EE/CprE/SE 4920 STATUS REPORT 2

31JAN2025 – 13FEB2025
Group number: sdmay25-04
Project title: Wireless Mesh Network for Pesticide Spray Monitoring and Mapping

Client: Claussen Lab- Iowa State University

Advisor: Nathan Niehart

Team Members/Role:
Software Team
- **Ashley Falcon:** IDEs and Microcontrollers, Group Communicator
- **Drew Scheidler:** Mesh Networking; Note Taker
- **Henry Hingst:** Mesh Networking; Group Leader

Hardware Team
- **Hector Perez Prieto:** Microcontroller; Circuit Design and Testing
- **Yok Quan Ong:** Circuit Design and testing; Microcontroller
- **Wesley Smith:** Circuit Design/Simulation; Microcontrollers; Note Taker

---

Period Summary

- Hardware Team Summary:

    The hardware team saw two solutions to the new problem presented by the client of an expanded measurement range. We're currently working in parallel with our previous Wheatstone bridge and a new idea using voltage dividers to simplify the circuit. We have laid the groundwork and initial designs for both methods and we hope to finalize them and present these findings in the next status report. We've also been looking into methods to switch between measuring circuits using multiplexers. We also need to finalize a method to isolate circuits. Our current idea is mosfets.

- Software Team Summary:

    The software team has been working on designing and implementing a user interface, abstracting the ADC and SD card code to be more simple to use as components called by the main program, and figuring out how to implement the mesh network with our current microcontrollers. For the user interface, so far we have a simple polling command line through Putty connected to the microcontroller with a serial connection. We are mostly finished with abstracting the ADC and SD card code, but just need to implement calibration to the ADC code. For the mesh network, we can create the network, but we are facing difficulties with actually

sending Wifi packets over the network, and we are planning on experimenting with a different board with Lora capabilities to see if we can implement a better, working network using Lora, while we continue to try to get the network to work with our current boards.

Past Period Accomplishments

Both our hardware and software teams met milestones and had accomplishments over the past two weeks. Here are our individual contributions:

- Ashley Falcon:
  - Communicated with client and advisor
    - Determined individual strengths and weaknesses
  - Set up a basic UIthis.groundPosition = initialthis.groundPosition = initialGroundPosition;GroundPosition;
    - Able to start and stop measurement readings from ADC
    - Implemented in Putty so that user dothis.groundPosition = initialGroundPosition;es not need to configure the ESP32-C6 IDF to send commands
  - Created a Wi-Fi server
    - Initialized wifi network
    - Able to join via cellphone
    - Added error handling capabilities for future testing and debugging
  - Explored HTTP communication
    - Initialized address utilizing server IP address and port
      - Implemented within host code for base station
    - Implemented code to allow client (node) to join host wifi network and communicate over HTTP
      - Currently having issues with sending wifi packets
      - Set up error handling code to better identify issue
  - Collaborated with other software members to better outline wifi packet structure

- Drew Scheidler:
  - SD Card Code Abstraction
    - Code designed and tested using dummy data
    - Code works reliably and is easy to use
  - ADC Code Abstraction
    - Code designed and tested using power supply as input and console as output
    - Code outputs raw readings to console

- ■ Readings need to be calibrated to better match actual supplied power
  - ○ Peer-to-Peer Wifi Packet Transmission
    - ■ Tested simple code to send Wifi packets from one microcontroller to another microcontroller which displays info from the packet
    - ■ Done to test sending packets only, and would need to be heavily modified for our needs

- ● Hector Perez Prieto:
  - ○ Designed new wheatstone bridges and voltage dividers to fit the new ranges given by the client

- ● Henry Hingst:
  - ○ Continued work on packet transmission over the mesh network.
    - ■ Have gotten packets to be created, transferred, and received over the mesh network.
    - ■ Have been stuck on actually accessing the data contained in the packets, and haven't been able to get it to work at all.
  - ○ Looked into alternatives to the mesh network provided by Espressif
    - ■ There is an API that supposedly streamlines using the mesh network interface provided by Espressif, however I ran out of time before I could fully dig into it.

