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ENGINEERING
TEXAS A&M UNIVERSITY

ECEN 404 Final Presentation
Team 29: Automated Greenhouse

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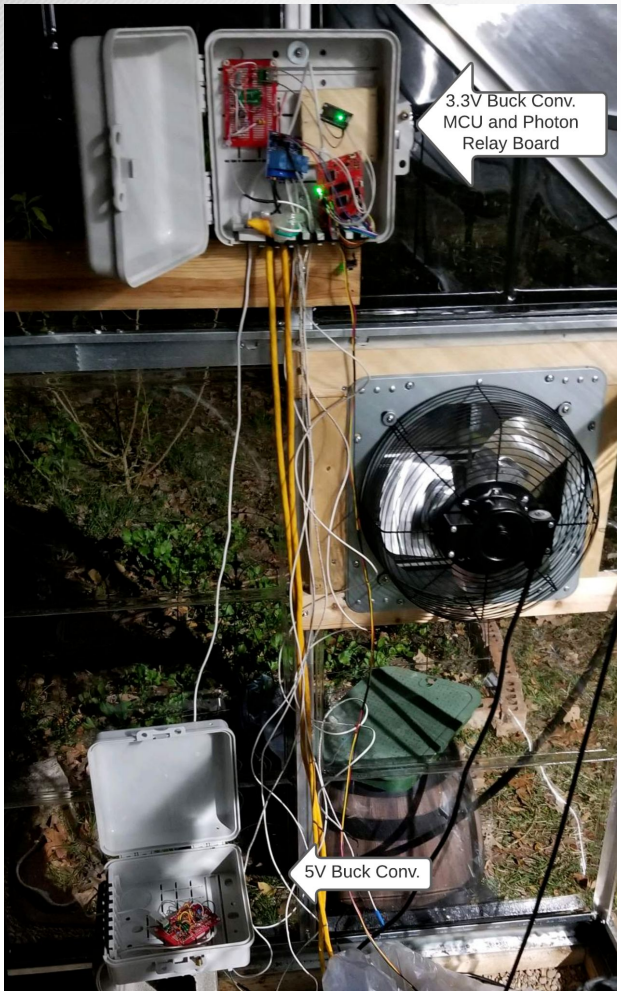
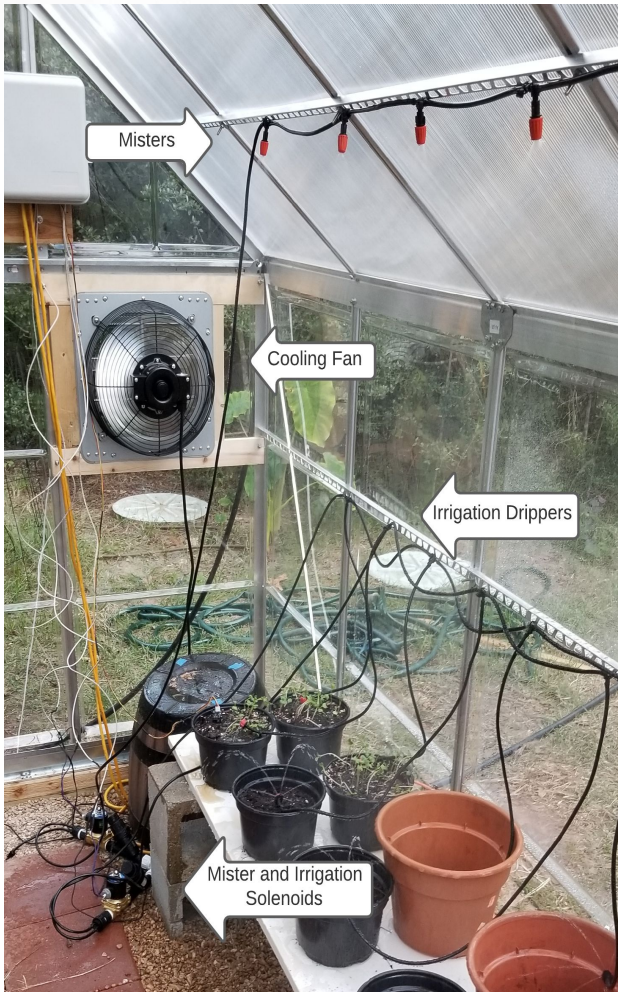
Problem Overview

- The Problem:
  - Greenhouses have no control over their environment
  - This can lead to unhealthy conditions for plants and reduced yields
- Our Solution:
  - An automatic control system that can adjust temperature, humidity, and soil moisture content, based on parameters specified by a remote user. These parameters are sent over wifi to a microcontroller that can automatically control a series of misters, fans, and drippers.

