Dwight Look College of ENGINEERING
TEXAS A&M UNIVERSITY

Team 0: Growable Space Habitat

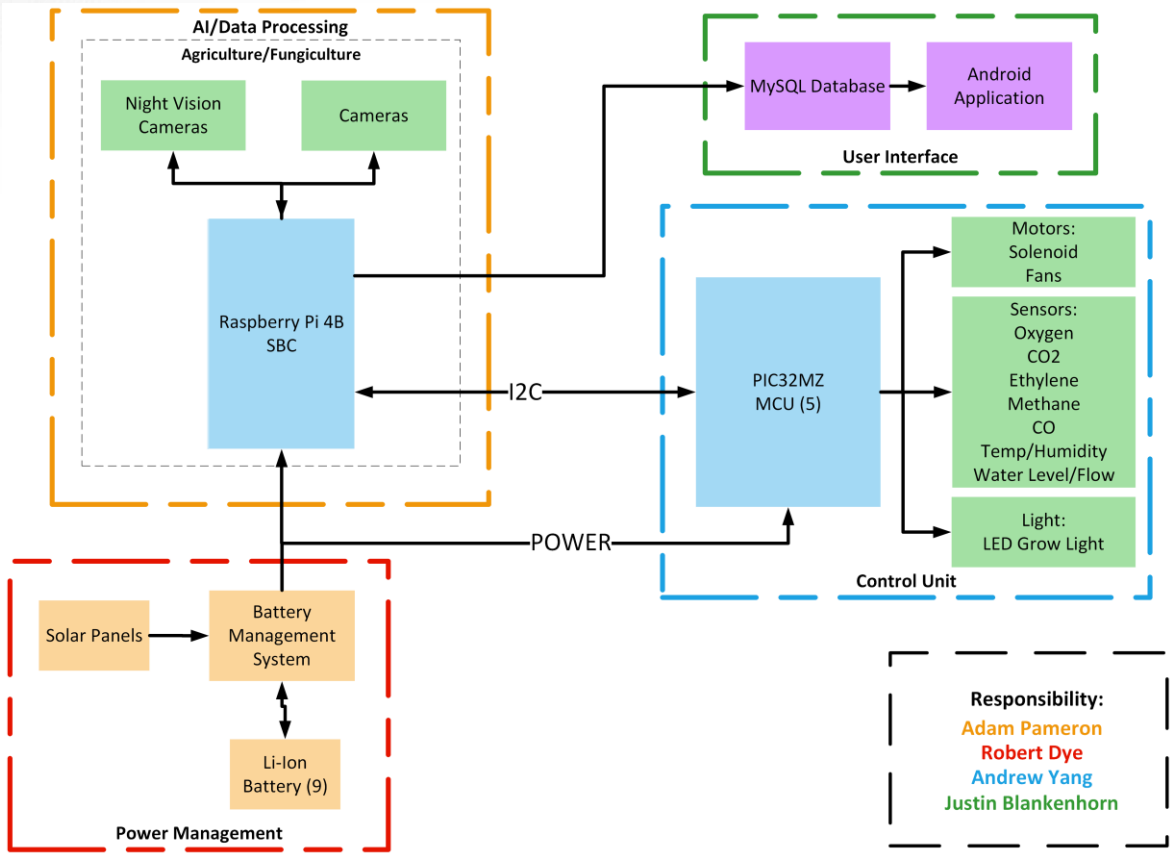
Robert Dye
Justin Blankenhorn
Andrew Yang
Adam Pameron

Sponsor: Dr. John Lusher II, Dr. Hope Rising
TA: Rohith Kumar

Project Summary

- Current space operations require constant resupply
  - Costly ($20,000 per kg)
  - Inefficient and wasteful
- Long term space missions need a sustainable food source
- Project provides electrical infrastructure for a self-sustaining system capable of recycling agricultural products

Project/Subsystem Overview



Major Project Changes Since Last Time

Power Management:

- Finalize 1 complete system by end of semester

User Interface:

- Converted to firebase

AI/Data Processing:

- Only working on baby spinach, no oyster mushroom

Microcontroller:

- Finalize 1 complete system by end of semester

Project Timeline

Milestone	Expected Time
Obtain significant data for charging of battery pack	September 9
Order BMS PCB	September 9
Order MCU PCB	September 9
Integrate Raspberry Pi and 5 MCUs	September 17
Integrate all sensors	September 23
Solder all BMS PCB components	October 12
Solder all MCU PCB components	October 14
Finalize and debug all BMS connections	October 23
Integrate Raspberry Pi and Database	October 30
Retrieve Baby Spinach Data from Horticulture Team and create CNN Model	October 30
Finalize and debug all sensors	October 30

AI/Data Processing Subsystem

Adam Pameron

- Create binary classifier using Convolutional Neural Network (CNN) Model
  - Baby Spinach
  - Oyster Mushroom
- Collect sensor data from 5 microcontrollers
- Send sensor data to database

AI/Data Processing Subsystem

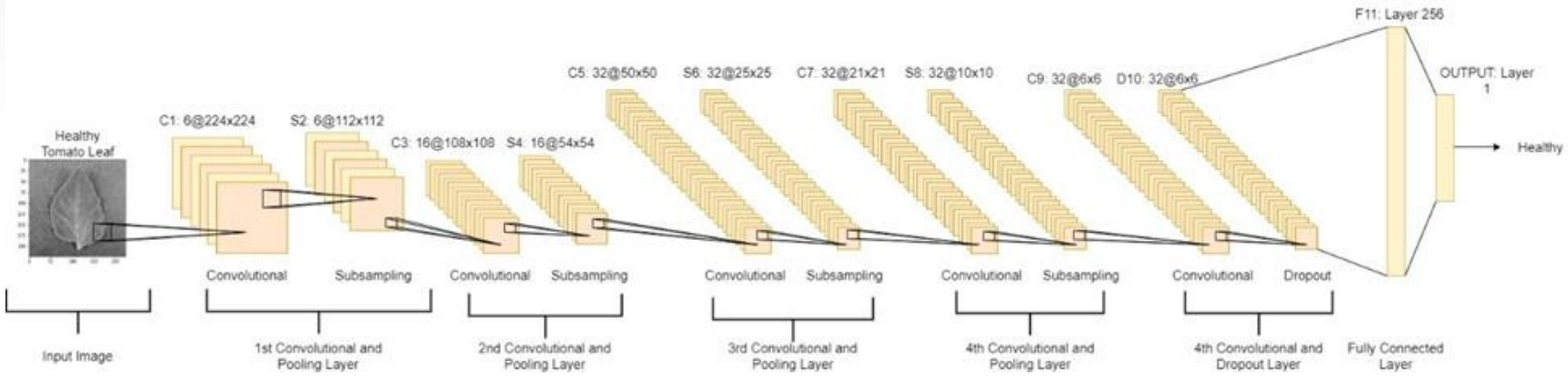
Adam Pameron

Accomplishments since last presentation	Ongoing progress/problems and plans until the next presentation

