Senior Design Project
Plant Monitoring via IoT

sddec21-08

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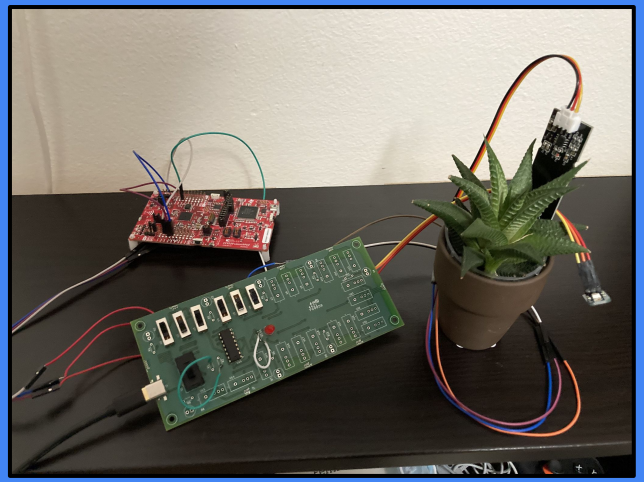
Thomas Smeed - Hardware
Walter Gilbert - Software

Advisor: Daji Qiao
Client: Mark Easley / Texas Instruments

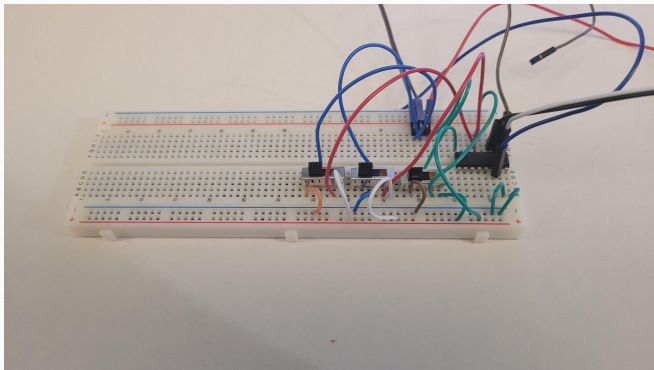


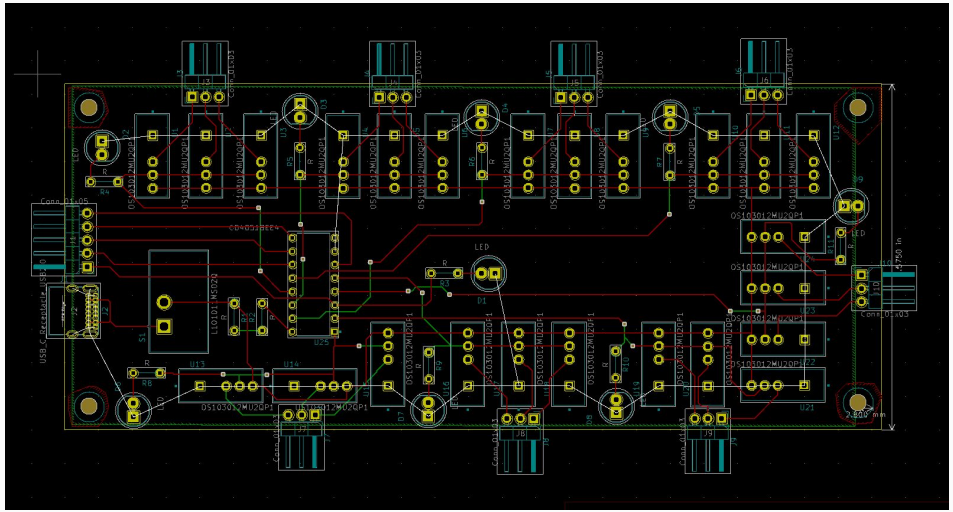
Problem Statement

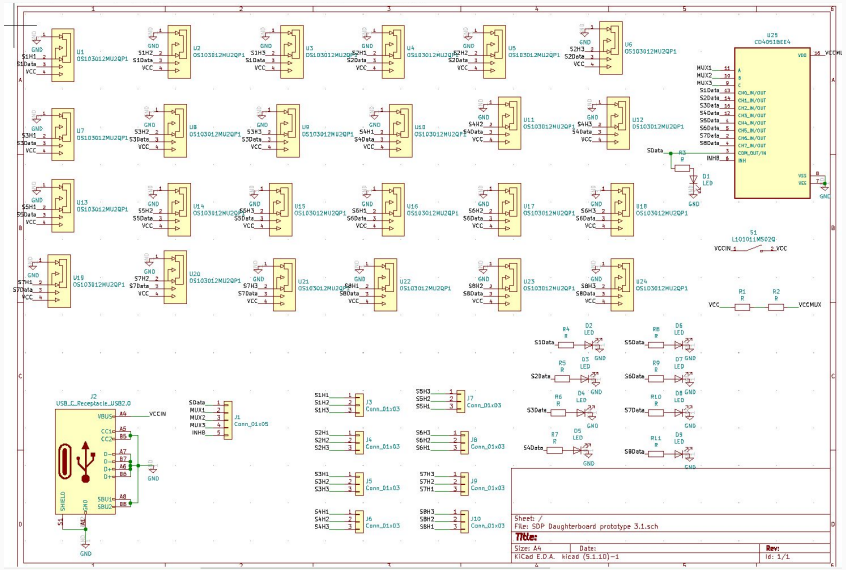
- Develop an easy-to-use IoT sensor ecosystem
- Sensor module with light, fertilizer, and moisture sensors
- Sends data to an AWS server
- Users can view sensor status on the website
- Users can create a graph view of sensor data over time
- Users will be notified if values go outside of a set range
- On-board LED that tells if sensors are in range

Hardware Design

- Receives analog data from 8 sensors per module
- Uses 4 GPIO ports from TI launchpad
  - 1 for data
  - 3 for mux logic
  - So expansion for, 1 pin for data*(# of daughterboards) + 3 pins for mux logic
- Modular pin header for sensors
- Powered by USB C



