EE/CprE/SE 491 WEEKLY REPORT 7

10/25/2024 – 10/31/2024
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

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Weekly Summary

- **Hardware Team**
    - Detailed how our circuit works with mathematical concepts
    - Researched voltage regulators and batteries to soon implement into our project
    - Ran a worst case simulation (as suggested by our advisor) on our current circuit to see if it would still output the voltage ranges we wanted
    - Implemented new components to LTspice and continued simulation
- **Software Team**
    - Successfully set up an tested board to board communication over wifi with two ESP32 boards
    - Found and started setup and testing of a wifi mesh framework provided by Espressif
    - Fixed issue with long compile times with FreeRTOS
    - Explored ADC calibration function
        - Calibrated ADC for voltage readings
        - Will be used to increase accuracy of resistance values

Past week accomplishments

- **Ashley Falcon:**
    - ESP32-C6 Microcontroller ADC Calibration
        - Looked into how to calibrate the ADC to get more accurate voltage readings
        - Reviewed documentation on how the ADC works and where it might have issues
        - Looked at ways to improve accuracy, like adjusting offsets
        - Checked out best practices, such as sampling rate filters
    - Researched how to set up a Windows environment to program the ESP32-C6
        - Looked into which tools and software are compatible with ESP-IDF
        - Necessary drivers and software dependencies to connect and communicate with the ESP32-C6
    - Communicated with clients to confirm details and finalize choices
        - Communication for consistency of resistor values
        - Communicated to acquire their sensors
        - Communicated to align on our process for flashing firmware
- **Drew Scheidler:**
    - Looked into how to set up ADC calibration for the ESP32-C6 microcontroller
        - Learned how the calibration process works
        - Checked out instructions on setting up and adjusting calibration
    - Researched setting up the ESP32-C6 programming environment on Windows
        - Reviewed the setup process, including the tools, drivers, and software needed
        - Looked into which settings make it easier to upload and test code on the ESP32-C6
        - Looked into potential issues specific to Windows
- **Hector Perez Prieto:**
    - Changed the source voltage of our circuit to 5V and changed some resistor values for our voltages to still fall in the desired range of 0.1 - 1.1 V.
        - Found equations that will help verify tested values
        - Further research on Wheatstone bridges and other components needed for our circuit
- **Henry Hingst:**
    - Successfully set up an tested board to board communication over standard wifi with two ESP32 boards
    - Found and started setup and testing of a wifi mesh framework provided by Espressif

        - The mesh network framework doesn't seem like exactly what we want but I need to test it more thoroughly to fully understand it
        - Managed to set up a three node network using three ESP32s and the wifi hotspot on my phone
        - This setup used standard wifi instead of the 802.11LR mode that we want to use
    - Fixed issue with long compile times with FreeRTOS
        - Originally we were using a Linux distribution of FreeRTOS that ran on a Windows 11 machine using Windows Subsystem for Linux
        - I figured out that a Windows version of FreeRTOS existed and I managed to install it
        - This reduced the compile time from >15 minutes to about 1 minute
- **Yok Quan Ong:**
    - Researched on the worst case analysis on LTspice
        - Simulated on the circuit we had
        - Simulated with 1% and 5% error
        - Compared the the output of both analysis
    - Researched on voltage regulator
        - How to implemented in our circuit
        - Can output both 5 and -5V
- **Wesley Smith:**
    - Researched power concepts applicable to our project
    - Created a spreadsheet of different voltage regulators
        - All regulators regulate 3.7V to 5V, 5V to 3.3V, and 3.7V to -5V
        - Found a particular regulator that would work very well
    - Created a spreadsheet of different batteries we could use in our project
        - Leaning towards 3.7V lithium ion rechargeable batteries
    - Implemented the regulators into LTspice and saw how they interacted with our circuit

NAME	**Individual Contributions**	**Hours this week**	**Cumulative Hours**
Ashley Falcon	ADC Calibration Research, Client Communication	**6**	**38**
Drew Scheidler	Windows Environment Research & ADC Research	**6**	**41**

Hector Perez Prieto	Redesign of our Sensor circuit	**6**	**40**
Henry Hingst	Wifi testing and research, speeding up compiler	**8**	**42**
Yok Quan Ong	Worst case analysis, research on voltage regulator	**6**	**38**
Wesley Smith	Power analysis, Regulator Simulation	**6**	**42**

Plans for the upcoming week

- **Hardware Team**
    - Run power ideas by Professor Neihart
        - If approved purchase and test said components
    - Look back into back to back diode circuits to implement to not fry GPIO pins
        - Need to pick diodes
        - Need to simulate
    - Begin looking into how stringing multiple circuits and ESP32s will look
        - How does power need to change / does it need to change?
        - What type of error do we run into when we string them all together
        - How do we mitigate error
- **Software Team**
    - Continue testing and researching the wifi mesh framework provided by Espressif
        - Need to see if it supports 802.11LR mode
        - Need to do more testing to fully understand how it works and how to send data using it
    - Further explore data packaging
        - How do frames work so that base station knows when data is faulty/not reading
        - Error messages?
    - Work with the HW team to integrate IDE into our readings
        - Determine a method to convert voltage inputs to ADC to resistance values

Summary of weekly advisor meeting

- Professor Neihart couldn't make it to the meeting this week
- In his email, he mentioned that we seem to be on track and making good progress