• Perform data augmentation with data set
  • Grayscale
  • Vertical Flip
  • Gaussian Blur
  • Shearing
  • Even number of data
• Request data from I2C with oxygen sensor
• Send trend data to Firebase Database
	• Waiting for Horticulture Team to fully grow Healthy and Nitrogen Deficient Baby Spinach to collect images [est. October]
	• Send images to Firebase database
	• Interfacing with microcontrollers using serial communication to request data, and validate all sensors data is collected and accurate
	• Build application code to repeat all routines (classify, request data, send data) at a set time

AI/Data Processing Subsystem - Parameters

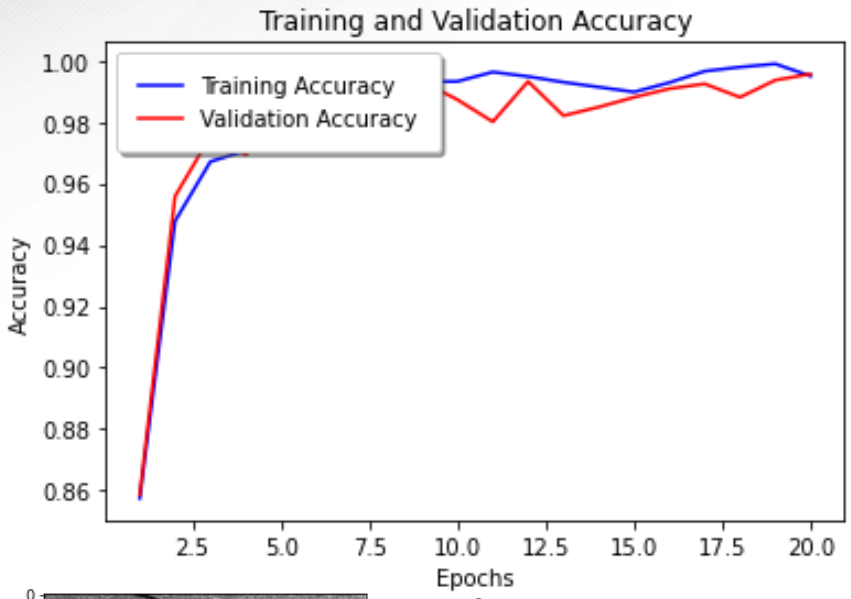