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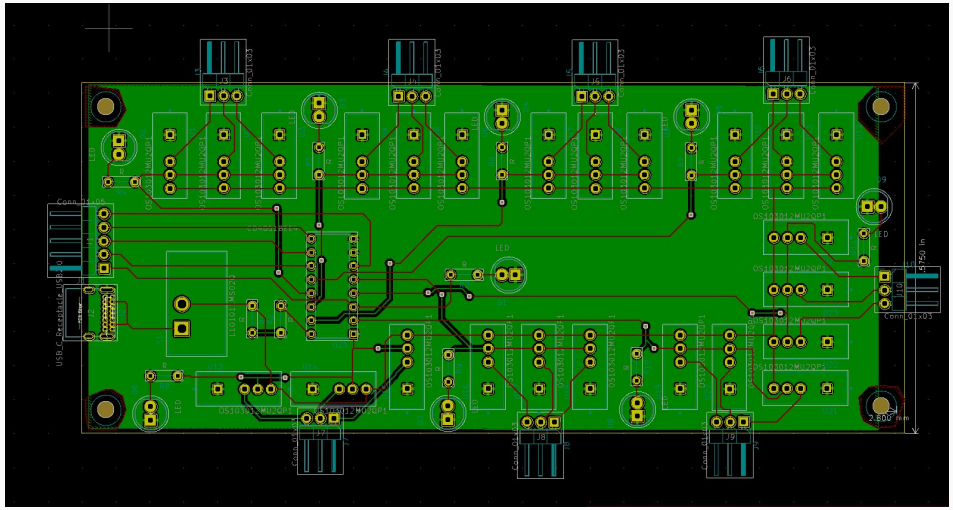
