EE/CprE/SE 4920 Status Report 3

2/14/2025 – 02/27/2025

number: 36

Project title: ***Ultrasonic Object Detector***

Client &/Advisor: Professor Jiming Song

Team Members/Role:
Nathaniel Clarke - Project Software Designer
Brock Dykhuis - Circuit Analysis
Nicholas Jacobs - Electronics
Jonathon Madden - UI Designer & Software Tester
Baoshan Liang - Testing and Analysis

Weekly Summary

The issue of continuous power to the transmitter was resolved, but we found that the current setup appears to not have sufficient power for accurate readings. We also found that the filter for the receiver may need additional changes to improve accuracy (focusing on the necessary frequency range). Additional changes have been made to improve the detector display (migrating to Python). An initial draft of the Phased Array code for the MCU has been developed and will be tested when the circuit has been designed.

Past week accomplishments

Brock Dykhuis -

- Multi transmitter code
    - added 4 additional pins and programmed them to send pulses 5 seconds after each other
        - this will ensure we are getting accurate data before lowering and adding the other 5 pins
    - Wrote a different program for the MCU that will allow more precise pulses
- Looked into other ways to create methods for the new MCU, as our current design may run into threading issues once we add more transmitters in rapid succession

Nicholas Jacobs-

- **Transmitter and Receiver Testing**
    - Tested MA40S4S transmitters and MA40S4R receiver for performance and signal integrity.

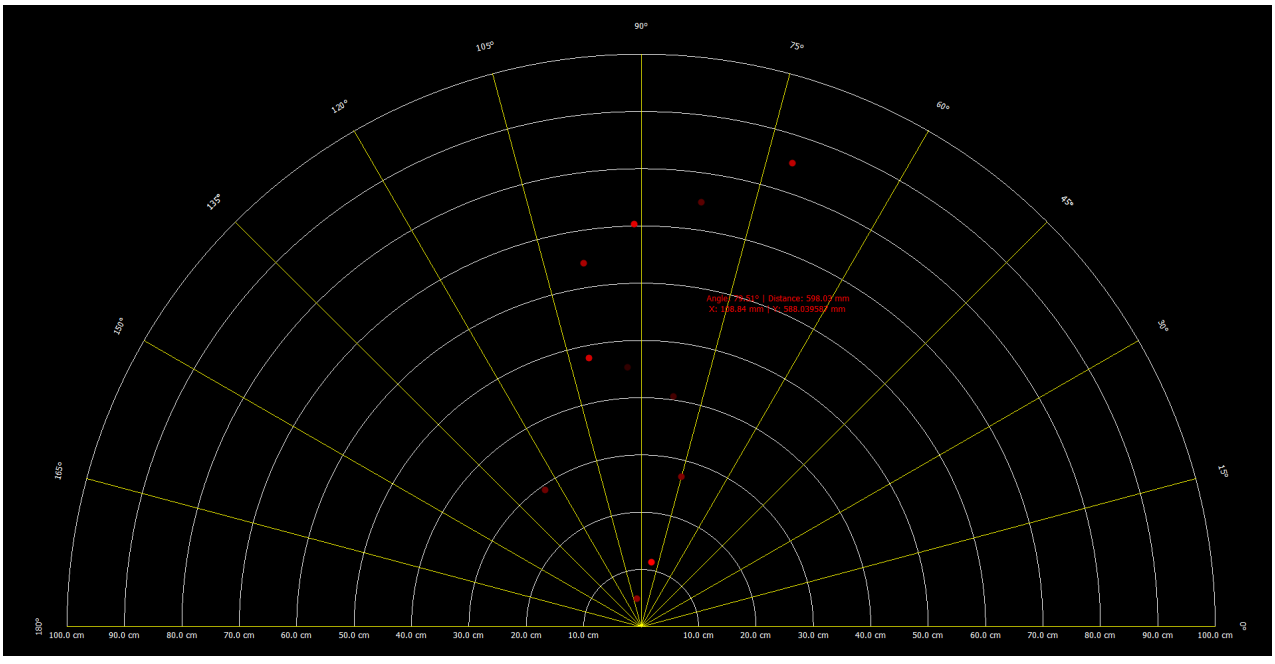
    - Assessed detection accuracy under different conditions.
- **Oscilloscope Analysis**
    - Analyzed waveform characteristics to refine signal processing.
    - Adjusted pulse-echo timing to improve clarity.
- **Component Research**
    - Researched new operational amplifiers and high/low pass filters.
    - Compared components for gain stability and noise reduction.
- **Signal Optimization**
    - Adjusted amplifier settings for better signal clarity.
    - Refined filter parameters to reduce interference.