Adam Pameron

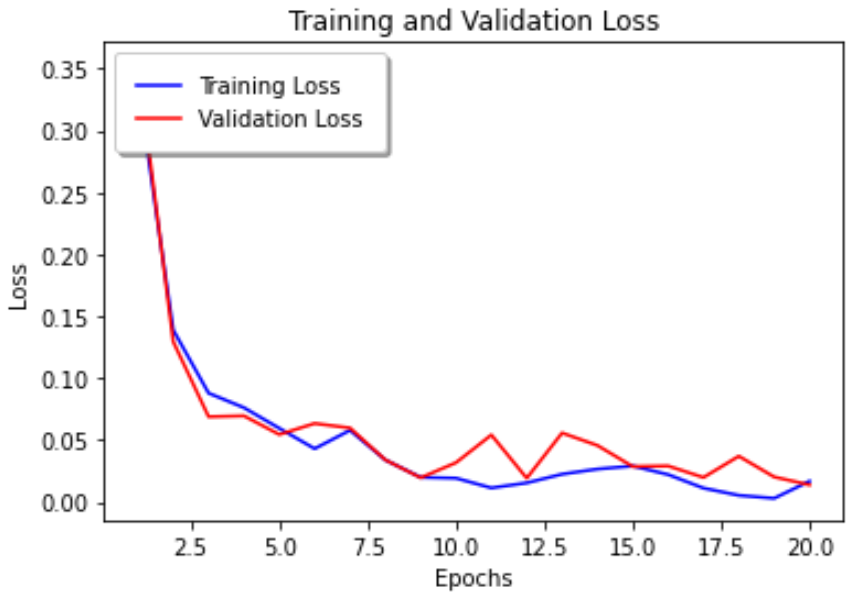


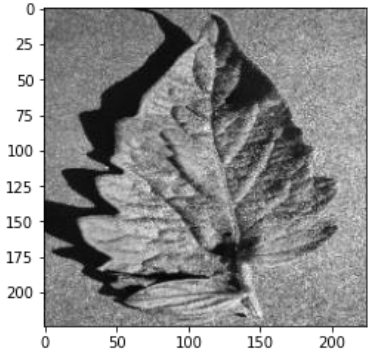
Modified LeNet Architecture

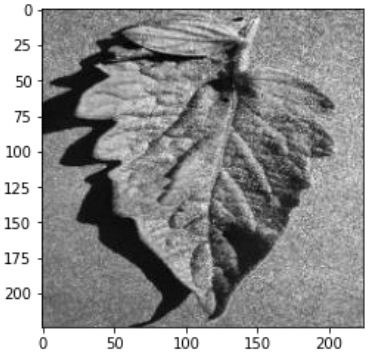
AI/Data Processing Subsystem

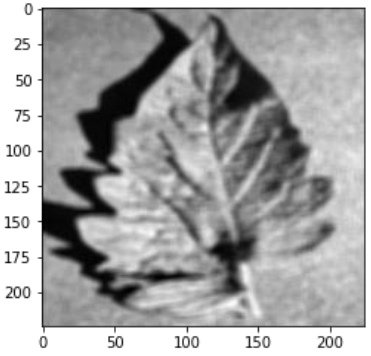
Adam Pameron

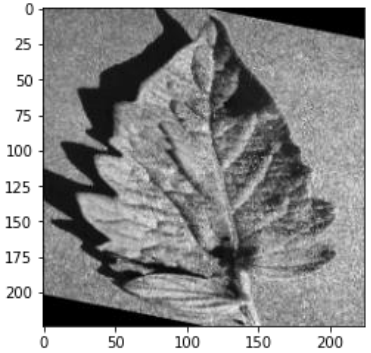






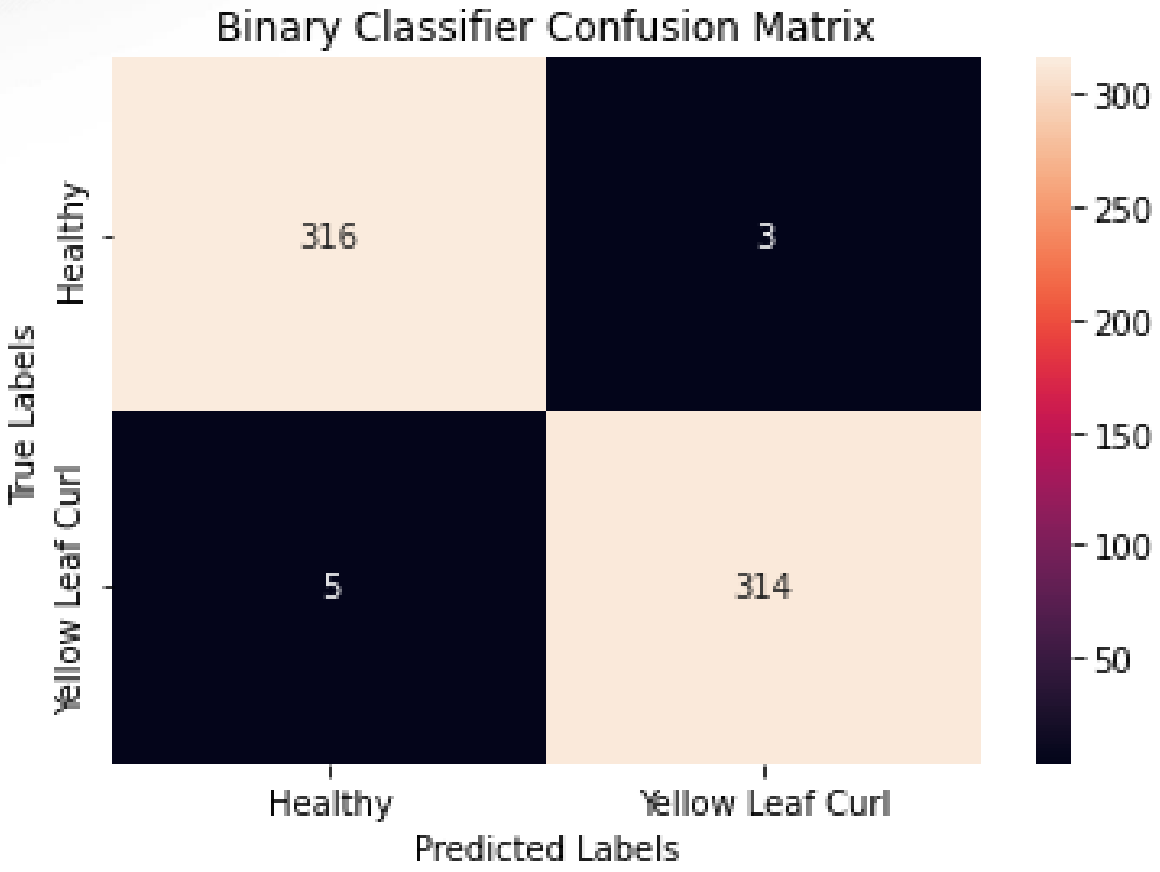






AI/Data Processing Subsystem

Adam Pameron



AI/Data Processing Subsystem

Adam Pameron

- Send oxygen data to Firebase
  - Time
  - Concentration

Power Management

Robert Dye

- Provide power to PCBs that house the microcontrollers as well as the pi that will be used to control AI subsystem
- BMS monitoring
- Charging

