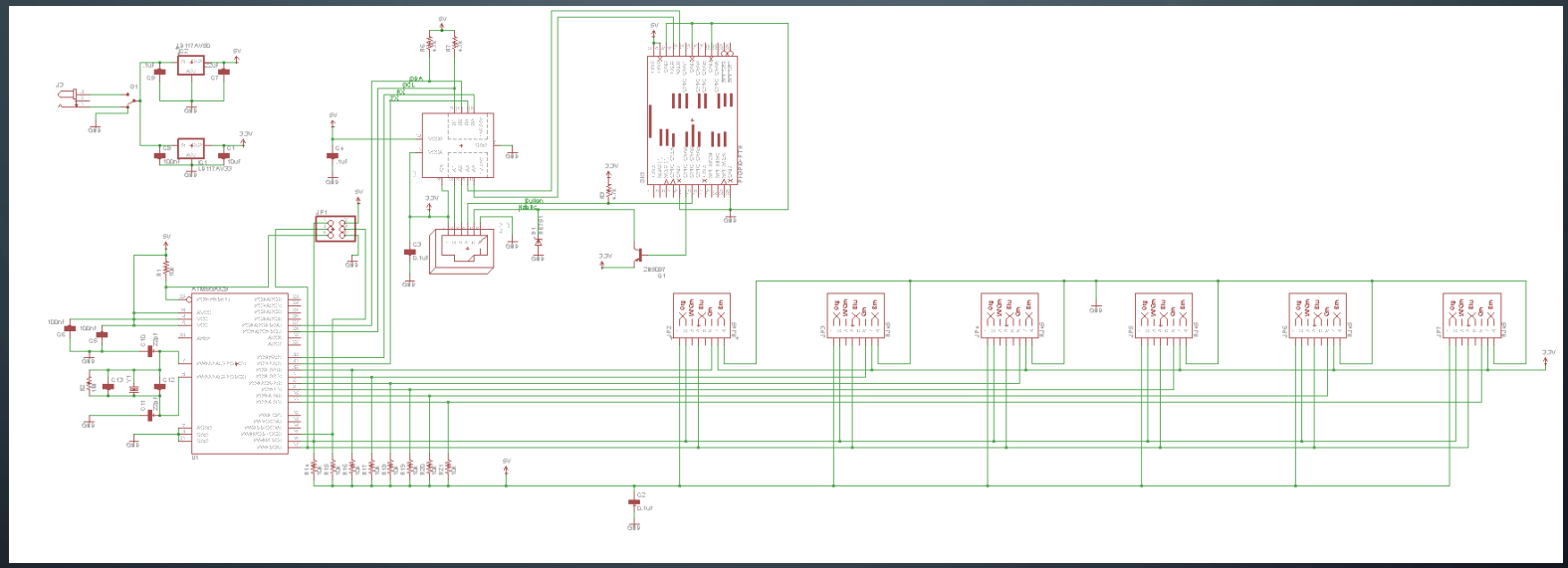
SCHEMATIC/THEORY OF OPERATION: *MAIN BOARD – POWER CIRCUIT*



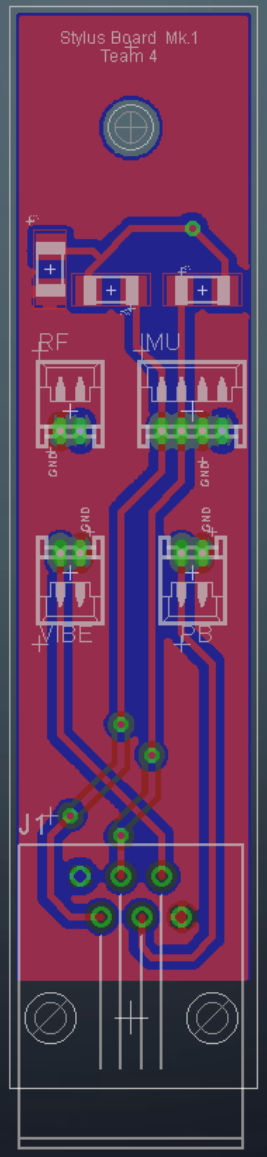
SCHEMATIC/THEORY OF OPERATION: *MAIN BOARD - CONNECTIVITY*



