

# Team Apple Final Presentation

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SCEL

Smart Campus Energy Laboratory

# Overview of Presentation

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2. Project Background & Project Goals
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# Kaeo Villa - Team Lead

Junior in Electrical Engineering

396 Project

Interested in renewable energy



# Tyrin Besas - Hardware

Junior in Electrical Engineering

396 Project

Interested in hardware design and renewable energy



# Tryston Fagarang - Hardware

Junior in Electrical Engineering

396 Project

Interested in renewable energy and hardware design

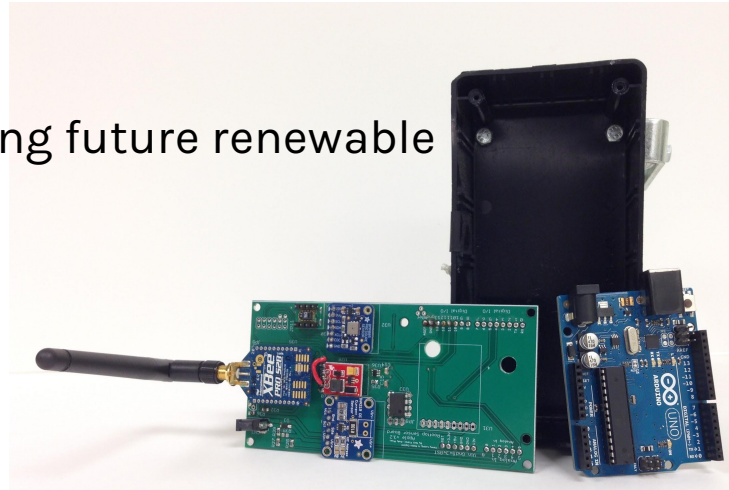


# Goal of the Project

Apple is the first stable platform in the weatherbox lineage

**Collect weather sensor data and send it back to a database**

The data will assist in planning future renewable energy installations



# Our Project Goals

## Fall 2015 Semester Goals

- Explored ways to advance the current Apple design
  - Created an easy to assemble housing structure
  - Solved power problems
- Improved the documentation of Apple
  - Updated the schematic and board design

## Long Term Goals

- Build 5-6 Apple weather boxes
- Have a network of Apple boxes that communicate with each other