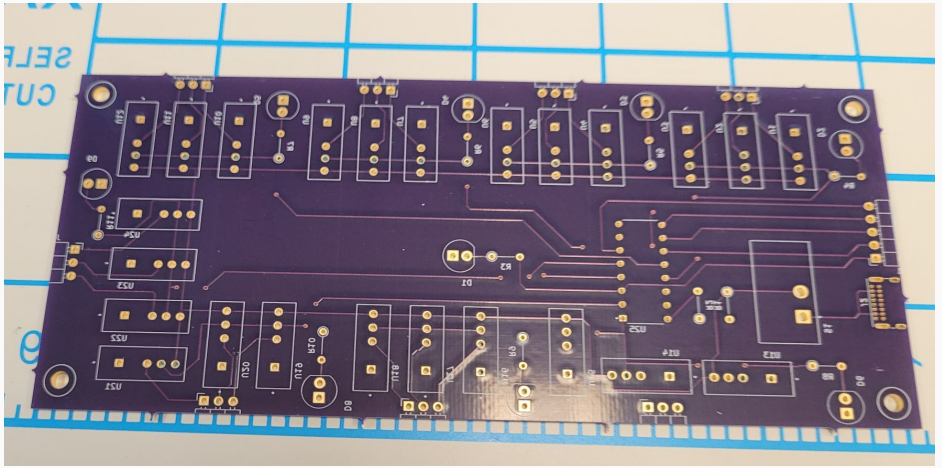
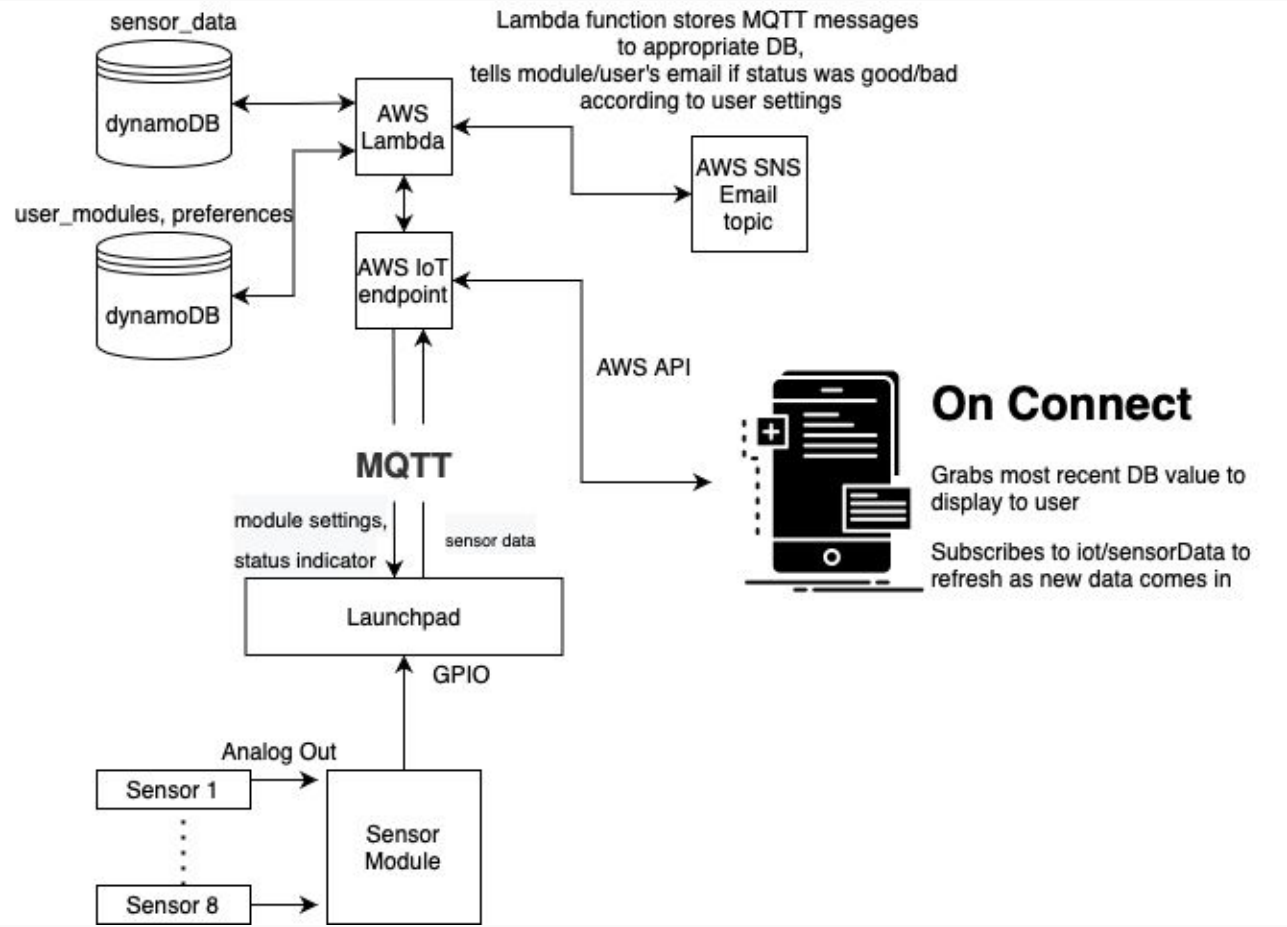


