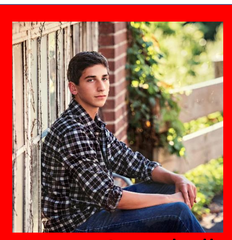
Wireless Microclimate System for Agrivoltaics


James Campbell
Electrical Engineering


Will Hopkins
Computer Science


Yulia Martinez
Computer Science


Anthony Napolitano
Electrical Engineering


Rose Saalman
Computer Engineering


Keith Springs
Computer Engineering


Mohsen Rezayat
Advisor


Je-Hyeong Bahk
Advisor

Problem

In agrivoltaics, shading created by PV panels can affect plant growth adversely for light sensitive crops, as it reduces the light for photosynthesis. Excess light exposure in warm to-hot summer climates is detrimental to many agricultural products, as it can cause “sunburn” that chemically damages the product and leads to poor quality.

Solution

We will develop a wireless microclimate sensor system that is capable of sensing local climate components such as temperature, humidity, light intensity, and frost at an agricultural site as well as the soil conditions such as soil temperature and moisture level. These sensing data will be collected remotely into an application, made accessible to the user, and will be used to make automatic decisions on the adjustment of the PV panel angle and other operations.

Challenges

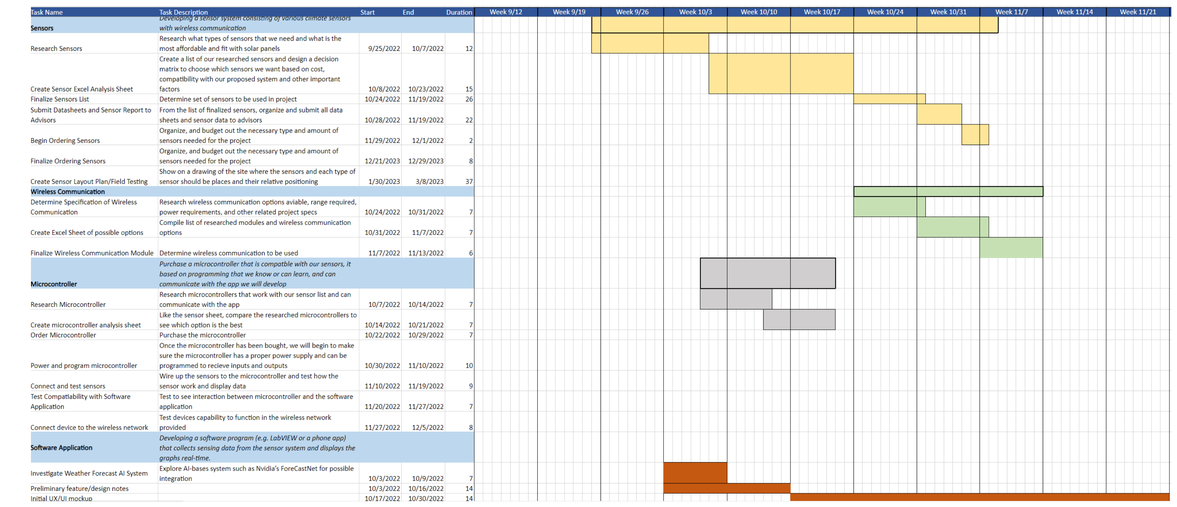
- Connecting the microcontroller to online databases to transmit and receive data
- Researching and connecting sensors to microcontroller
- Implementing different filters in the app

Broader Impacts

- Farmers can now get alerts and be prepared to save their crops which help feed a community
- These alerts also help farmers save money on equipment, especially with frost detection and the supplies to combat frost
- The data collected can be analyzed and help for predictability
- This design will be open to the public, so other engineers can build upon and improve the current model