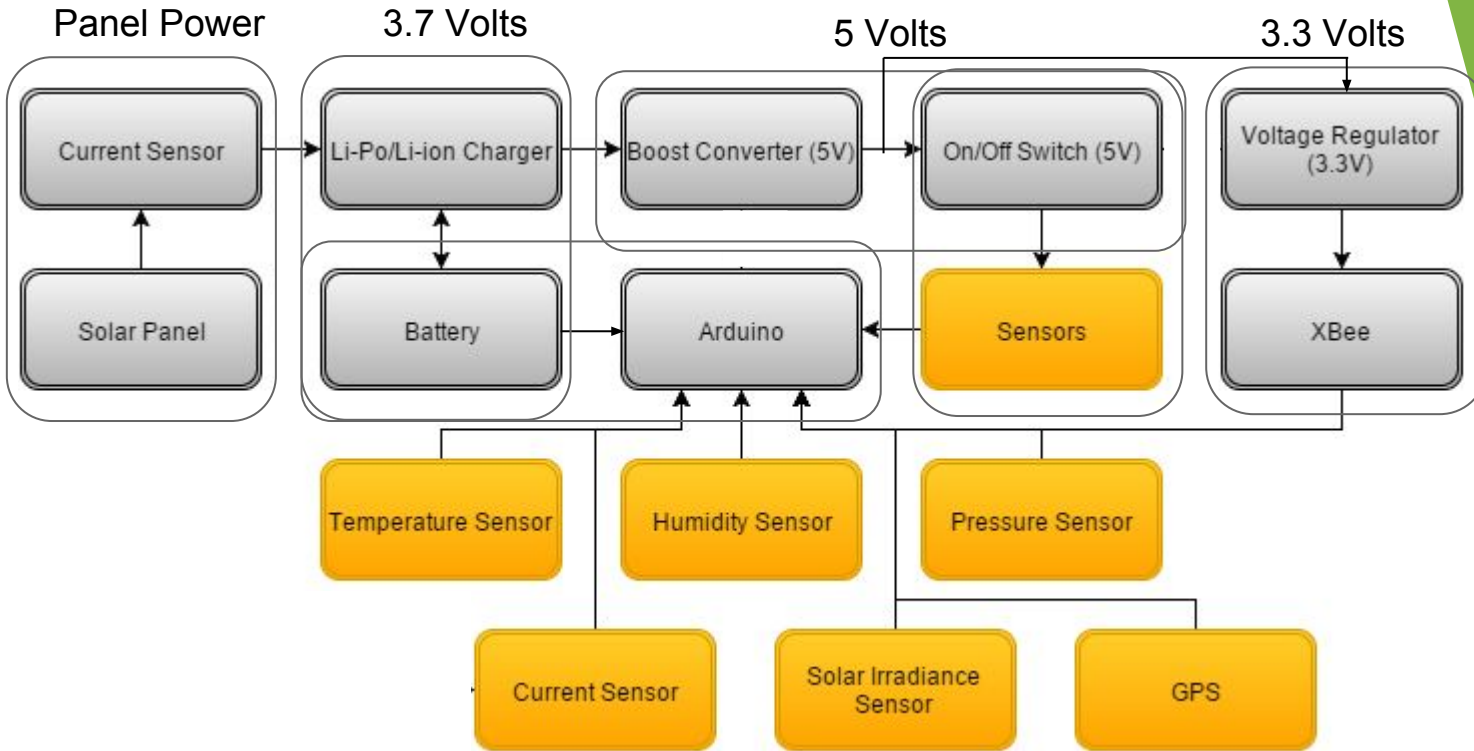


# Design Process





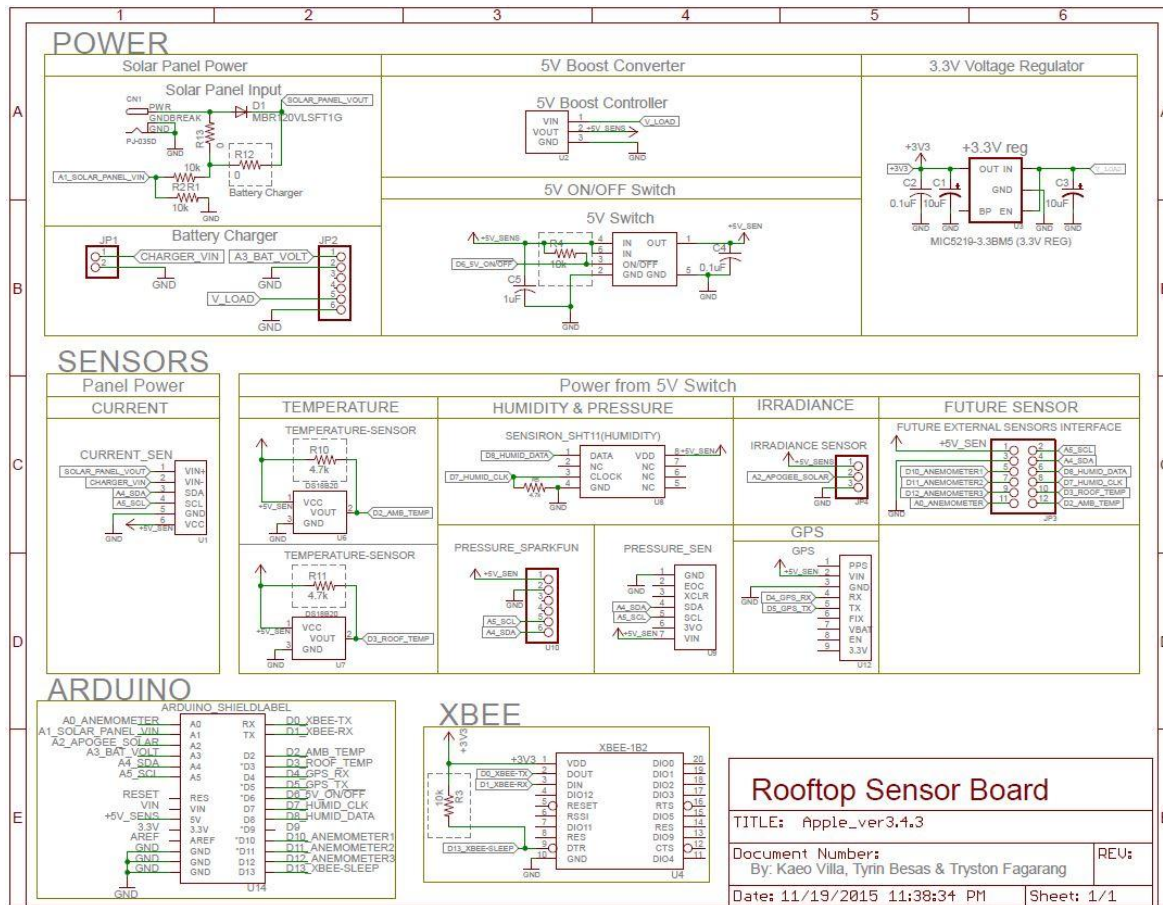
# Block Diagram



Gray = Power

Yellow = Sensors





# Schematic Version 3.4.3

# Schematic Changes

## Updated Previous Apple design

- ▶ Used Ver2.3 from Andy's Thesis