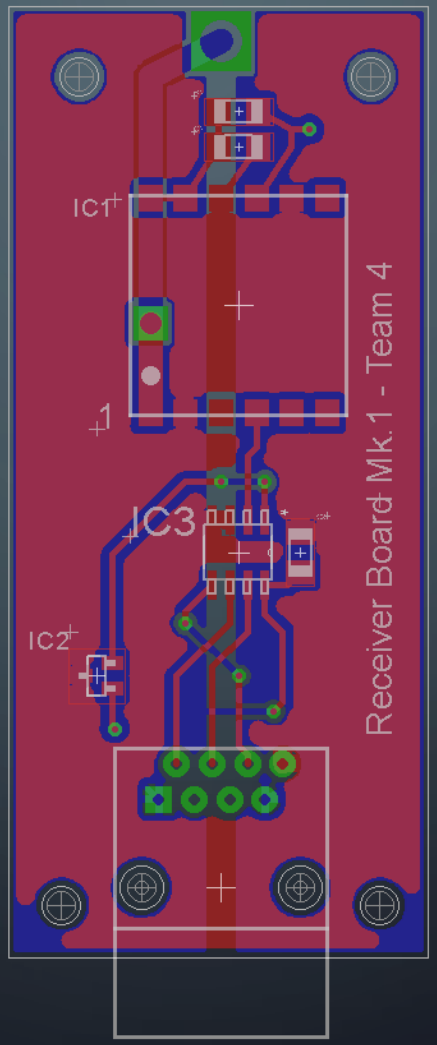
SCHEMATIC/THEORY OF OPERATION: *MAIN BOARD*