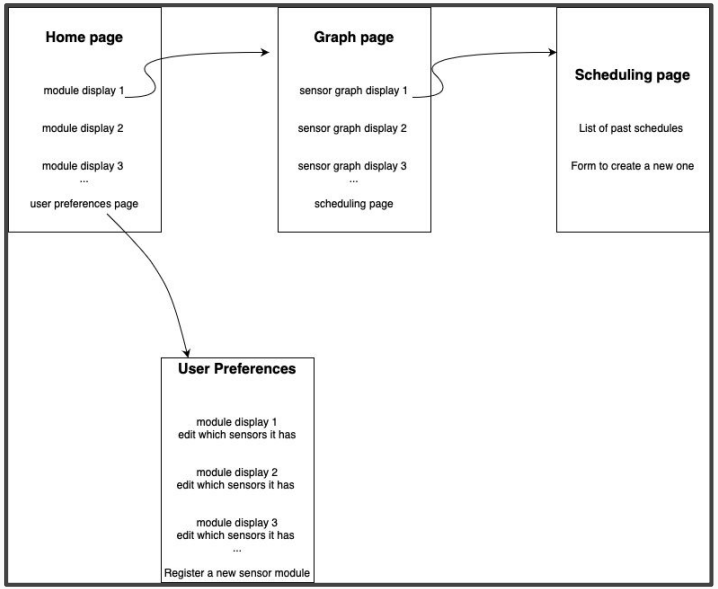


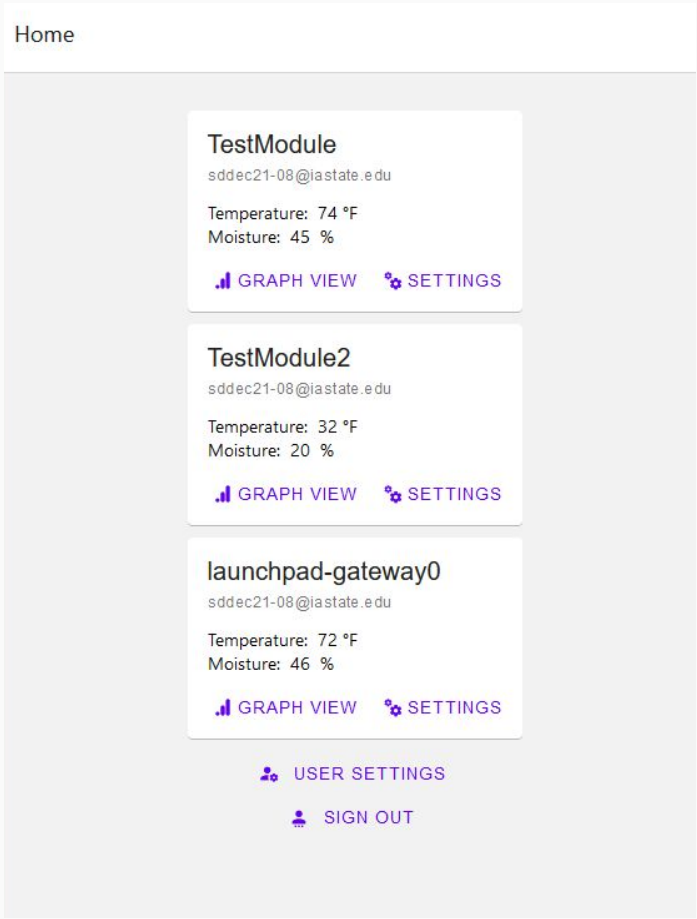


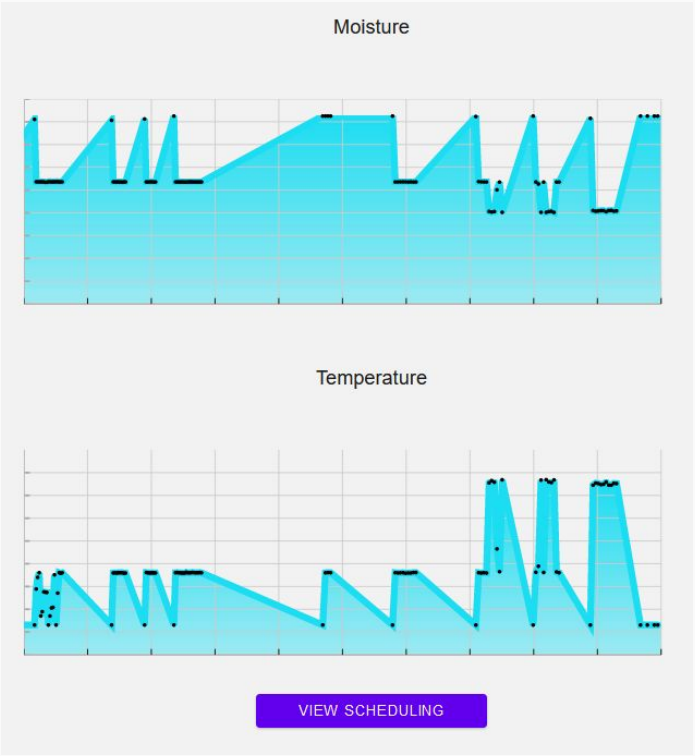
Project Design

Software Design

- Frontend built with Amplify
  - Easy to integrate with AWS
  - Provides authentication API we can use
  - Sign Up/In Pages use Amplify Authentication
- Home Page
  - Grabs all sensor modules belonging to your user
  - Looks at DynamoDB for last value on connect