## Changed Irradiance Sensor - Apogee SP-215

- ▶ No op-amp needed; Sends amplified signal
- ▶ Not self powered

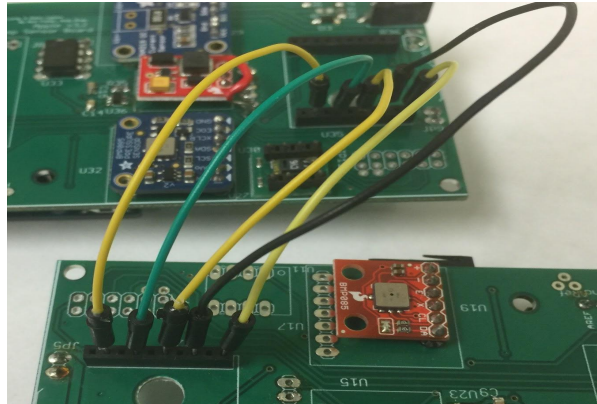


# Board Layout Design Idea

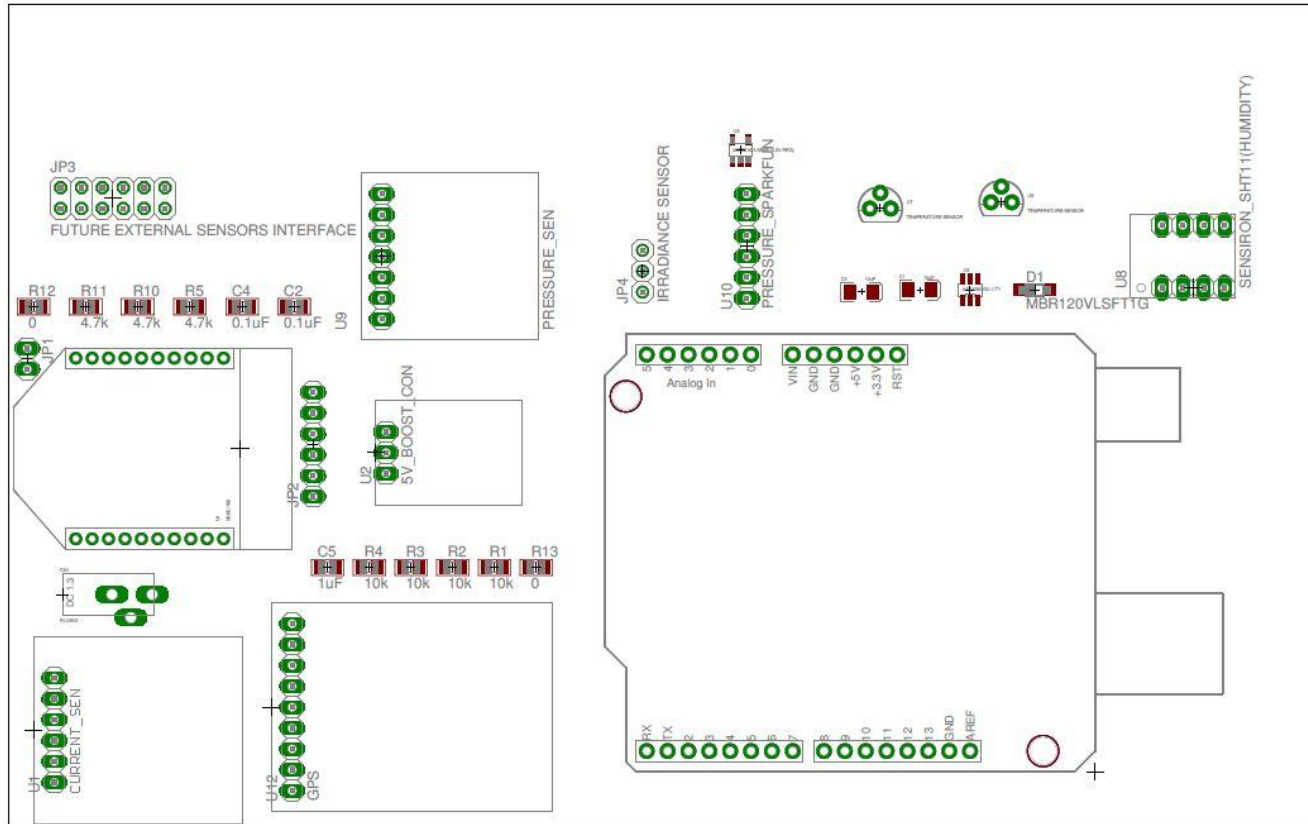
Use headers to connect sensors to the PCB