Integrated Project Diagram





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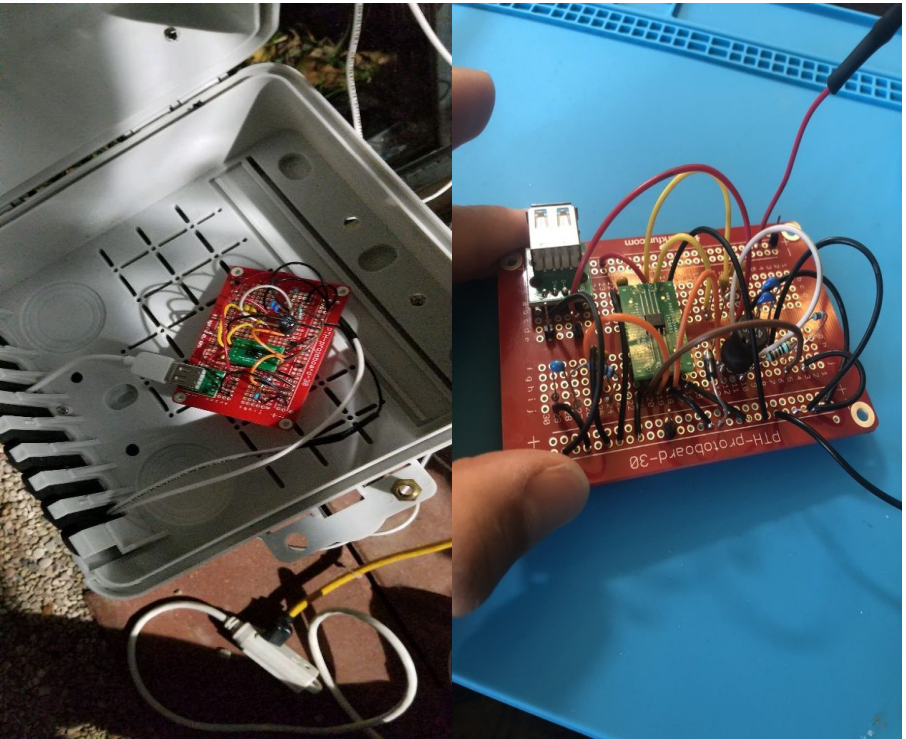
Power Subsystem

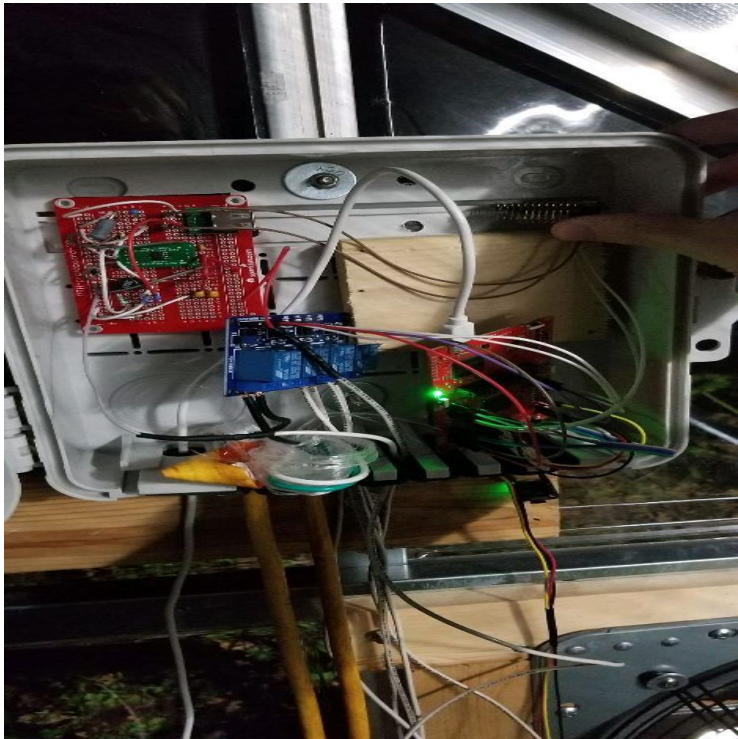
- Created two buck converter circuits to power MCU and Photon Board.
- Prototypes bench tested and integrated with the greenhouse.
- PCBs are soldered and have passed functionality testing.

- MCU and Photon Board had difficulties under same power circuit.
- Time constraint with PCB design/shipment.

