Wireless Mesh Network for Pesticide Spray Monitoring and Mapping

Detailed Design

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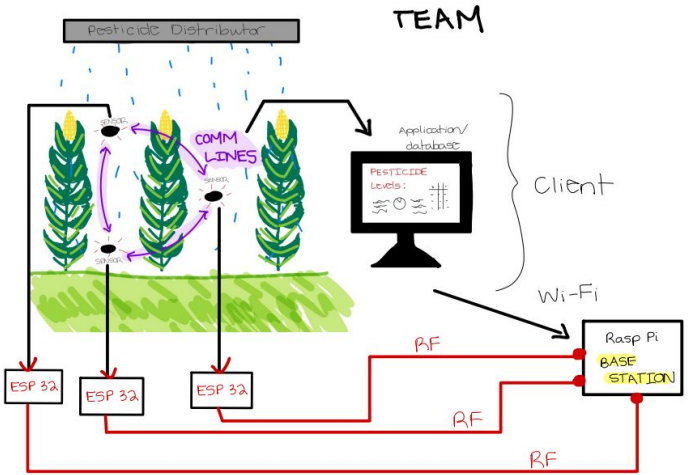
Ashley Falcon, Henry Hingst, Wesley Smith,
Yok Quan Ong, Drew Scheidler, Hector Perez Prieto

Advisor: Nathan Neihart
Client: Claussen Labs

Project Overview

Goal: Wireless Mesh Network for Pesticide Spray Monitoring and Mapping

- Collect resistance data from IDEs (Interdigitated Electrodes) at various levels of crop canopy
- ESP32s microcontrollers will also be placed on poles at various levels of corn canopies and locations and create a “mesh network”
- Measurements will be sent to a centralized device to be pulled by user
    - Centralized device will be a Raspberry Pi
    - Transmitted over wifi
    - Text files must be user friendly



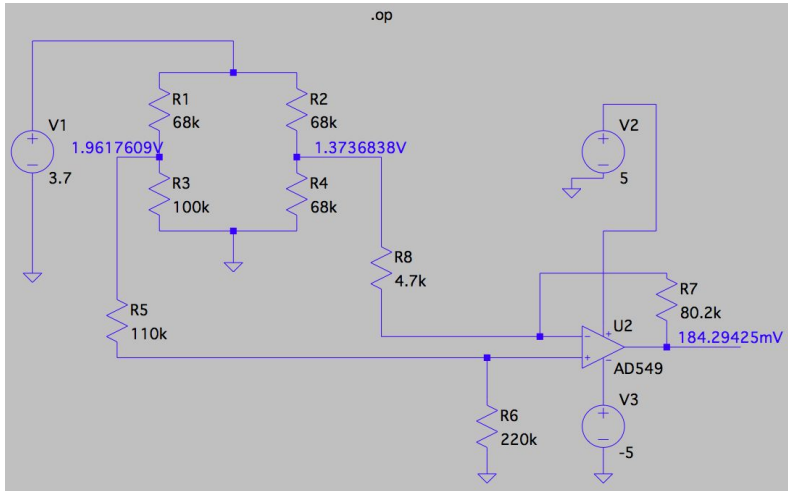
Functionality

- Our users will use our design by deploying our poles in a field, activating them via the base station, and collecting the data from the base station once their test is concluded.
- The control of the base station will be utilized via an SSH connection over wifi with a laptop that the user will bring with them
- They will use terminal commands to start and stop recording data from the sensors as well as downloading the sensor data
- The terminal will also be used to report information about the mesh network so that the researchers can determine if all of their poles have successfully or not

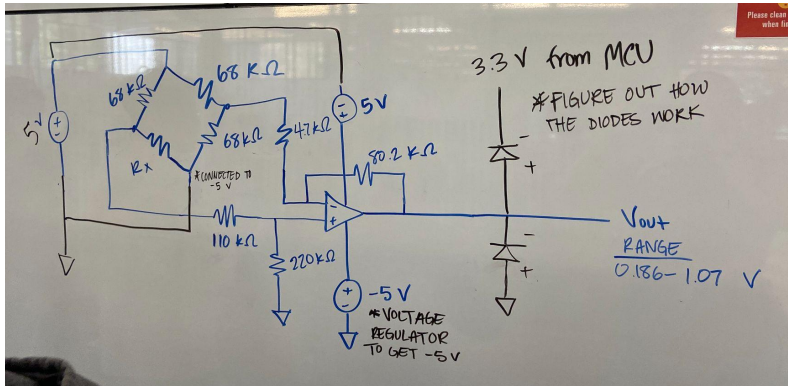
Circuit Diagram

- Implemented to read pesticide sensor readings
- Circuit output sent to the ADC of the ESP32 microcontroller to read and write data
- Changes weekly according to what we accomplish that week in correlation with the current plan our hardware team has
- Both sketch-noted and simulated
- Tested on breadboards weekly