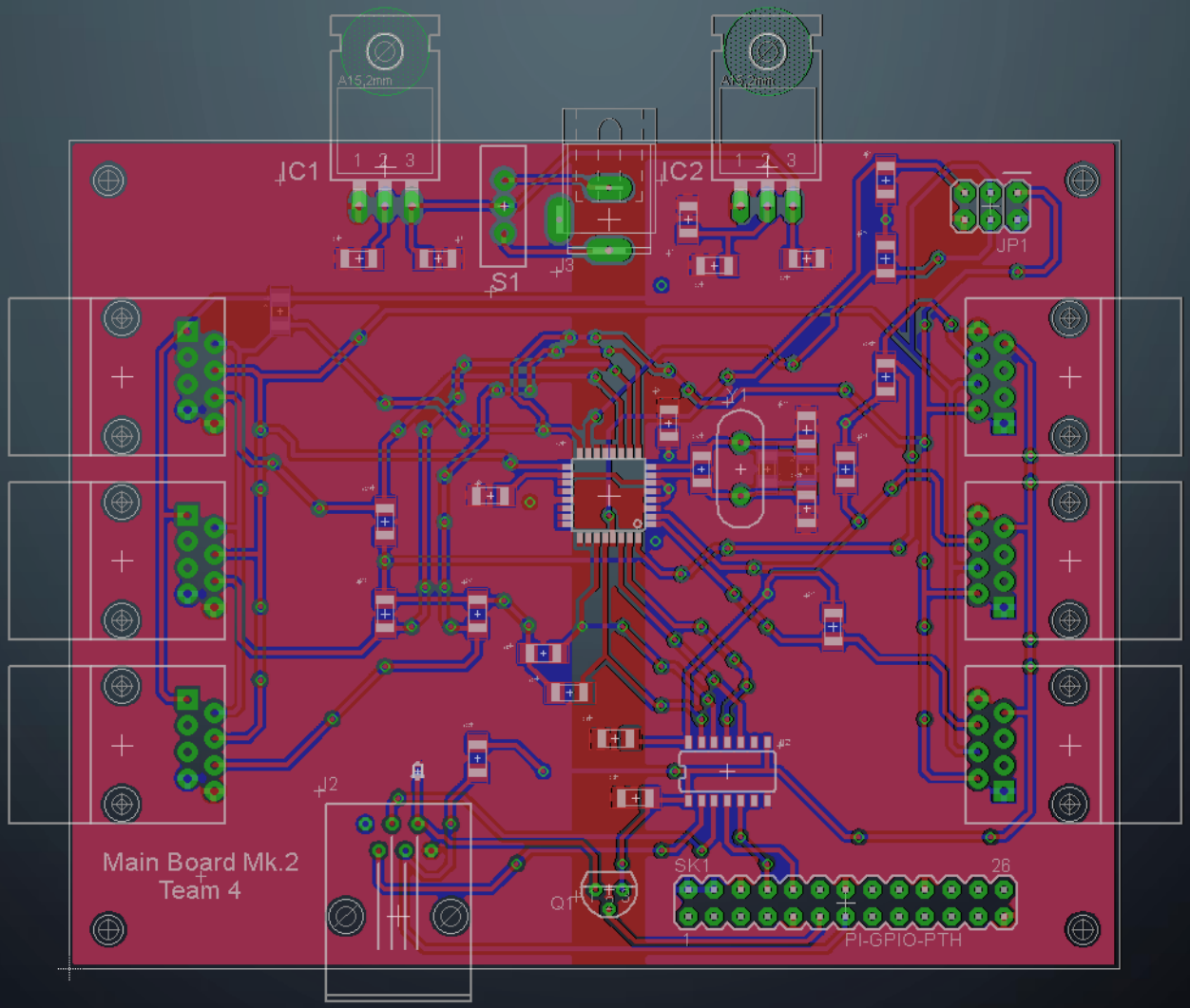
PCB LAYOUT – STYLUS



PCB LAYOUT – RECEIVER



PCB LAYOUT – MAIN BOARD



SOFTWARE DEVELOPMENT STATUS: *RASPBERRY PI ENVIRONMENT*

- Camera Location: In Progress
- Object Drawing
  - Single Point Objects: COMPLETE
  - Double Point Objects: In Progress
- Intersection Detection: COMPLETE
- Save/Load: Future

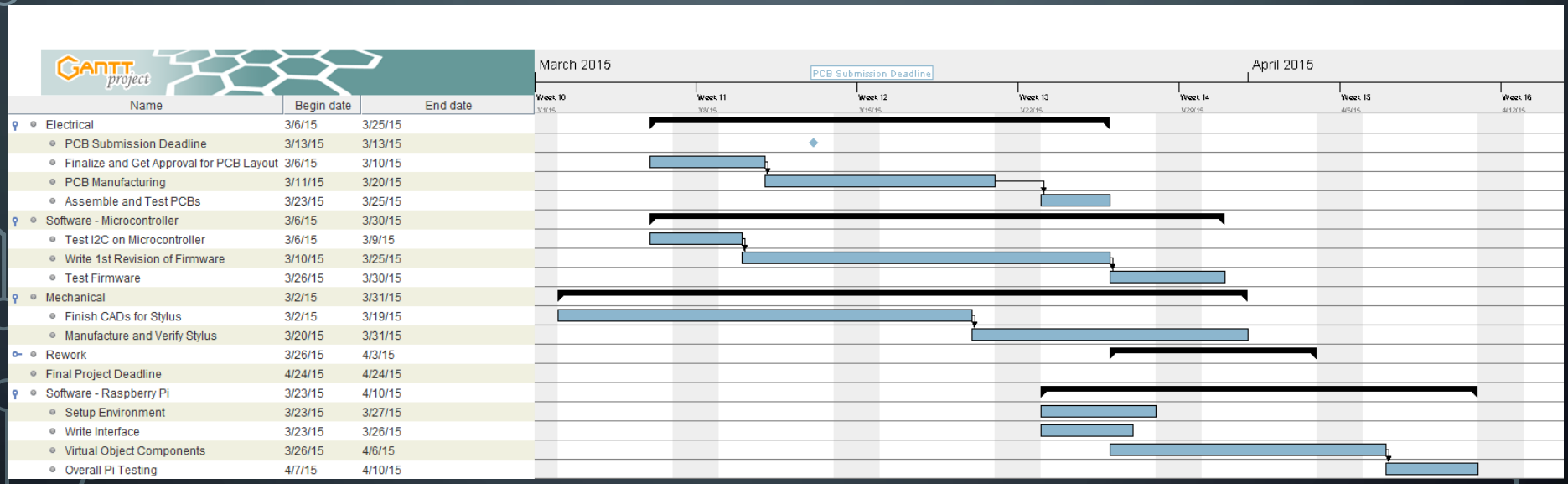
SOFTWARE DEVELOPMENT STATUS: *RASPBERRY PI INTERFACE*

- Coordinate Input (UART)
  - Determine Transmission Standards: In Progress
  - Convert Raw Signal to Float: COMPLETE
- Button Input (GPIO): In Progress
- Haptic Feedback (GPIO): In Progress

SOFTWARE DEVELOPMENT STATUS: *MICROCONTROLLER*

- Process RSSI Input (SPI): In Progress
- Transmit Coordinates (UART): COMPLETE
- Process IMU Input (I^2C): Future
- Compute Coordinates: In Progress
- Smooth Coordinates: Future