- ▶ Replace or take out sensors
- ▶ Use jumpers and connect to Verification board

Rotate arduino for easy access when debugging (Firmware)



6.299 inches



4.288 inches

## Board Layout Placement

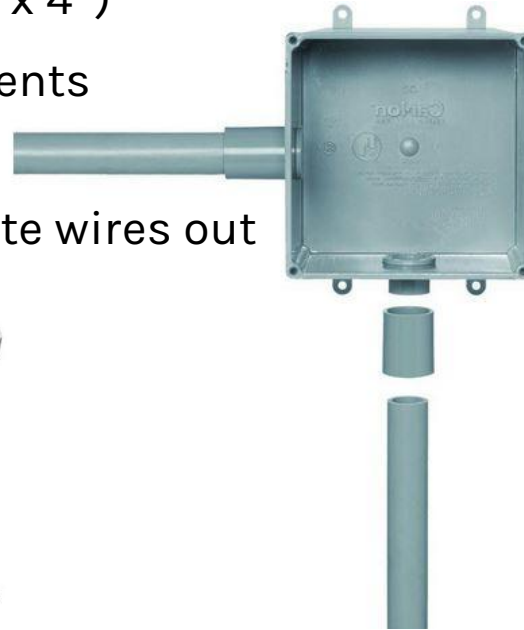
Note: This is not the exact placement of parts.

# Housing Design Idea

ThermoPLASTIC junction box (6" x 4" x 4")

- ▶ Built to withstand outdoor elements
- ▶ Fire rated

Drill “Knockouts” and use PVC to route wires out of the box



# Problems We Came Across

**Housing** - Consequences of a metal box

**PCB Design**- Unfamiliarity with PCB Software (Eagle)

**Documentation** - A little unclear and a little unorganized



# Apple Board Power Budget Version II

5 Volt Module	Data Sheet Values			Calculated Values		
Part Name	Idle Current (mA)	Typical Current (mA)	Max Current Draw (mA)	Average Current Draw (mA)	Average Power Consumed (mW)	Max Power Dissipated (mW)
Arduino Uno R3	0.0001	20	50	10.00005	50.00025	250
DC Current Sensor	0.006	0.7	1	0.353	1.765	5
GPS Sensor	4	12	20	8	40	100
Humidity/Temperature	0.0003	0.028	1	0.01415	0.07075	5
Pressure Sensor	0.001	0.65	1	0.3255	1.6275	5
Roof Temperature	0.75	1	1.5	0.875	4.375	7.5
Solar Irradiance	0.0001	0.15	0.3	0.07505	0.37525	1.5
<b>Total</b>	4.7575	34.528	74.8	19.64275	98.21375	374