  - Subscribes to MQTT topic for real time updates
- Graph View
- Alert setup page
- Modularity in sensor display



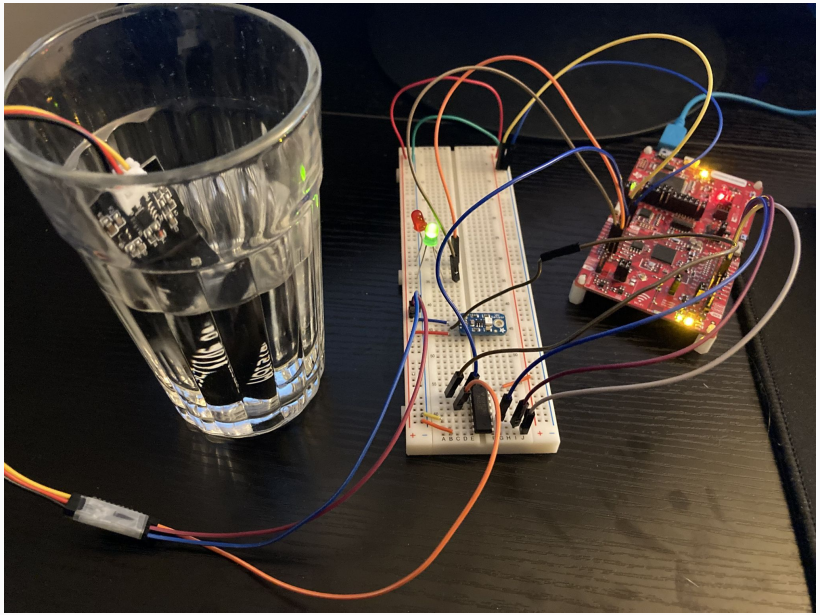

Home
TestModule
sddec21-08@iastate.edu
Temperature: 74 °F
Moisture: 45 %
GRAPH VIEW
SETTINGS
TestModule2
sddec21-08@iastate.edu
Temperature: 32 °F
Moisture: 20 %
GRAPH VIEW
SETTINGS
launchpad-gateway0
sddec21-08@iastate.edu
Temperature: 72 °F
Moisture: 46 %
GRAPH VIEW
SETTINGS
USER SETTINGS
SIGN OUT