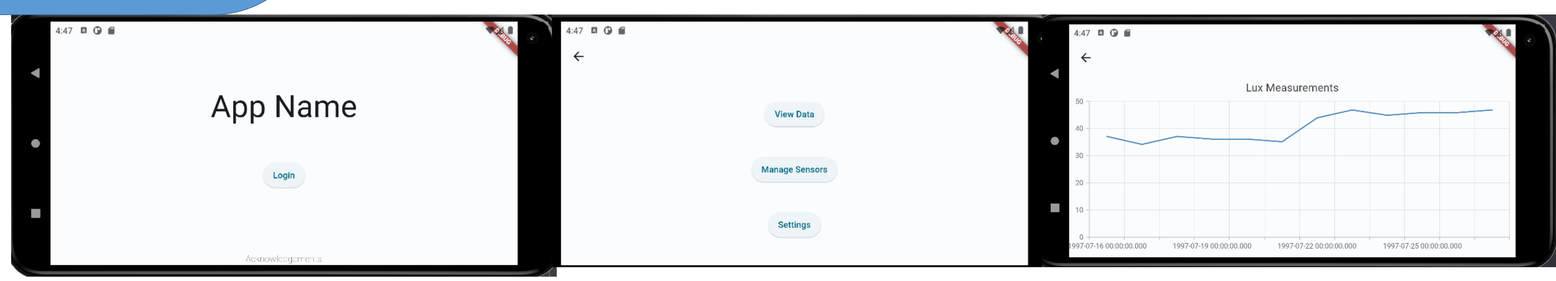
Gantt Chart

Task Name	Task Description	Start	End	Duration
Sensors	*Developing a sensor system consisting of various climate sensors with wireless communication*			
Research Sensors	Research what types of sensors that we need and what is the most affordable and fit with solar panels	9/25/2022	10/7/2022	12
Create Sensor Excel Analysis Sheet	Create a list of our researched sensors and design a decision matrix to choose which sensors we want based on cost, compatibility with our proposed system and other important factors	10/8/2022	10/23/2022	15
Finalize Sensors List	Determine set of sensors to be used in project	10/24/2022	11/19/2022	26
Submit Datasheets and Sensor Report to Advisors	From the list of finalized sensors, organize and submit all data sheets and sensor data to advisors	10/28/2022	11/19/2022	22
Begin Ordering Sensors	Organize, and budget out the necessary type and amount of sensors needed for the project	11/29/2022	12/1/2022	2
Finalize Ordering Sensors	Organize, and budget out the necessary type and amount of sensors needed for the project	12/21/2023	12/29/2023	8
Create Sensor Layout Plan/Field Testing	Show on a drawing of the site where the sensors and each type of sensor should be places and their relative positioning	1/30/2023	3/8/2023	37
Wireless Communication				
Determine Specification of Wireless Communication	Research wireless communication options aviable, range required, power requirements, and other related project specs	10/24/2022	10/31/2022	7
Create Excel Sheet of possible options	Compile list of researched modules and wireless communication options	10/31/2022	11/7/2022	7
Finalize Wireless Communication Module	Determine wireless communication to be used	11/7/2022	11/13/2022	6
Microcontroller	*Purchase a microcontroller that is compatible with our sensors, it based on programming that we know or can learn, and can communicate with the app we will develop*			
Research Microcontroller	Research microcontrollers that work with our sensor list and can communicate with the app	10/7/2022	10/14/2022	7
Create microcontroller analysis sheet	Like the sensor sheet, compare the researched microcontrollers to see which option is the best	10/14/2022	10/21/2022	7
Order Microcontroller	Purchase the microcontroller	10/22/2022	10/29/2022	7
Power and program microcontroller	Once the microcontroller has been bought, we will begin to make sure the microcontroller has a proper power supply and can be programmed to recieve inputs and outputs	10/30/2022	11/10/2022	10
Connect and test sensors	Wire up the sensors to the microcontroller and test how the sensor work and display data	11/10/2022	11/19/2022	9
Test Compatability with Software Application	Test to see interaction between microcontroller and the software application	11/20/2022	11/27/2022	7
Connect device to the wireless network	Test devices capability to function in the wireless network provided	11/27/2022	12/5/2022	8
Software Application	*Developing a software program (e.g. LabVIEW or a phone app) that collects sensing data from the sensor system and displays the graphs real-time.*			
Investigate Weather Forecast AI System	Explore AI-bases system such as Nvidia's ForeCastNet for possible integration	10/3/2022	10/9/2022	7
Preliminary feature/design notes		10/3/2022	10/16/2022	14
Initial UX/UI mockup		10/17/2022	10/30/2022	14



Sample Data Graphed in InfluxdB

App Mockups



University of CINCINNATI