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# EE/CprE/SE 491

## wDAQ System (sddec24-19)

### Weekly Report 1

Jan 23 - Feb 6, 2024

Client: Manojit Pramanik and Avishek Das

Faculty Advisor: Manojit Pramanik

## TEAM MEMBERS

**Adam Shoberg [EE]** - Circuit Design & Simulation, PCB Design, Team Communications Leader

**Henry Chamberlain [EE]** - PCB Design & Construction

**Lisa Tordai [SE]** - Software Development, Wireless Data Sharing

**Vaughn Miller [CprE]** - Computer Engineering

## SUMMARY

Over the past two weeks, we made our first contact with our faculty advisor and client, completed some preliminary research on our project as a team, and got a start on circuit simulation and parts searching. We kicked things off officially on Friday, January 26, with an introductory meeting with Avishek and Prof. Manojit, where we got an idea of what we would be working on throughout the semester and were assigned some initial research tasks. The following week, on January 31, we met with Avishek again to discuss our findings and discuss what needed to be done next, which included circuit simulation, part sourcing, and simulation of some of the Bluetooth and data acquisition technologies that will be used.

## ACCOMPLISHMENTS

### Adam:

- Sourced parts through DigiKey and communication with Avishek to ensure items would work for our device
- Searched for viable low-noise amplifiers, including LMH6629 by Texas Instruments, which offers high-end capabilities and small profile size at a reasonable price
- Concluded based on simulation that active filtering would complicate the circuit and stress the capabilities of most cheap amplifiers
- Identified passive elements for our design through simulations in LTSpice.
- Designed a passive filtering stage that has a band of roughly 100 MHz whose lowest frequency passed was 20 MHz.

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**Henry:**

- Sourced devices including LNAs, programmable gain amplifiers (PGAs), active filters, and passive filter components
- Compiled Excel spreadsheet featuring device characteristics, pricing, and lead times
- Completed and assisted Adam with circuit simulations and research on active filtering designs, including a cascade of two Sallen-Key Filters (high-pass into lowpass)
- Assisted Adam with passive filter and amplifier design, including component calculations and multi-stage op amp gain/bandwidth calculations
- Condensed individuals' findings into a Powerpoint to be presented to Avishek
- Requested NI MultiSim student license from ETG

**Lisa:**

- Researched and decided upon a potential solution for data handling
- Investigated Bluetooth/WIFI communication methods and parts
- Contributed to findings into a Powerpoint to be presented to Avishek
- Purchased Bluetooth module and components for testing setup
- Obtained LabVIEW software from ISU Student Software Resources

**Vaughn:**

- Sourced and chose specific ADC IC that meets/exceeds requirements
- Added to ADC parts spreadsheet with selected IC
- Researched configuration requirements for using ADC with desired application
- Discovered potential hang ups with specing an MCU and how to get around them

**PENDING ISSUES****Adam:**

- Simulations for the LNA: struggling to accurately import device models into LTSpice to extract data, performance and design structures. Looking to start using NI MultiSim.

**Henry:**

- Part specifications: still somewhat unclear on some of the required specifications for the amplifiers, filters, and ADCs (e.g., supply voltages, device sizing and speeds, power dissipation, gain and bandwidth characteristics). Need to discuss further with Avishek.

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**Lisa:**

- Need to create LabVIEW virtual instruments for Bluetooth Server Application and Bluetooth Client Application
- Create test setup for Bluetooth module and LabVIEW connection

**Vaughn:**

- Need to consult ADC datasheet and external sources for further information on what circuit is required on the front end of the IC and what kind of input and output modes are ideal for our application.
- Setup of the ADC to best fit our application and interfacing between it and the microcontroller appear to be the biggest challenges on my agenda for design.

## INDIVIDUAL CONTRIBUTIONS

Name	Contributions	Weekly Hours	Total Hours
Adam Shoberg	Circuit simulation, passive & active filter design, amplifier design, part sourcing	8	8
Henry Chamberlain	Circuit simulation, presentation of findings, part sourcing & spreadsheets	8	8
Lisa Tordai	Wireless data sharing research, Potential data storage research, Purchased parts to create Bluetooth to LabVIEW test setup, Began assembling test setup	8	8
Vaughn Miller	ADC research, comparison, selection, and part sourcing. Microcontroller research and comparison. Investigating on how to interface ADC output bits with MCU.	8	7

## COMMENTS AND EXTENDED DISCUSSION

**Adam:**

- Should start considering the power supply for the circuit. The current design concept uses a rechargeable battery, which enables the device to hold charge for an extended period.
- Would like to pursue possibly implementing a multistage LNA

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**Henry:**

- Should communicate more to get a more firm understanding/agreement on the specs of the components that should be used to narrow down the part search.

**Lisa:**

- Ensure Bluetooth module is up to expectations for data transfer and working distance
- Verify student license for LabVIEW is compatible with Bluetooth

**Vaughn:**

- Should decide on an appropriate microcontroller and research on how to interface the output of the ADC with the microcontroller digital inputs.
- Ideally I want a digital input test bench with a microcontroller soon to get familiar with programming on the microcontroller of choice.

**PLANS FOR UPCOMING WEEK****Adam:**

- Continue furthering simulations on design concepts for the circuit
- Source batteries to power the overall device
- Strive to push the design along and move toward other design topics (PCB, EM, etc.)
- Look for ADCs

**Henry:**

- Obtain student license to NI MultiSim through ETG for team member use
- Continue sourcing parts and condensing part lists to most desirable options
- Try to help more on circuit simulation side

**Lisa:**

- Created LabView Bluetooth receiver
- Assemble a test setup with Bluetooth module and temperature sensor to represent working data sharing
- Create Labview GUI for temperature sensor

**Vaughn:**

- Investigate interface requirements and how to read parallel high-frequency inputs
- Decide on a microcontroller to use, or if an FPGA as a buffer might be necessary

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## **SUMMARY OF ADVISOR MEETINGS**

### **Advisor and Client Kickoff Meeting (1/26):**

- Team members introduced themselves to Avishek and Prof. Manojit and gained insight into the scope of the project and team/individual expectations for the semester
- Discussed initial assignments with Avishek: Broad research on the project, presentation of the project flow and components, and initial research into potential ADC components

### **Second Advisor Meeting (1/31):**

- Presented initial findings on the project and discussed potential options for amplifier, filtering, ADC, and software components
- Discussed assignments for the next week, including circuit simulation, part sourcing for amplifiers and ADC, and preliminary software simulations
- Went to see the Photoacoustic Tomography (PAT) system in the lab