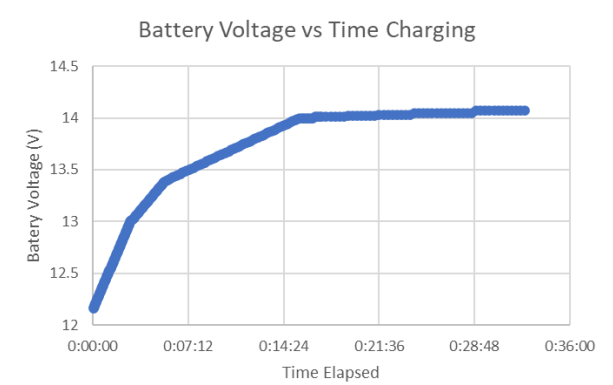
Power Management

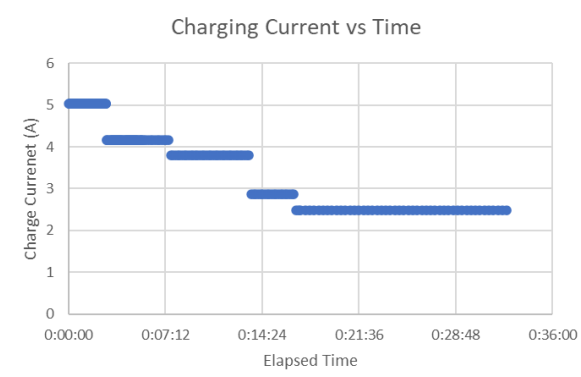
Robert Dye

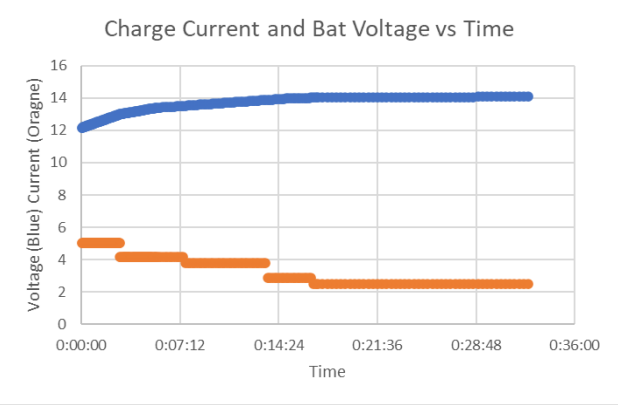
Accomplishments since last presentation	Ongoing progress/problems and plans until the next presentation
• Performed extensive testing on battery and solar panel with smaller loads • Ordered PCB	• Perform same tests with a heavier load • Solder Components on PCB once it arrives • Help MCU subsystem

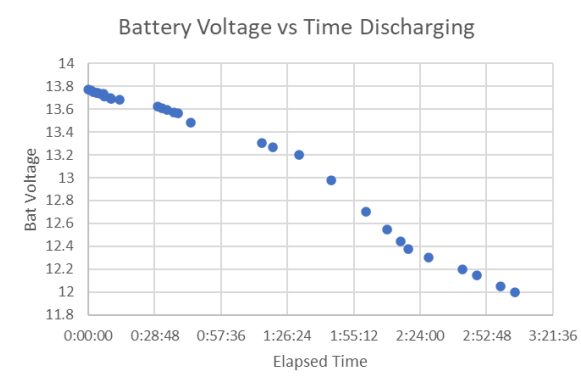
Power Management

Robert Dye









Microcontroller

Andrew Yang

- 200 Peripherals modularized between 5 microcontrollers
- 20 Oxygen, 20 CO2, 20 NO2, 20 Methane, 20 Ethylene, 20 Carbon monoxide, 12 Temp/Humidity, 4 water level, 4 water flow sensors
- 9 types of sensors using I2C, UART, Analog, or digital communication
- 38 solenoids and 26 fans controlled using GPIO + switching circuit

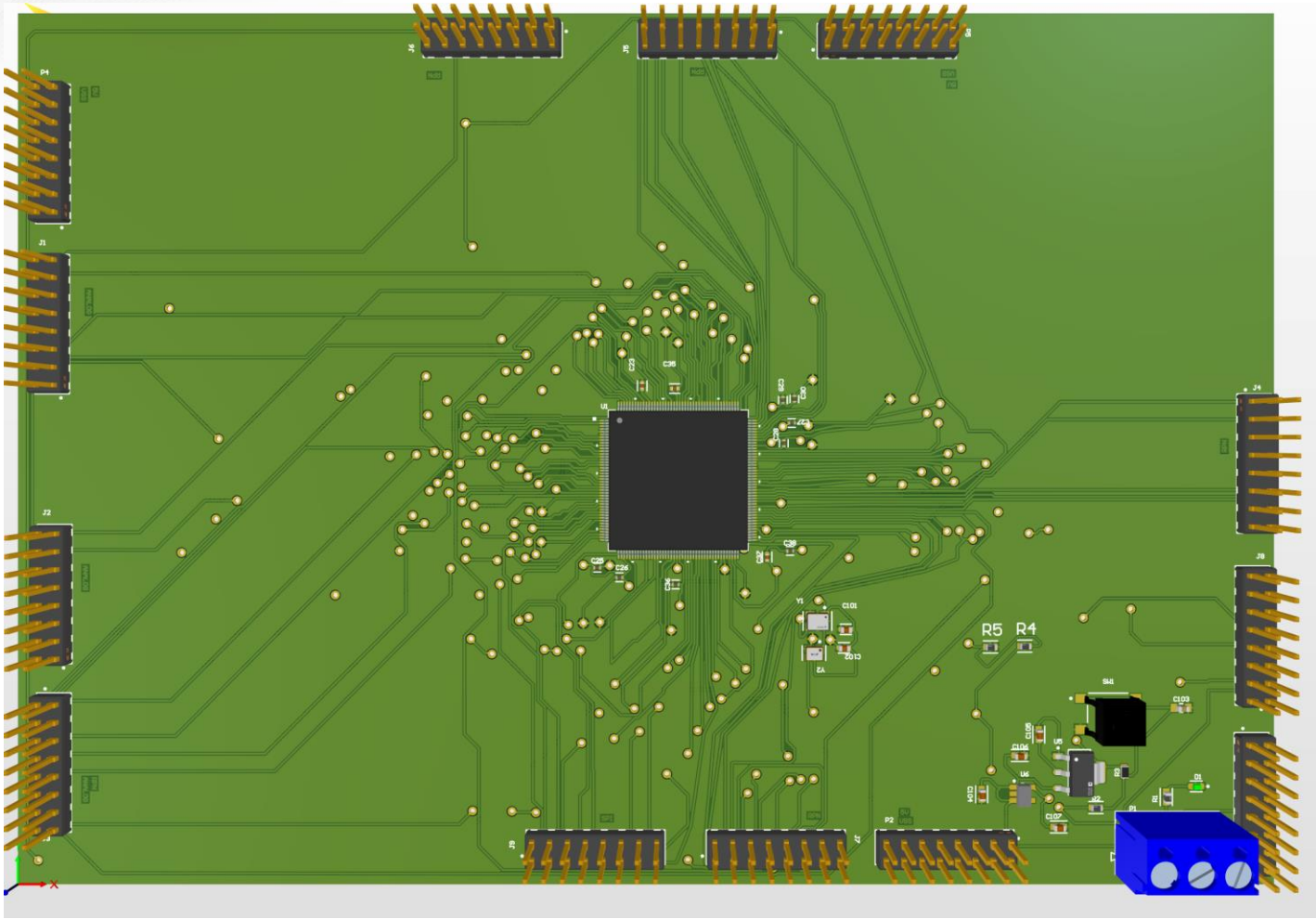
Microcontroller

Andrew Yang

Accomplishments since last presentation	Ongoing progress/problems and plans until the next presentation
• Redesigned MCU PCB • Verified Oxygen I2C sensor operation • Ordered new MOSFET for solenoid switching	• Verify Temperature/Humidity I2C sensor operation • Verify UART sensor operation • Implement PWM logic for water flow sensor • Design op-amp circuit and verify analog sensor operation • Design I2C multiplexer circuit for fan and solenoid switching