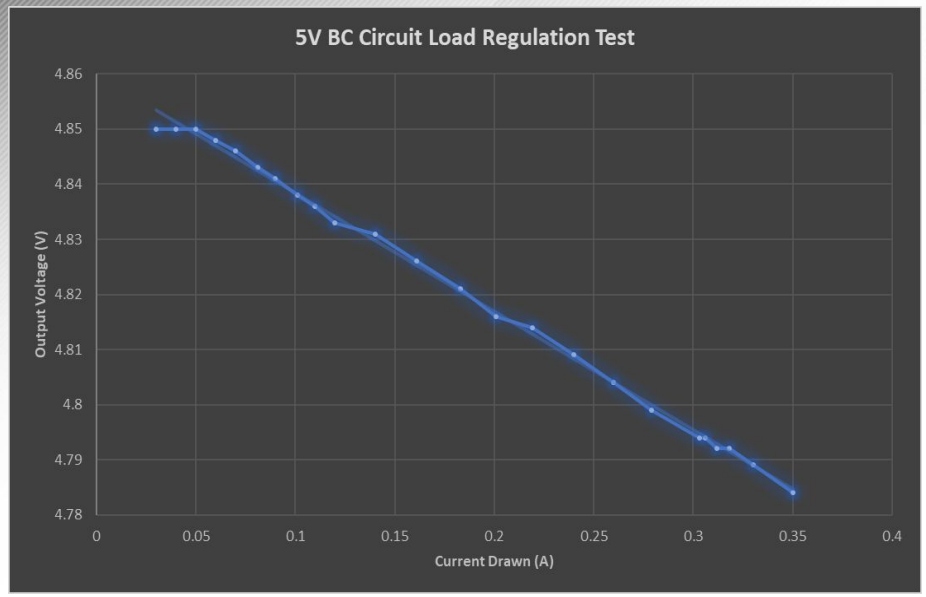
5V BC Circuit

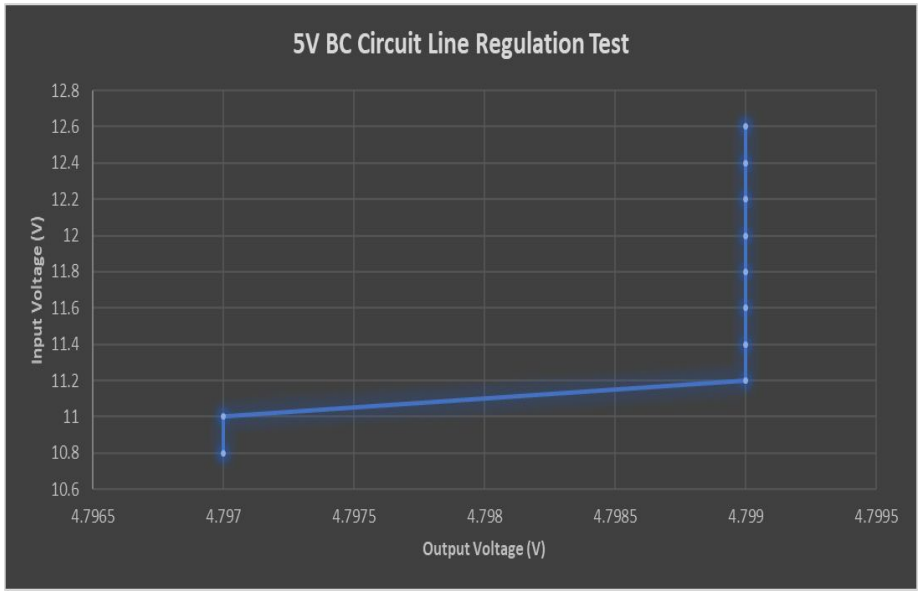


3.3V BC Circuit

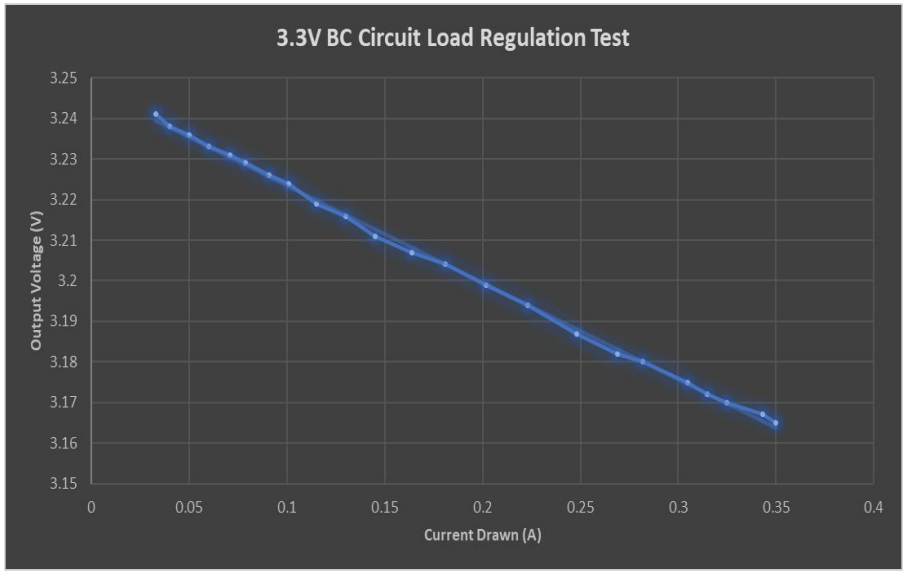


Power Subsystem



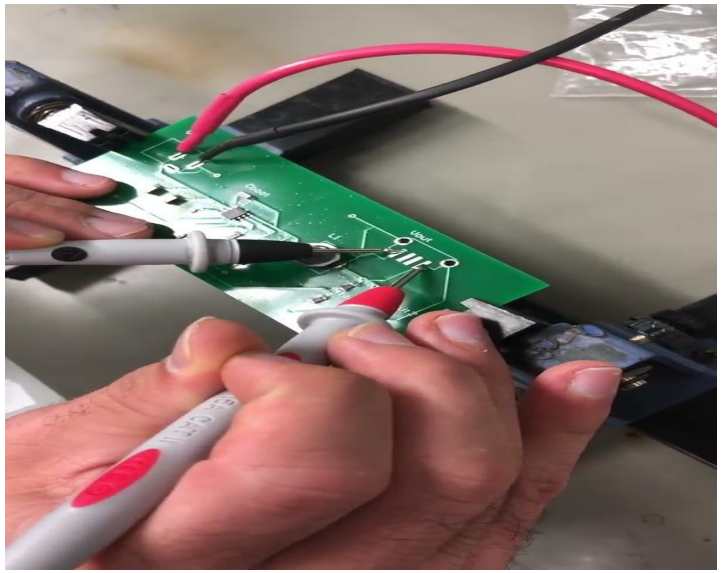


- Specs for BC's (12V 2A, 5V .3A).