Last week

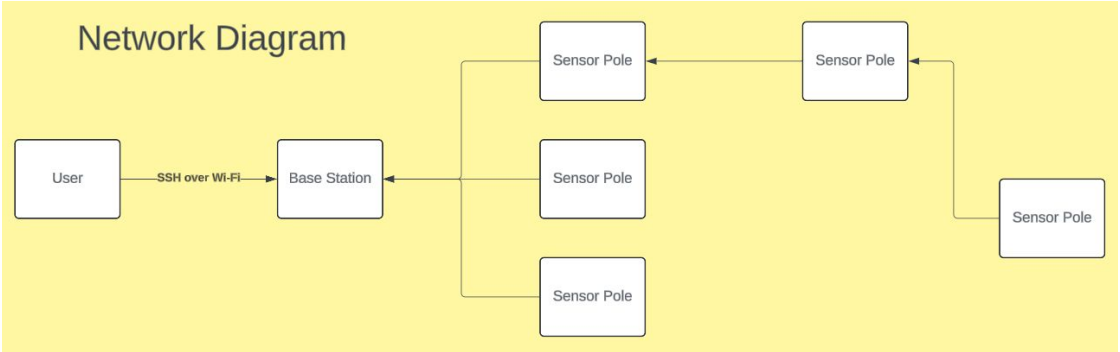


This week



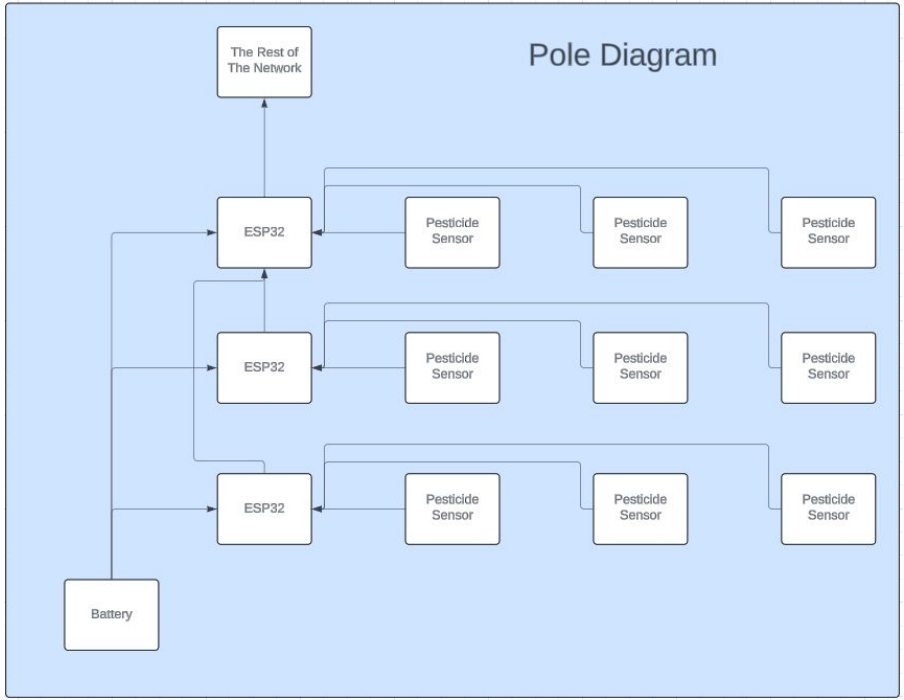
Network Diagram

- Network consists of
  - Poles distributed to collect data
  - Base station to communicate with said poles
  - Centralized Raspberry Pi base station
  - Computer to activate sensors and collect base station data
- Communicate using Expressif 802.11 LR wifi mode
- Configured as a mesh network
- Currently configuring data to a .txt file



Pole Diagram

- Nine sensor poles consist of
  - Three ESP32s each connected to three Claussen Lab sensors
  - Battery for power
- The ESP32 closest to the top of the pole will do the mesh networking
- Battery will be connected to voltage regulators to keep the supplied voltages constant, preventing damage



Technology Considerations

- Wifi - The ESP32 boards have wifi functionality built in. One consideration this brings is the low range and penetrating power of wifi. This limitation will be mitigated by utilizing a mesh network and by using the 802.11LR wifi mode.

- Battery Power - One of our requirements is that each sensor pole must be able to operate for three hours on a battery attached to the pole. We can mitigate this limitation by implementing functionality on the ESP32s so that when they aren’t recording sensor data they go into a low power mode.

Areas of Concern and Development

- Crop height interfering with network connectivity
- Data Accuracy
- Sensor Calibration
- Power Management
- Scalability

Conclusions

- Circuit Diagram
  - Implemented to read pesticide sensor readings
  - Circuit output sent to the ADC of the ESP32
  - Changes weekly
- Network Diagram
  - Communicate using Expressif 802.11 LR wifi mode
  - Configured as a mesh network
  - Currently configuring data to a .txt file
- Pole Diagram
  - The ESP32 on top will do the mesh networking
  - Battery will be connected to voltage regulators
- Areas of concern
  - Discussed in our group meetings and are thought of during our design processes