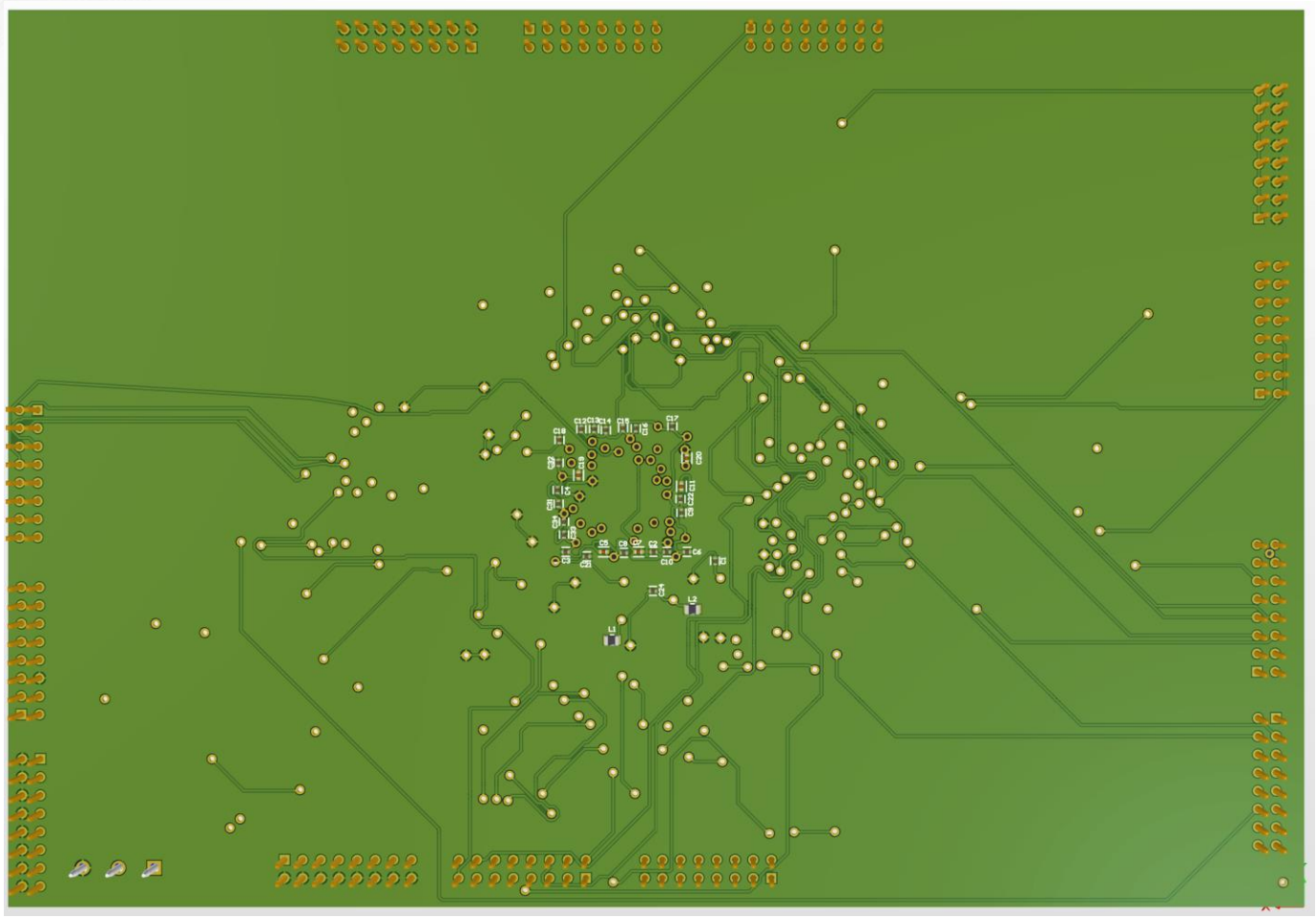
Microcontroller

Andrew Yang



Microcontroller

Andrew Yang



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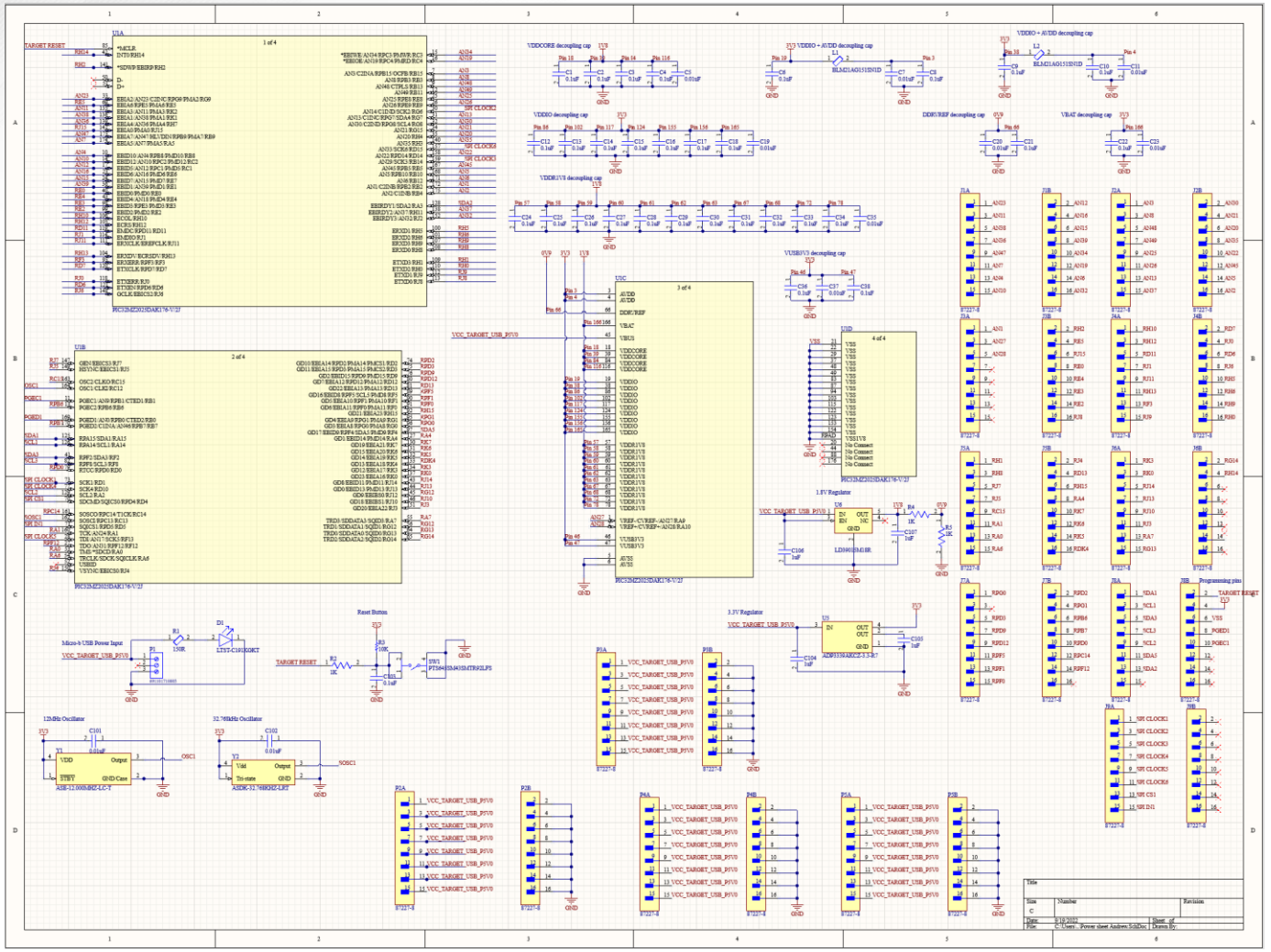
Microcontroller

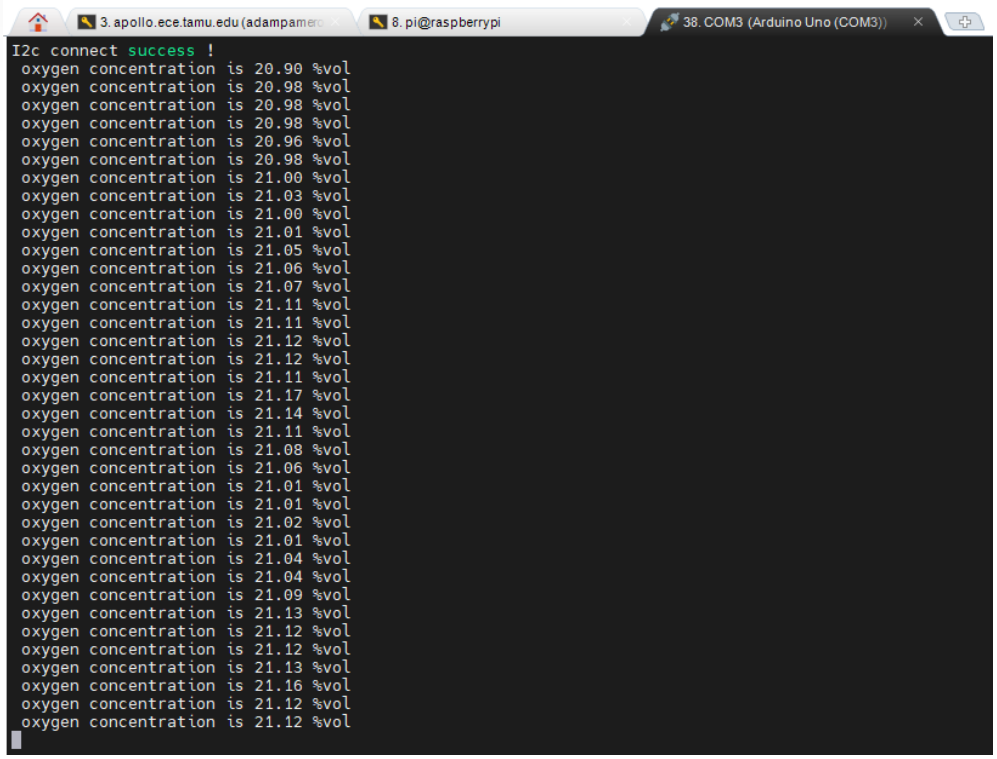
Andrew Yang



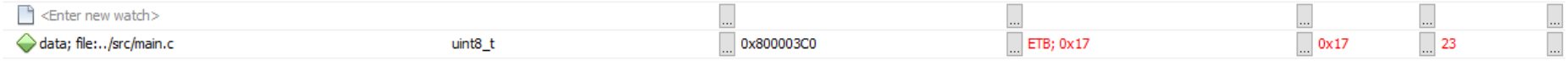
Microcontroller

Andrew Yang

Expected Result from Arduino



Result from Microchip Dev Board



User Interface

- Display Data from MCU sensors on app
- Visualize sensor values over time
- Display camera pictures on app