- Different source for 3.3V Circuit.
- Data specs.



Power Subsystem

- PCBs
- Functionality Testing



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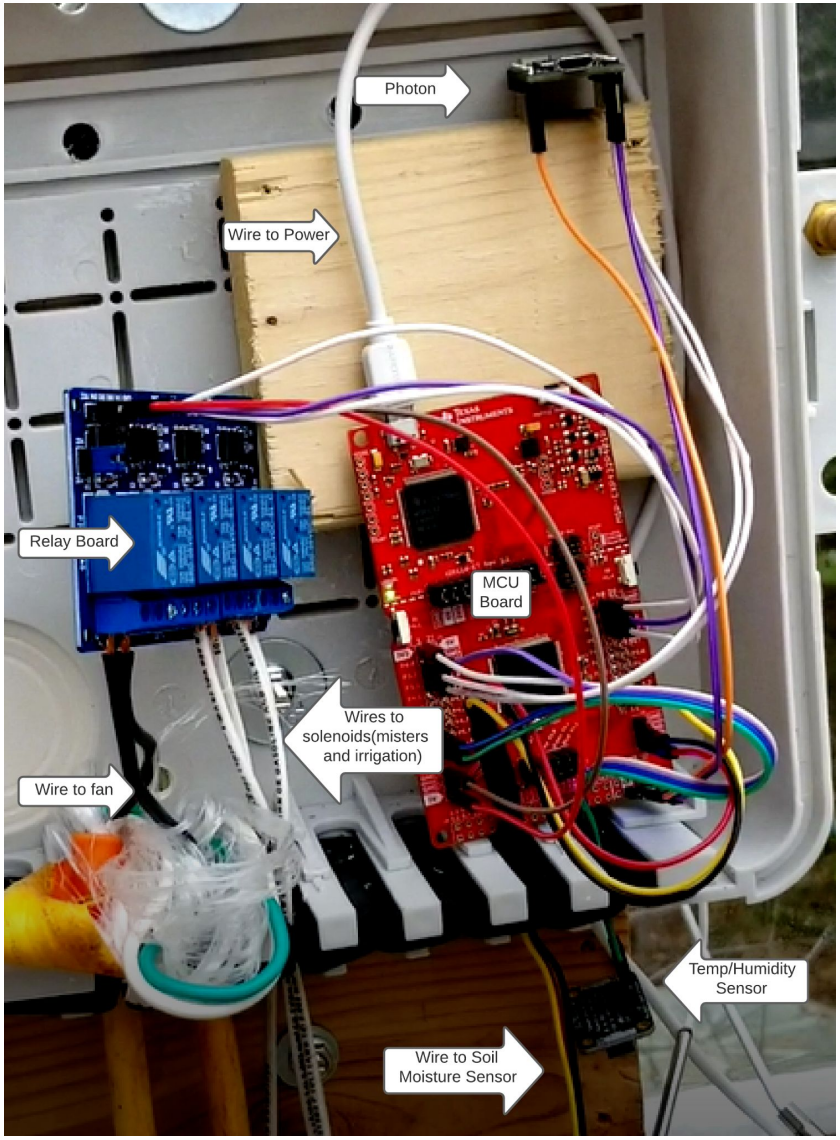
MCU and Sensor Subsystem