PROJECT COMPLETION TIMELINE



Name	Begin date	End date
Electrical	3/6/15	3/25/15
PCB Submission Deadline	3/13/15	3/13/15
Finalize and Get Approval for PCB Layout	3/6/15	3/10/15
PCB Manufacturing	3/11/15	3/20/15
Assemble and Test PCBs	3/23/15	3/25/15
Software - Microcontroller	3/6/15	3/30/15
Test I2C on Microcontroller	3/6/15	3/9/15
Write 1st Revision of Firmware	3/10/15	3/25/15
Test Firmware	3/26/15	3/30/15
Mechanical	3/2/15	3/31/15
Finish CADs for Stylus	3/2/15	3/19/15
Manufacture and Verify Stylus	3/20/15	3/31/15
Rework	3/26/15	4/3/15
Final Project Deadline	4/24/15	4/24/15
Software - Raspberry Pi	3/23/15	4/10/15
Setup Environment	3/23/15	3/27/15
Write Interface	3/23/15	3/26/15
Virtual Object Components	3/26/15	4/6/15
Overall Pi Testing	4/7/15	4/10/15

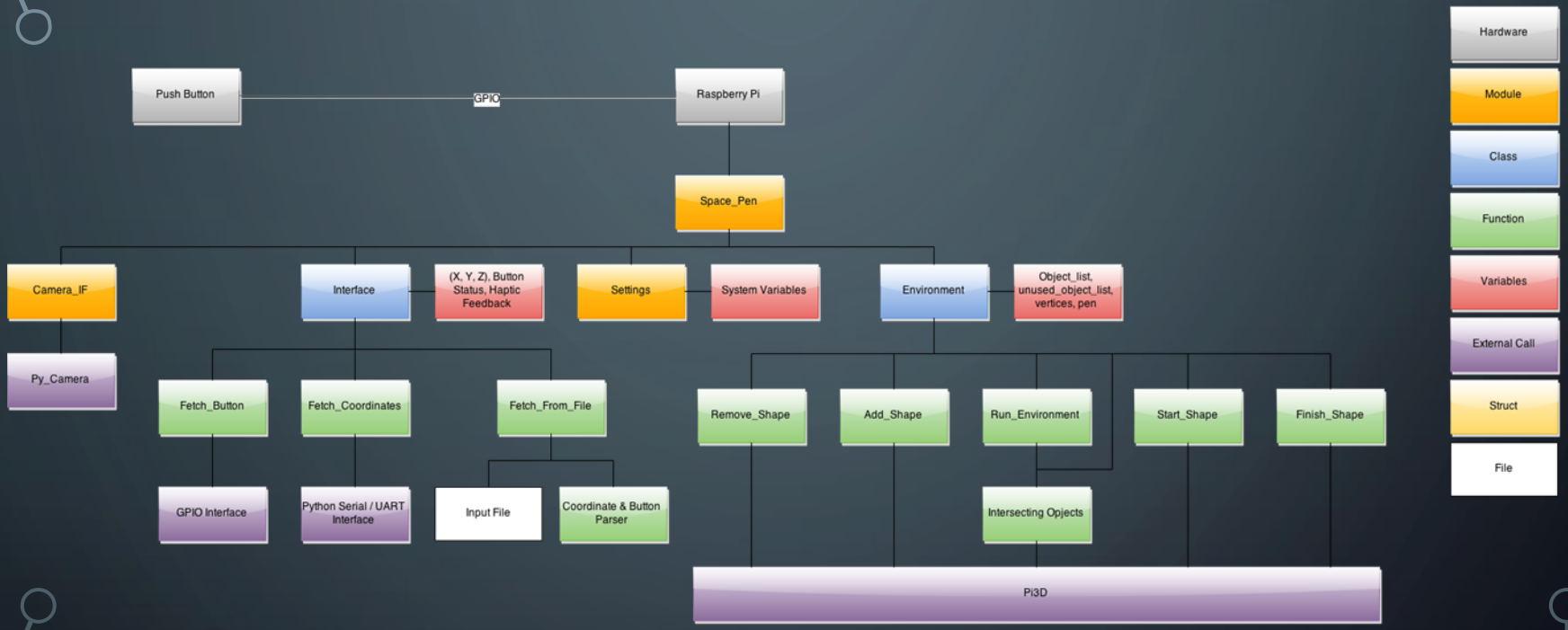
Projection Completion Goal: 3rd week of April

QUESTIONS?

SOFTWARE:
TESTING STILL TO BE DONE

- Camera Alignment
- Dual Point Object Drawing
- Saving/Loading Objects
- GPIO (Button) Input
- Haptic Feedback
- Computing/Smoothing Coordinates
- Processing IMU Input

RASPBERRY PI SOFTWARE LAYOUT



RASPBERRY PI SOFTWARE PROGRESS