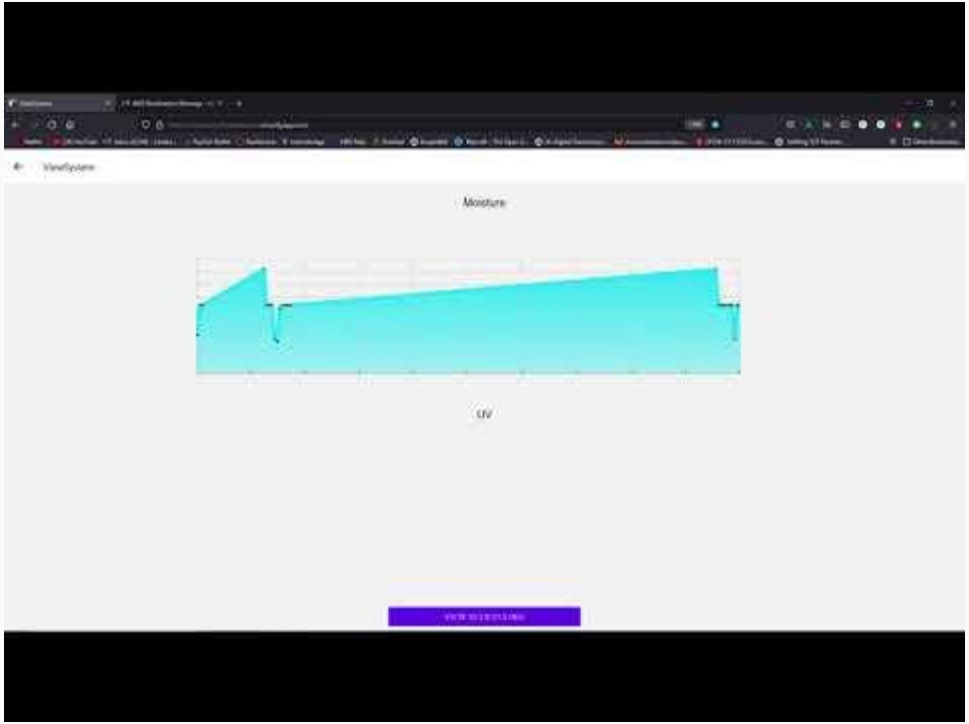

Moisture
Temperature
VIEW SCHEDULING

Frontend

Notification System

- Built on top of AWS's Simple Notification Service (SNS)
  - Easy to integrate
  - Flexible publish/subscribe architecture that meets our needs
- AWS Lambda function triggers whenever data comes in
  - Checks if the user who the data belongs to has any thresholds set up
  - Checks if the data is in/out of bounds with respect to those thresholds
    - Emails the user if it's not
    - Sends the board "status=good" or "status=bad" message





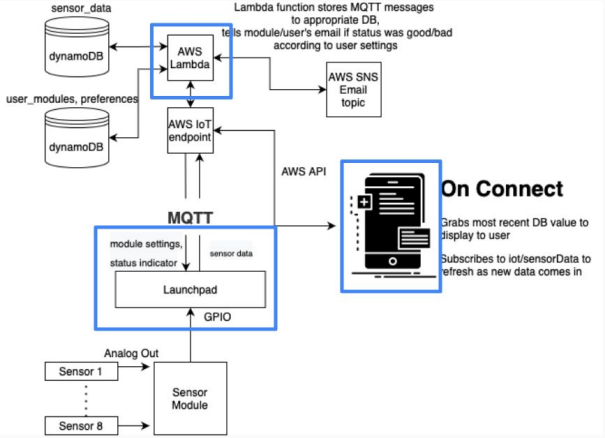
Demo Video

Software Challenges we faced

- Planning out the firmware to read sensor data without the daughter board ready.
- AWS was quite involved to get setup with for beginners.
- Managing AWS accounts and access.
- Working with and debugging software libraries.
- Maintaining flexibility with sensors.