- MSP432 running control algorithm
- Gets environment parameters from photon board
- 4 relay switching board to control fan/solenoids
- Analog soil moisture sensor and temperature/humidity sensor (I²C)



MCU and Sensor Subsystem

- Issues with sensors
  - Signal Integrity
    - Wire runs were shortened, testing involved long periods of the program running to make sure data was being properly processed.
  - Physical Reliability
    - Humidity sensor slow to measure humidity fall-off
    - Soil moisture sensor values often vary wildly
    - Partially mitigated issues with algorithm adjustments, using experimentally determined offsets to adjust for poor sensor data

Client Interface Subsystem

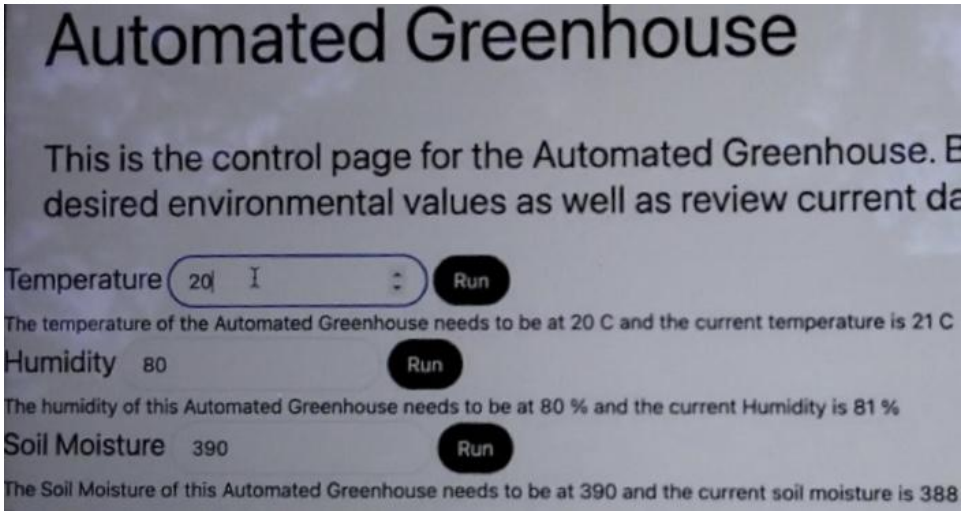
- Build connection among the client interface (html), photon Wifi development board and MCU(MSP432p401r)
- Tested the UART communication between photon Wifi development board and MCU
- Display data every second in the client interface as well as modify temperature, humidity and soil moisture level.

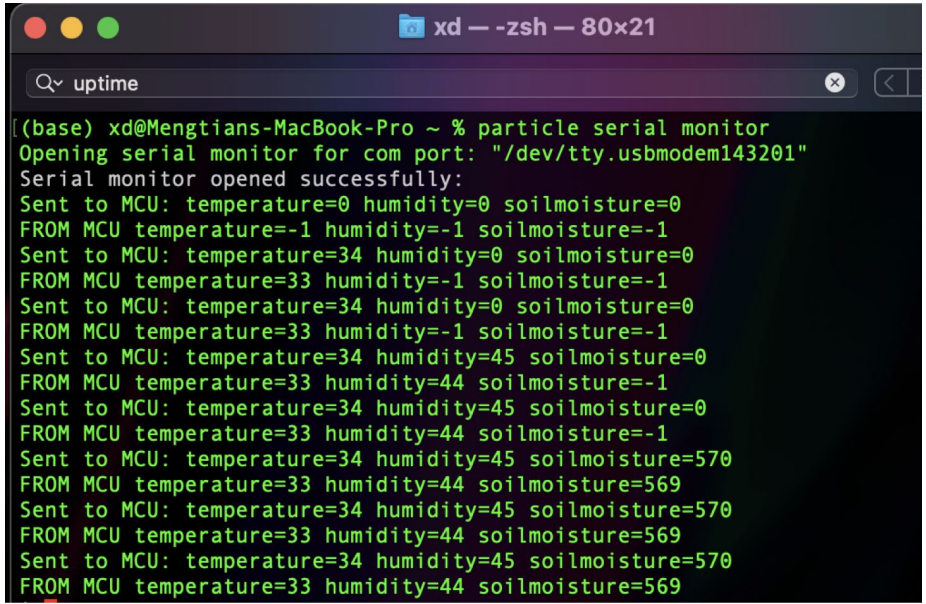
Challenges:

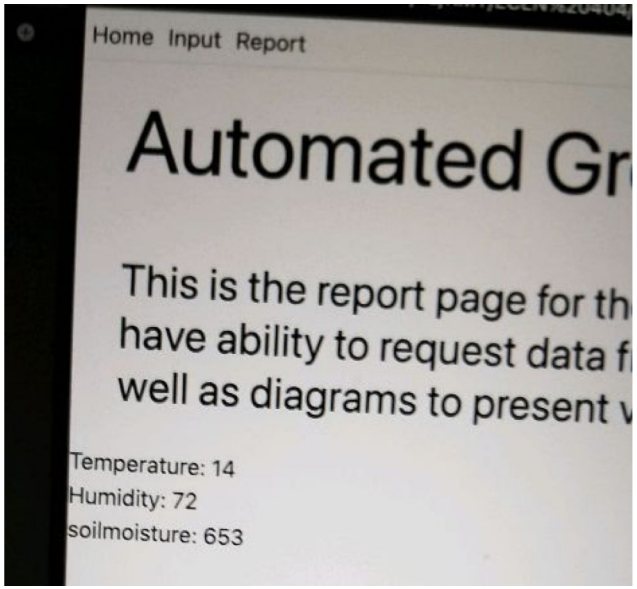
- Photon board does not receive power from the Vin pin
  - used 3.3V instead
- The original MCU board had a broken UART pin
  - exchanged to the backup MCU

Client Interface Subsystem

- Transceiver between photon and MCU board
- Data updates every second
- Client input impacted the effect of greenhouse