3.3 Volt Module	Data Sheet Values			Calculated Values		
Part Name	Idle Current (mA)	Typical Current (mA)	Max Current Draw (mA)	Average Current Draw (mA)	Average Power Dissipated (mW)	Max Power Dissipated (mW)
XBee Pro S2B	0.0035	15	220	15.02241333	49.57396398	99.14792795
<b>Total</b>	0.0035	15	220	15.02241333	49.57396398	99.14792795

Overall Power						
Overall Totals	Total Idle Current (mA)	Net Typical (mA)	Net Max Current (mA)	Net Average Current Draw (mA)	Net Average Power (mW)	Net Max Power (mW)
Values	4.761	49.528	294.8	34.66516333	147.787714	473.147928



### Battery Supply

Part Name	Supply Voltage (V)	Discharge Rate (mAh)	Usable Energy
3.7V 6600 mAh	3.7	6600	80%

### XBee Characteristics

Idle Time	99.9891%
Transmit Time	0.01093%

### Calculated Run Time

Energy (mWh)	Efficiency of Regulator	Max Power Consumed (mW)	Max Run Time (Hours)	Max Run Time of Regulated Efficiency (Hours)	Conversion (Days and Hours)	Average Conversion
19536	80.00%	473.147928	41.28941256	33.03153005	1 Days, 9.03 Hours	6 Days, 3.79 Hours

### Apple Notes and Assumptions

- \*Typical Current of Arduino is the DC Current Per I/O Pin
- \*Battery voltage low power mode polls every 10 minutes
- \*Solar Irradiance polls every 3 seconds
- \*Battery Voltage and Panel polls every 10 seconds
- \*Everything else polls every 30 seconds
- \*XBee transmits every 3 seconds
- \*XBee receives every 3 seconds
- \*Values are in bold are assumed
- \*Xbee Characteristics % and the Usable Energy % given to us by our mentors
- \*XBee Max Power calculated using double the Average Power

	Part Name	Vendor	Product ID/#	Unit Cost	Quantity
1	USB LiPoly/Li-Ion Charger (3.7/4.2V) MCP73871	Adafruit	390	\$17.50	1
2	Arduino Uno R3	Adafruit	50	\$24.95	1
3	Ultimate GPS Breakout v3	Adafruit	746	\$39.95	1
4	Digi International XBee Pro S2B	Adafruit	967	\$37.95	1
5	Tenergy Li-Ion 18650 3.7V 6600mAh	Adafruit	353	\$29.50	1
6	Barometric Pressure Sensor BMP180 (newer model)	Adafruit	1603	\$9.95	1
7	INA219 High Side DC Current Sensor Breakout 26V ± 3.2A Max	Adafruit	904	\$9.95	1
8	Interface Cable - RPSMA Female to RPSMA Male (25cm)	Sparkfun	12860	\$4.95	1
9	Silicon-Cell Pyranometer SP-215	Apogee	SP-215	\$235.00	1
10	Large 6V 3.4W Solar Panel 3.4 Watt	Adafruit	500	\$39.00	2
11	AL-100 Solar Sensor Leveling Plate	Apogee	AI-100	\$35.00	1
12	One Wire Digital Temperature Sensor - DS18B20	Sparkfun	245	\$4.25	1
13	2.4GHz Duck Antenna RP-SMA - Large	Sparkfun	558	\$9.95	1
14	Sensirion Temperature/Humidity Sensor - SHT11	Adafruit	246	\$35.00	1
<b>Unit Sub Cost (Major Parts)</b>					
\$571.90					

# Bill of Materials

# Teams We Communicated With

**Cranberry** - Help with Hardware

**Dragonfruit** - Overall hardware questions

**Firmware** - Software and debugging

**Forecasting** - Confirmed sensors used

**Verification** - Part placement & board design

**XBee** - Antenna placement & box material



# Final Status of our Project

**Housing** - ThermoPLASTIC Junction Box

**Schematic** - Organized with updated parts

**Documentation** - Parsed through previous documentation, and organized our own documentation utilizing the Wiki.



# Future Tasks/Improvements

**Board** - Layout and Fabrication

**Housing** - Acquire and Assemble

**Documentation** - Complete and Organize

**Post Assembly** - Test and Deployment



**Thank you.  
Any Questions?**