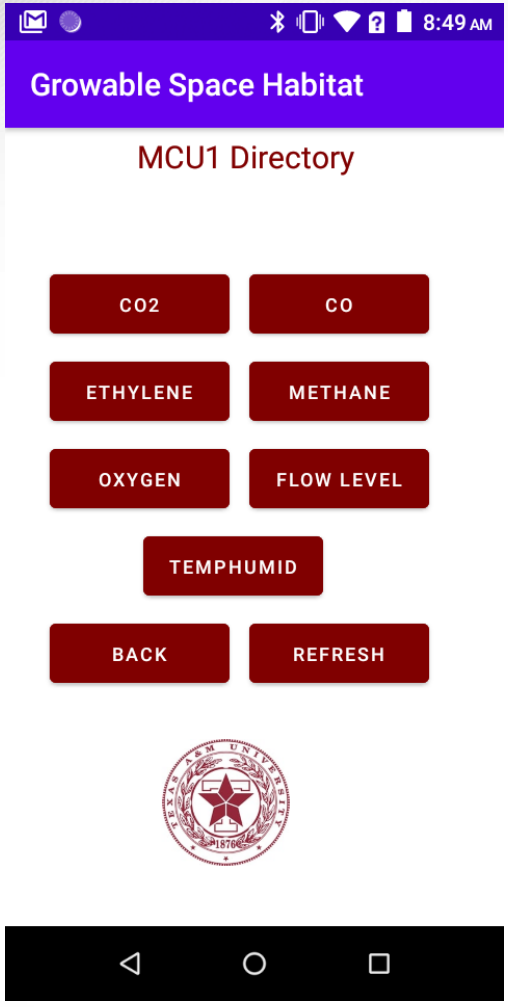
User Interface

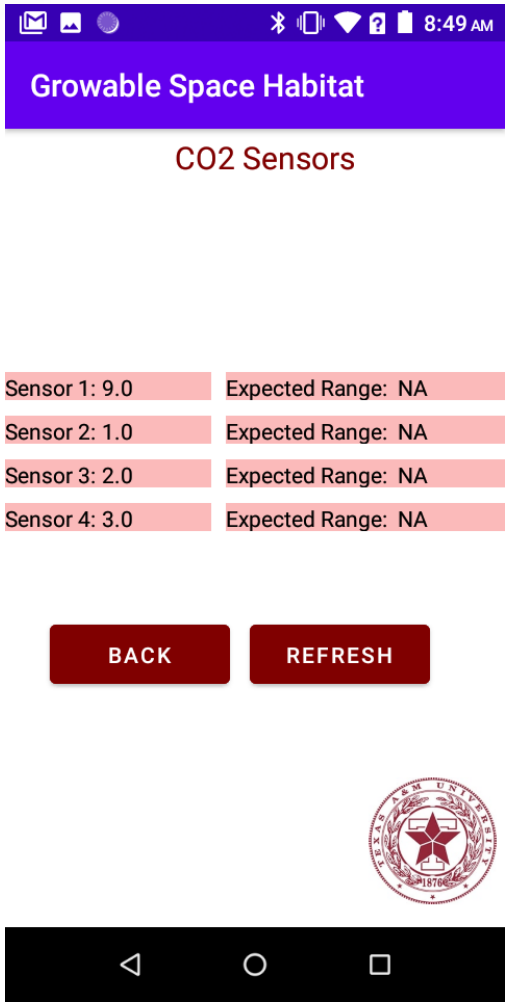
Justin Blankenhorn

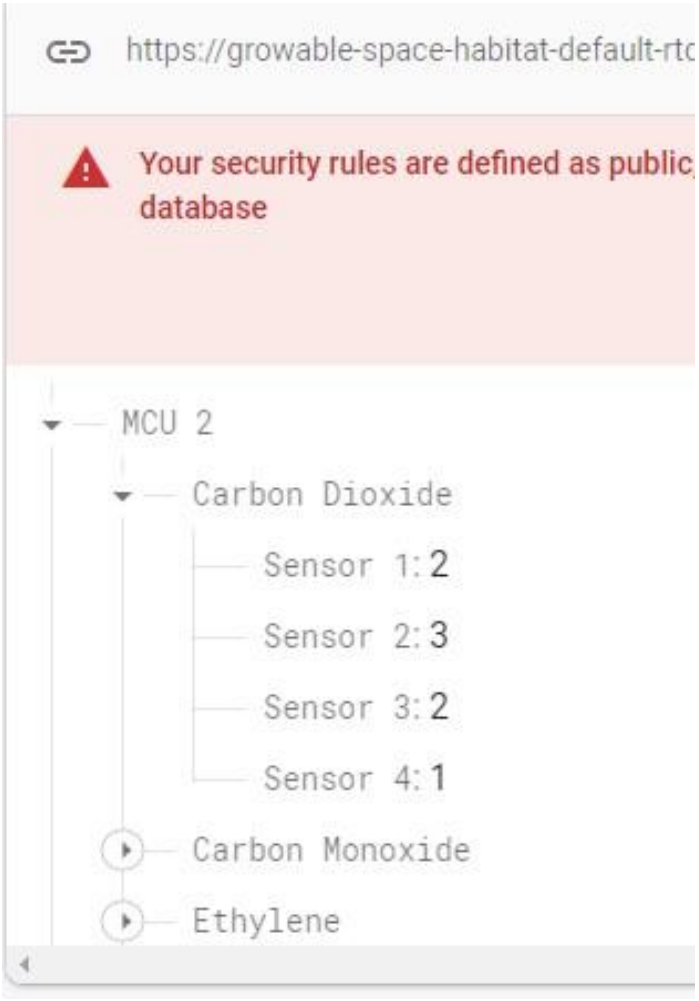
Accomplishments since last presentation	Ongoing progress/problems and plans until the next presentation
• Established connection between Android Studio and Firebase App • Set up Firebase database sensor data display on app for 3 MCU units	• Add display from other MCU units • Display images to app using firebase • Develop graphs for sensor data over time