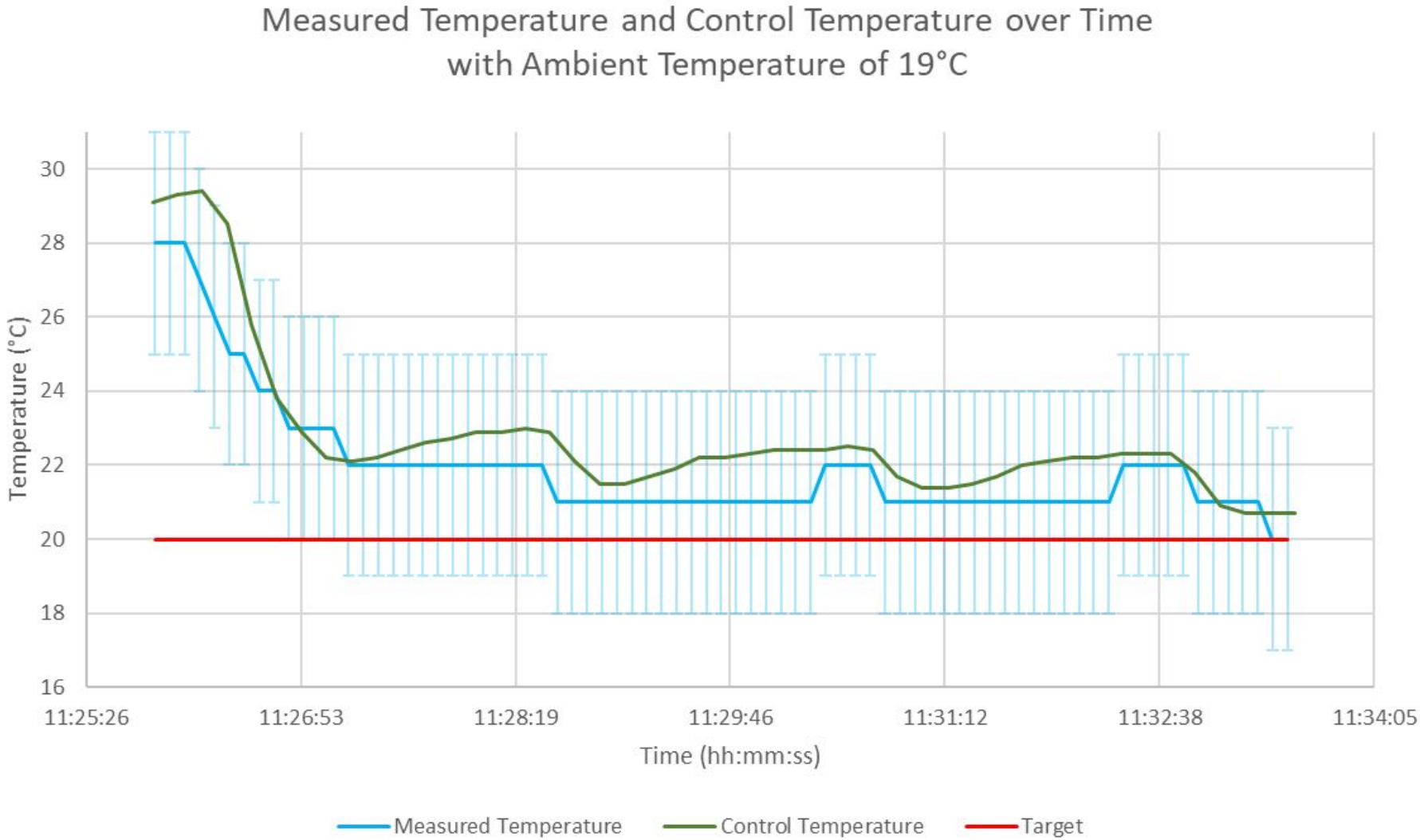


Integrated System Results

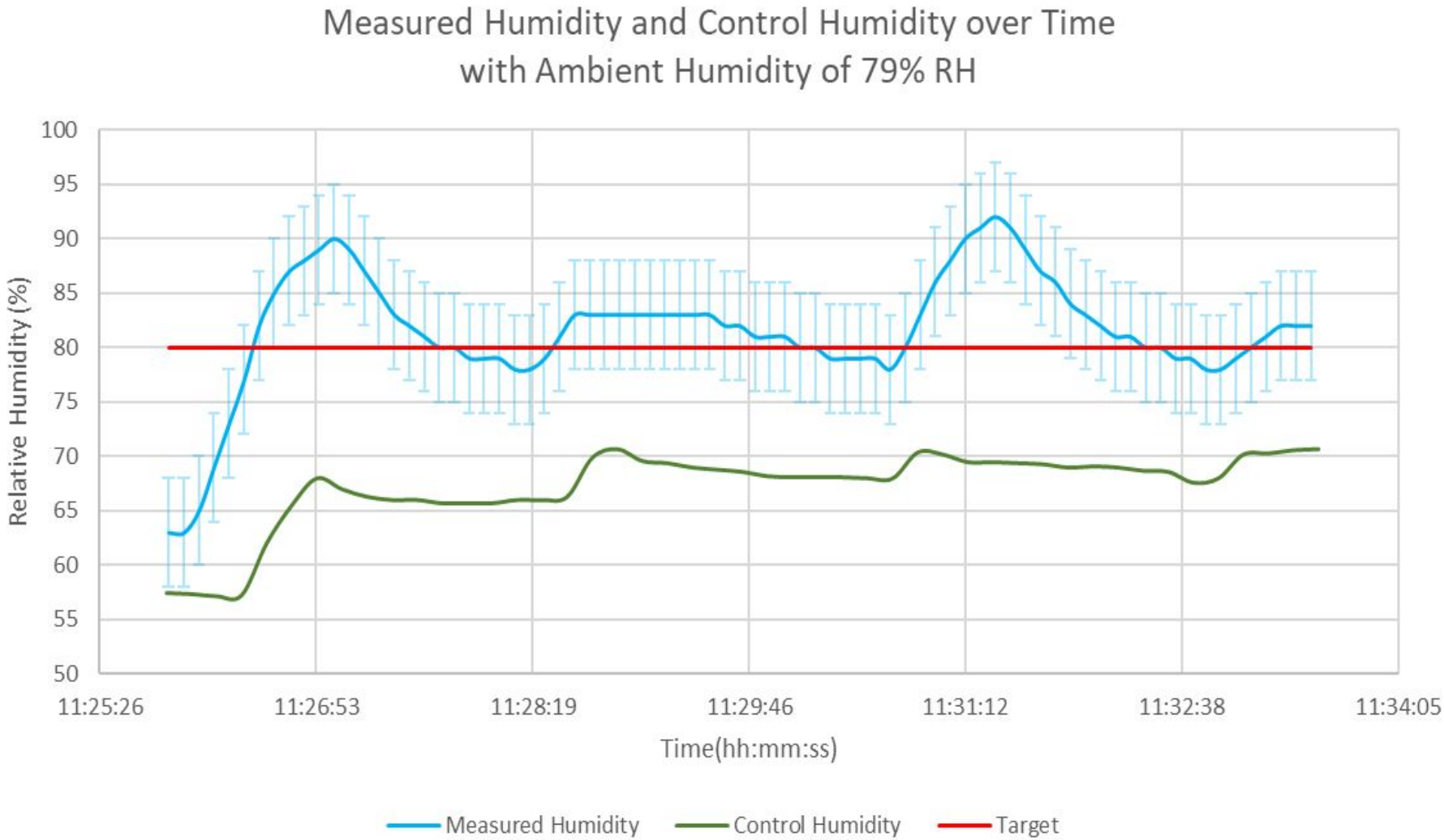
- Rainy Day Scenario: Greenhouse is too hot, low humidity
- Lower and maintain temperature, raise and maintain humidity, maintain soil moisture content
- Greenhouse was heated to maximize temperature and minimize humidity, heater was on throughout entire test
- Results of 7:30 minute test shown below

