EE/CprE/SE 4920 STATUS REPORT 5

14MAR2025 – 03APR2025
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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Period Summary

- Hardware Team Summary:

Received our first order of parts and PCB design. We also took inventory of what we had and looked over our components and checked if they would work for our PCB design. After finding a few problems we redesigned our PCB and ordered a few more components that we were missing. We also created and revised a test plan for our PCB, this includes testing voltages of certain components of our circuit and testing functionality. This period we were not able to accomplish a lot of testing that we wanted to due to having to wait for the new components and PCB to arrive.

- Software Team Summary:

We finalized our block diagram of how the software will work on our initial prototype. We finished the design and implementation of the last few key features required in our initial prototype. Now that we have been able to do the large chunks of our design independently we are working to combine these features into a prototype. During this period we have been working on getting two half-prototypes working. One is for the physical recording of sensor data

utilizing the ADCs, electronic switches, and SD card. The other is for the communication and user interaction utilizing the LoRa modules.

Past Period Accomplishments

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

- Ashley Falcon:
    - Implemented interrupts in ADC driver code
        - Data stored in the ADC queue
        - Sent and received ADC data using a readADC task
        - When DOUT_RDY pin is toggled, data is read
    - Met with the software team to discuss progress
        - Decided to ignore interrupts for now
            - Required completely revising my ADC driver code
            - Went back to using basic while loops that poll until DOUT_RDY signal is pulled low
        - Made revised block diagram
        - Made a schedule to ensure milestones are met
    - Created header file for code so that functions can be easily found and accessed
        - Made functions more dynamic so that all 3 ADC sensors can be read separately

- Drew Scheidler:
    - With Henry, designed block diagrams for our measurement and base nodes
    - Progressed in code for measurement nodes
        - With Ashley and Henry, ironed out the details of the ADC driver
        - Wrote a pin config text file to be used by all code
        - Wrote code to setup switches and read ADCs iteratively
        - Wrote code to store data in organized files on the SD card
    - Researched LoRa module capabilities
    - Experimented with capabilities of SD card reader and code

- Henry Hingst:
    - Familiarized myself with the practical operation of the LoRa modules
        - Not just the abstract knowledge as noted last period but actually sending data using two modules and esp32s
    - Created functions to be used to create the “packets” used in communications between the boards

        - I use quotation marks because they are not traditional wifi packets but instead raw binary data
        - This data always starts in a specific way so that a board can identify what format the data is in and thus what it means
        - This means that the format of this data is extremely important and thus I've created functions that generate this data in order to reduce the chance of mistakes and simplify the process for the other members
    - Began creation of the networking prototype
        - Esp32s will be coded to act as dummy measurement nodes
        - Another esp32 acts as the base node, communicating with the measurement nodes to start/stop recording as well as recording dummy sensor data and consolidating it into text files
        - Currently I'm about half done with this

- Hector Perez Prieto:
    - Revised Test Plan
        - Test voltages after certain components
        - Test resistance values of our voltage divider circuit
    - Helped redesign PCB layout and order new components
    - Took inventory of what components we had

- Yok Quan Ong:
    - Create a test plan
    - Redesign PCB layout and order new PCB
    - Parts selection

- Wesley Smith:
    - Created a plan to move forward after realizing our current design wouldn't work
        - Formed a document laying our pros and cons of making a new PCB design or just ordering new parts to try and make our old PCB design work
        - Picked and debated new parts for the new PCB design, specifically mounting equipment for the test leads
            - This also made it so we could use our test leads as the parts we ordered were the wrong dimensions
    - Assist in test plan creation after input from our advisor

NAME	**Individual Contributions**	**Hours this Period**	**Cumulative Hours**

Ashley Falcon	ADC driver code updates	**15**	**58**
Drew Scheidler	Code diagram, LoRa research, SD code, Measurement node code, Pin config file	**28**	**85**
Henry Hingst	System Design and Networking Prototype	**22**	**62**
Hector Perez Prieto	Redesign of PCB, Part selection and inventory	**13**	**56**
Yok Quan Ong	PCB Design, part selection	**12**	**60**
Wesley Smith	PCB redesign, Part pick	**12**	**54**

Plans for the upcoming period

- **Hardware Team**
  - Create a plan for the upcoming testing for the testing of the parts and PCBs ordered last week
  - Redesign PCB
  - Wait for new PCBs to come
  - Test components that we can prior to PCB arrival

- **Software Team**
  - Decide how often the reset function should be called (every read vs. initialization).
  - Determine if the same ADC handler can be used for multiple inputs.
  - Possibly implement LoRa interrupt on GPIO 12 and confirm it is interrupt-capable.
  - Test code for hardware integration, ensuring ADC inputs and switch outputs initialize correctly
  - Store ~4 packets in the buffer, limiting to 128 bytes if necessary, and check RAM constraints
  - Implement measurement node storage for diagnostic data, including delta time (0.01 sec resolution) and absolute time
  - Define the number of readings to average and store only averaged readings (for now, also log timing data)
  - Build a prototype sensor reading setup, logging data to SD and testing switch controls with ADC bounds
  - Finish networking prototype

Summary of Weekly Advisor Meetings

- Week 8 (Mar 25th)
    - **Hardware:**
        - Looked over the new components that we ordered and the PCB.
        - Discovered a few problems with the PCB and had to redesign it and order a few more components.
        - Revised our Test Plan for when we can begin testing on our PCB.
    - **Software:**
        - Checked with Advisor if the same ADC handler can be used for multiple ADCs → no longer applicable due to not using interrupts
        - PCB redesign will delay testing
        - LoRa interrupts on GPIO 12 (must support interrupts).
        - Consider ADC clocks and PDRSTs.
        - Write code for the hardware team (inputs, switch control, ADC setup).
        - Test send/receive, verify ADC values, and ensure voltage safety.
        - Store ~4 packets in the buffer, and check RAM limits.
        - Log diagnostic info, timestamps, and averaged reading.
        - Prototype sensor reading with SD storage.
        - Determine if interrupts are needed for ADC speed.

- Week 9 (Apr 1)
    - No meeting and nothing new to discuss due to having to wait for new components and PCB. We did not meet as we did not have any questions and thought the time would be more valuable if used to continue programming.