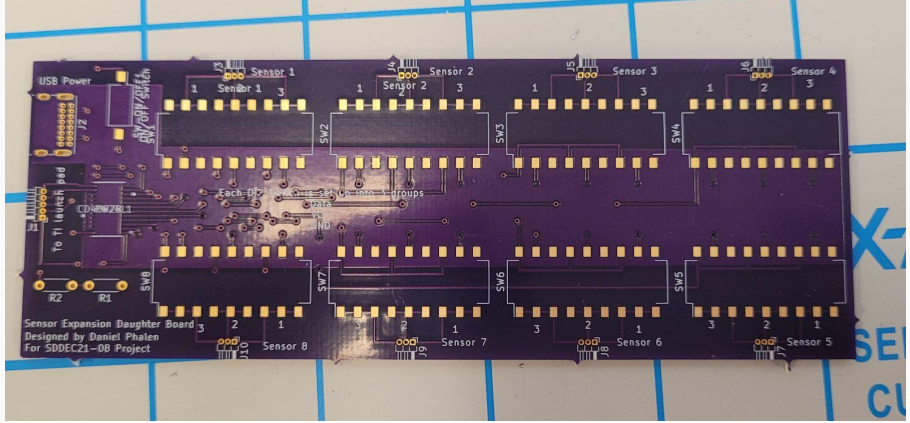
Lessons Learned - Software

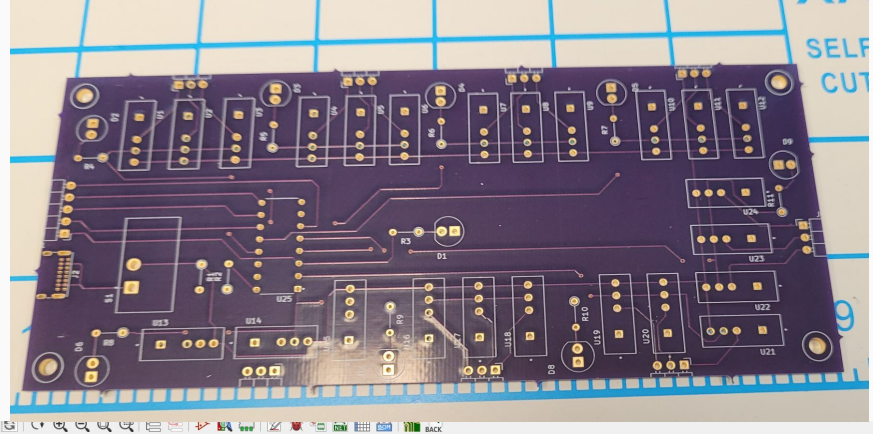
- Benefits and challenges of working with AWS
- Managing simultaneous updates across firmware, backend, and frontend at the same time
- Picking out software libraries to use