- ● Yok Quan Ong:
  - ○ Looked into the switching circuit for the Wheatstone bridge with different ranges of measurement
  - ○ Create a new design for the Wheatstone bridge that can cover the new ranges
    - ■ Looked into voltage divider and try to create circuit for the project

- ● Wesley Smith:
  - ○ Formulated a rough new design implementing our previous method of measuring, Wheatstone bridges, to measure new range provided by the client
    - ■ Circuit isn't up to 1% accuracy as client requested yet
  - ○ Also created a rough idea of how the switching will go between the circuits using the microcontroller to isolate the circuit using mosfets

NAME	Individual Contributions	Hours this Period	Cumulative Hours
Ashley Falcon	Set up advisor meeting time. Made a basic UI. Initialized wifi server. Began HTTP comm.	12	19
Drew Scheidler	Abstracting SD card and ADC code. Sending PTP Wifi packets.	13	28
Hector Perez Prieto	Designed new Wheatstone Bridges and Voltage Divider circuits	12	18
Henry Hingst	Met with the software team to make a plan. Continued work on mesh network packet transfer	15	6
Yok Quan Ong	Wheatstone Bridge and Switching circuit	12	18
Wesley Smith	Wheatstone Bridge Circuit Revision	12	18

Plans for the upcoming period
- **Hardware Team**
  - The hardware team will be working in parallel to see which method of measuring will be easier or superior between Wheatstone bridges and voltage dividers
  - Continue working on the Wheatstone Bridge idea
  - Start the design of the voltage divider that has the same functionality as the Wheatstone Bridge method
  - Do the calculations for the circuit design and do the error calculations
  - Simulate the worst case for the new circuits
  - Research on how do the isolation for the switching circuit when other is not used
  - Finalize the switching circuit for different ranges and switching

- **Software Team**
  - Henry - Determine which LORA board to order. Continue original Espressif mesh network implementation.
    - Specifically debug packet data reading problems with the mesh network.
    - Try using the alternative API found this week.
  - Drew - Hand-off ADC and sd code to Ashley. Determine which LORA board to order. Dive into LORA documentation.

- ○ Ashley - Work with HW to decide on multiplexer and switching code. Determine time frame and testing.
    - ■ 4-1 MUX to select range.
    - ■ If one range is maxed, switch up to the next.
    - ■ ID which range measurement is from to choose correct resistance conversion.

Summary of Weekly Advisor Meetings
- ● Week 2 (Feb 4th)
    - ○ Reflected on previous semester's workflow
        - ■ Professor Neihart advised us that, although we were productive last semester, this semester required more tangible progress
        - ■ One of the hindrances identified from last semester in 4910 was that we lingered far too long when decisions needed to be made
            - ● Solution: establish decision deadlines
            - ● Ex. switching from C to arduino for mesh network
        - ■ Suggested have more routine team meetings
        - ■ We need prioritize senior design instead of simply working when other homework is complete
    - ○ Basic housekeeping
        - ■ Established routine meeting times and dates
        - ■ Will start inviting clients to more meetings
        - ■ Began organizing tasks for team
- ● Week 3 (Feb 11th)
    - ○ Discussed hardware team circuit design
        - ■ Due to increased range in theoretical measurements, circuit needs to split into 4 ranges to maintain accuracy over a large range of resistance values
        - ■ Will need a multiplexer to switch between based on resistance input range
            - ● Microcontroller will select range
                - ○ Connect resistors to different GPIO pins?
            - ● Need to finalize voltage divider
    - ○ Discussed SW progress
        - ■ Abstracting code
        - ■ Successful P2P network
    - ○ Explored SW hurdles and solutions

- - Use LORA dev board to attempt to replace Mesh network by compensating with range
    - Or even use a mesh network on the LORA
  - In conjunction, one member continues working on implementing the original mesh network idea on the espressif board
  - Another will work with HW to
- Received feedback from client
  - Interface: what options do they need from the base?
    - Serial Putty connection → SSH instead ideally
    - Operator will need to have Putty and be able to start/stop
      - User should NOT have to stay connected for system to operate
  - Record data on SD and send that to the base node
    - Text files of converted data
  - Send over documents in future meeting invites
  - HW needs to hammer down ranges and figure out switching later
    - One person looks at bridge
    - One person at the voltage divider