Data from Greenhouse Sensors	Temperature (°C)	Relative Humidity (%)	Soil Moisture Content
Initial State	28	63	433
Target State	20	80	390
Final State	20	82	391

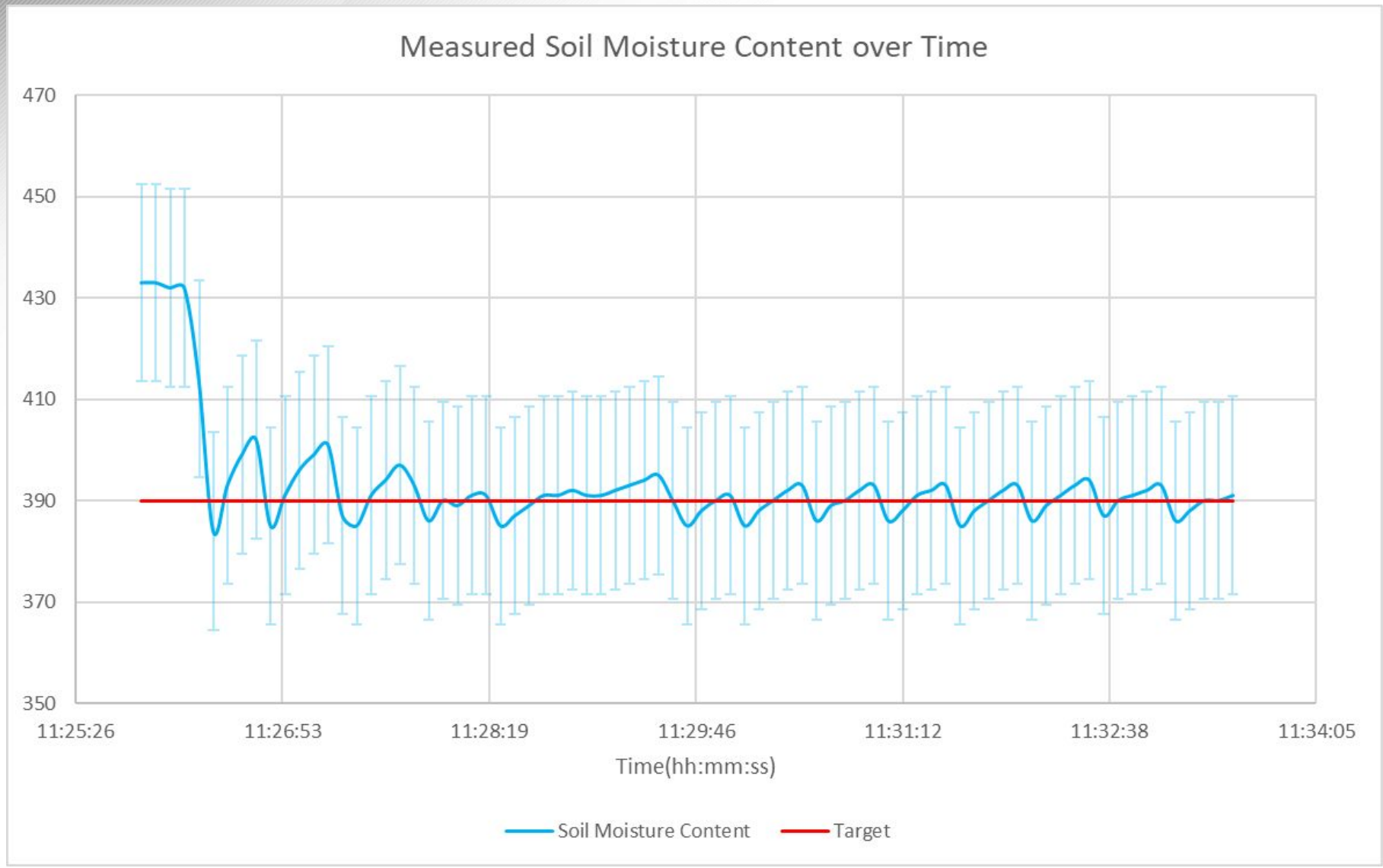
Temperature Control



Humidity Control



Soil Moisture Content Control



Conclusions

- **Major Changes from FSR/ICD**: Two BC circuits for power subsystem, enclosure dimensions, environmental actors upscaled, irrigation system restructured.
- **Current status**: Integration complete. Testing and Validation complete; Prototype power supplies are validated and integrated in greenhouse. PCB boards are tested but not validated or integrated in enclosure. Expected completion is one week.

Thank You!