User Interface

Justin Blankenhorn







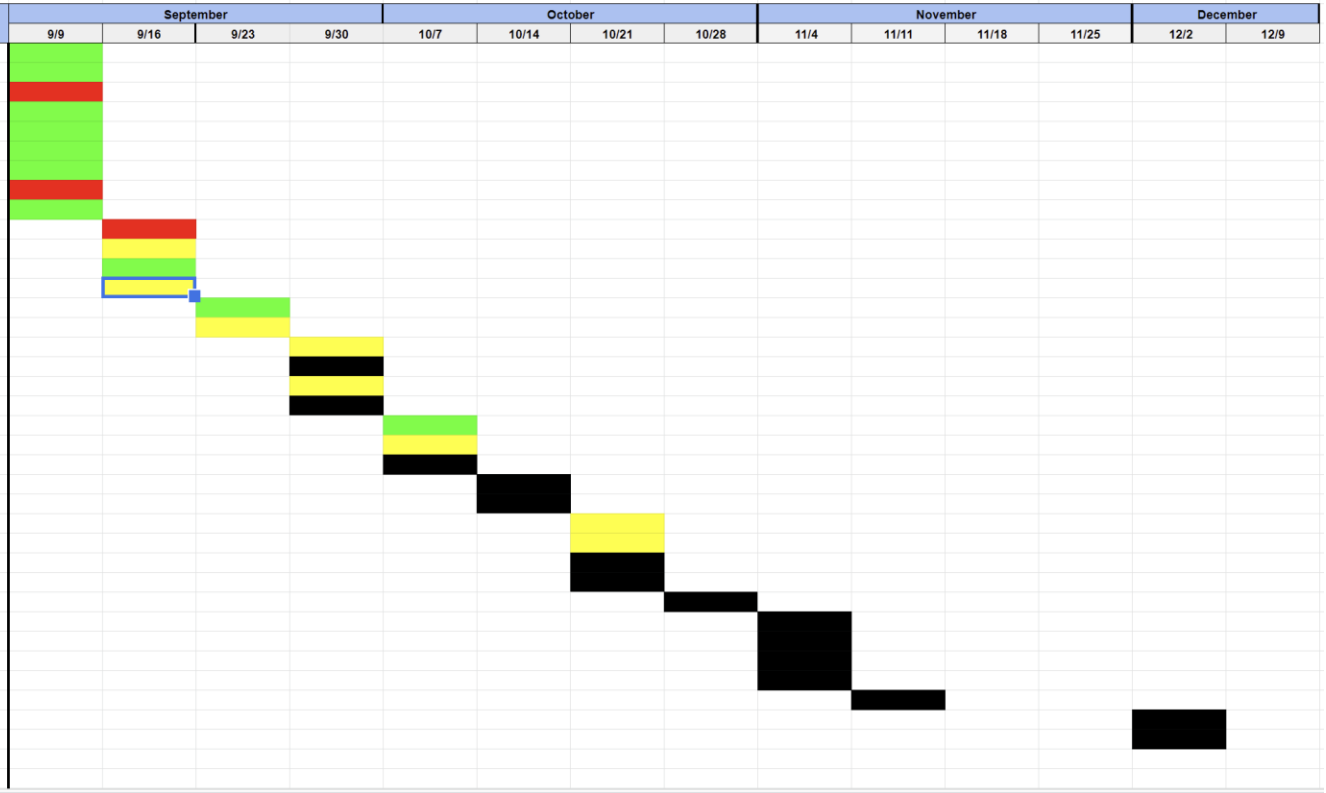
Parts Ordering Status

Susbsytem	Item	Quantity	Price	
AI/ Data Processing Subsystem	Raspberry Pi 4 8GB Kit	1		$169.95
	Arducam IMX519 Quad-Camera Kit	1		$169.99
	Arducam Camera Case and Mini Tripod	4		$11.99
Power Management Subsystem	100 watt solar panel	2		$100
	BQ78350DBTR-R1A Fuel Guage	10		$4.00
	BQ7693000DBT Battery Monitor	10		$4.00
	14.8V 13Ah Battery Pack	6		$194.00
	DC Power Supply	1	N/A	
	Victron MPPT Controller	1		$137
	DROK Buck Converter	10		$14.00
	PCB	5		$63.64
Control Unit Subsystem	PIC32MZ2025DAK176-V/2J	10		$19.58
	Gravity: Electrochemical Oxygen Sensor	10		$43.12
	004-0-0053 CO2 Sensor	8		$53.36
	110-507 NO2 Sensor	4		$20.00
	IR33BC Methane Sensor	4		$262.63
	ME3-C2H4 Ethylene Sensor	8		$91.95
	SEN0485 Liquid Level Sensor	8		$9.90
	SEN0227 Temperature/Humidity Sensor	8		$22.50
	110-102 CO Sensor	8		$20.00
	PCB	5		$126.37
	PG164140 Pickit4 Programmer	2		$65.32
	Mini solenoid	4		$12.49
	NF-A4x10 5V Fan	8		$13.95
	Water Flow Sensor	4		$10.99
	2N7000 N-MOS	2		$5.50
	BS170 N-MOS	2		$7.25
User Interface	Android EL 6C Cell Phone	1		$73.00
Total				**$6,832.78**

Execution & Plan

Robert Dye	Completed
Adam Pameron	In progress
Justin Blankenho	Not Started
Andrew Yang	Behind Schedule

Tasks	Target Date
Completed pcb design for power management	9/2
Testing of charging controller with battery	9/2
Completed MCU PCB design	9/5
Update Presentation #1	**9/5**
Testing the abiltiy to power other subsytem	9/8
Collect Significant data of how long battery takes to charge under various conditions	9/8
Order PCB for power management	9/8
Order MCU PCB	9/8
Implement fan control	9/9
Implement I2C Sensors	9/16
Integrate I2C Connection between PI and 5 MCUs	9/17
Update Presentation #2	**9/19**
Restructure Android Studio code to use Firebase database	9/20
Implement UART Sensors	9/23
Implement solenoid control	9/23
Implement Analog Sensors	9/30
Unpack battery packs to connect cells to battery monitor and fuel guage	9/30
Receive BMS PCB and begin soldering all components	9/30
Receive MCU PCB and begin soldering all components	9/30
Integrate PI with database to send sensor data	10/3
Measure current draw per hour of all used peripherals	10/3
Update Presentation #3	**10/3**
Finishing soldering components to BMS PCB	10/12
Finish soldering components to MCU PCB	10/15
Display Sensor Data into graphs on app	10/16
Integrate PI to send pictures to app	10/16
Update presentation #4	**10/19**
Complete MCU PCB testing	10/21
Verify data collected from the MCU is accurate	10/25
Verify data and picture received from pi is accurate	10/30
Validate sensor data with controlled test	**10/30**
Update presentation #5	**10/31**
Perform all testing of subsystems connected to BMS	11/4
Final Presentation	**11/14**
Final Demo	**12/2**
Final Report	**12/3**



THANK YOU!