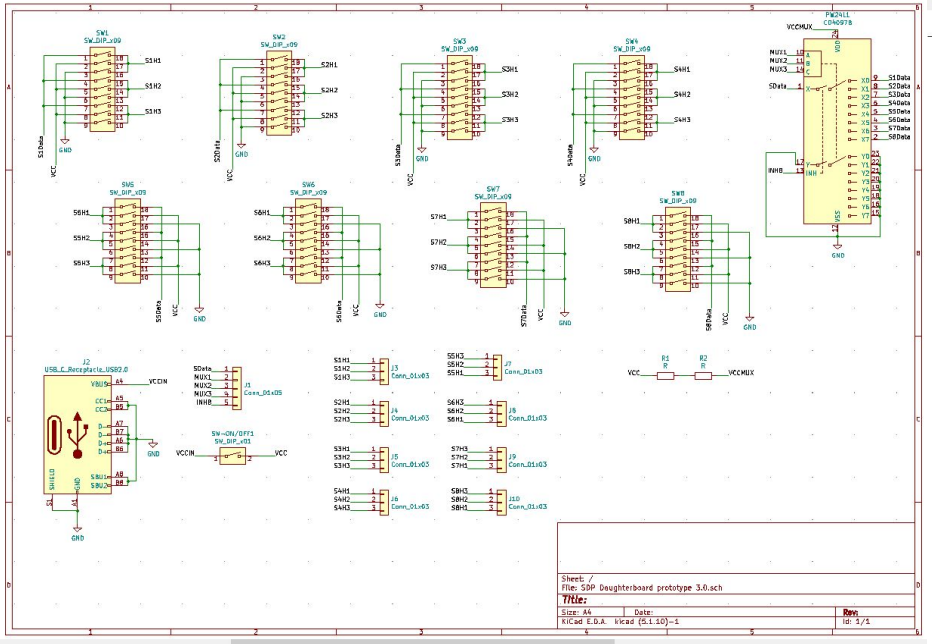


Hardware Challenges we faced

- Figuring out best hardware solution to connect to the software end
- Designing PCB
- Ordering components and pcb
- Testing the pcb designs


USB Power
Sensor 1
Sensor 2
Sensor 3
Sensor 4
Sensor 5
Sensor 6
Sensor 7
Sensor 8
Sensor Expansion Daughter Board
Designed by Daniel Phalen
For SDDEC21-08 Project

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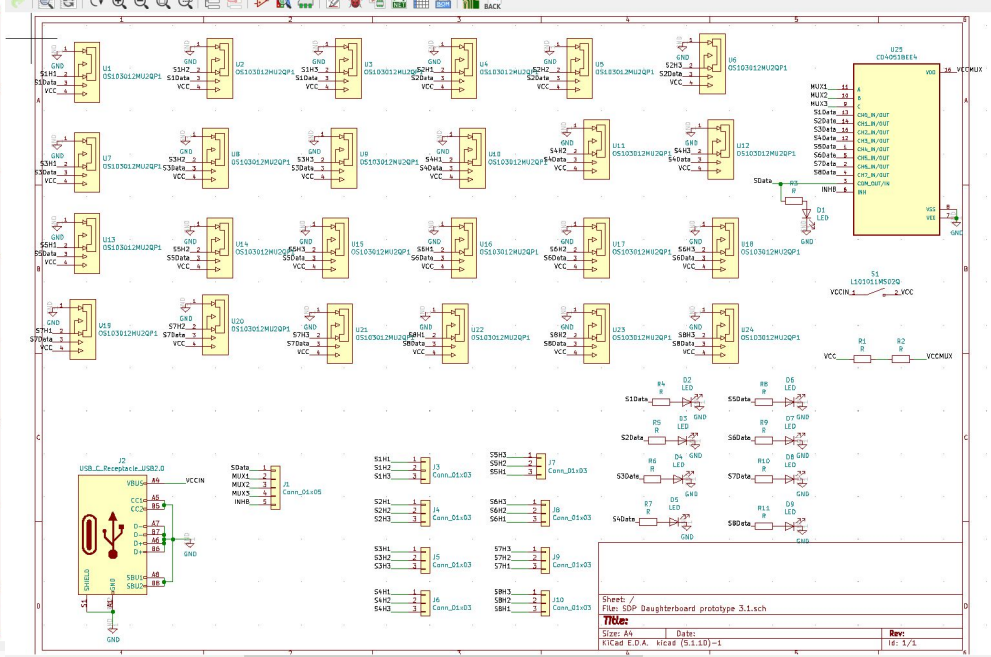
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Lessons Learned - Hardware

- Better PCB design practices
- The software pros and cons of different PCB software
- Improving soldering skills

Drawbacks

- Reliant on AWS
  - Affected by their outages
  - Limited in usage
- Frontend not optimized for mobile
- PCB not ready for final demo

Conclusion

- We have developed a streamlined, flexible sensor ecosystem for watching plants and keeping track of sensor values.
- Software side was a success and met our goals
- Hardware design was solid but PCB delays prevented us from testing with the final revision