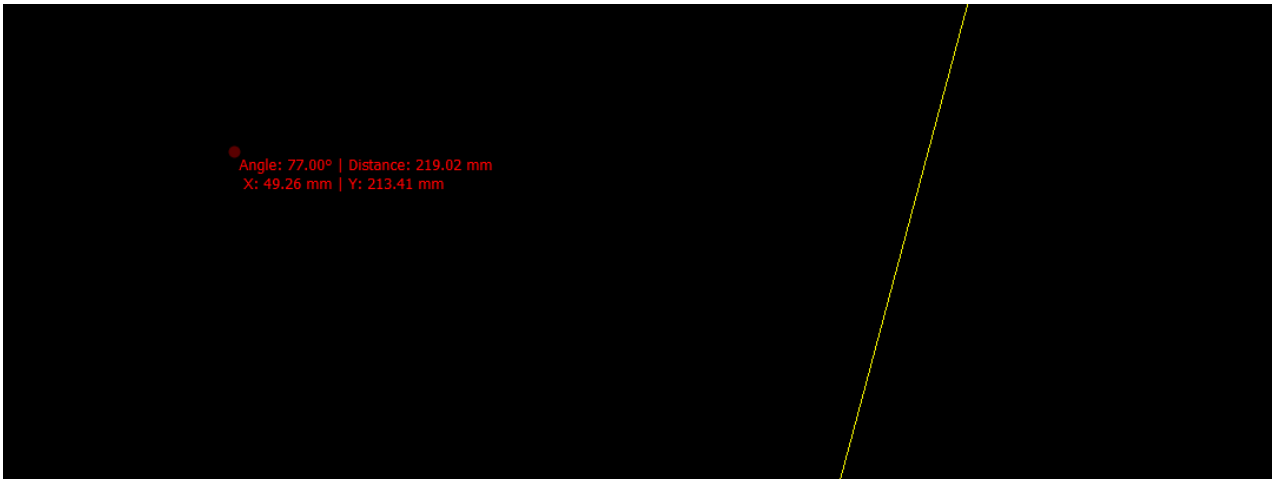
Jonathon Madden -

- **Tested to get single transmitter code working**
- **Worked on multiple transmitter code**
    - Learned more about how the phase array is used to control wave
    - Looked into different ways to implement the beam steering code

Nathaniel Clarke -

- **Tested MCU Code During Team Meetings**
- **Migrated Display to Python**
    - Opted against the previous plan of using C++ and OpenGL, as this would make the display less accessible across various devices due to its more demanding requirements.
    - Added helpful zoom functionality.
    - Provided more prompt and accurate cursor position readings (especially more accurate when used while zooming in)
    - Started initial object grouping logic.





Baoshan Liang -

- **Tested Transmitter and Receiver Signals Using an Oscilloscope**
  - Identified excessive noise at the receiver end.
- **Analyzed Waveforms to Identify Signal Integrity Issues**
  - Observed distortions and unexpected variations.
- **Decided to Implement a Band-Pass Filter to Reduce Noise**
  - Selected a suitable frequency range to preserve the desired signal.
  - Will compare results before and after filtering.

Individual contributions

NAME	Individual Contributions	Hours this week	HOURS cumulative
Nathaniel Clarke	Added past status reports to the team website, tested MCU code at team meetings, and migrated display to Python.	12	97
Brock Dykhuis	Looked into sending pulses to multiple receivers and if there is a more efficient way to code those pulses	8	86
Jonathon Madden	Looked more into the multiple transmitter code. Tried to see if there was any error in the single transmitter code.	8	68
Nicholas Jacobs	Completed transmitter and receiver testing, conducted oscilloscope analysis, researched new operational amplifiers and filters, and optimized signal clarity through amplifier and filter adjustments.	9	77
Baoshan Liang	Tested signals with an oscilloscope and found excessive noise at the receiver. Observed distortions, decided to use a band-pass filter, and investigated noise sources. Planned further testing to compare results before and after filtering.	10	17

Comments and extended discussion

We will need to start finalizing the circuit design and look into PCB design.

Plans for the upcoming weeks

Brock Dykhuis - Finalizing code for multiple transmitters and test on the updated circuit.

Nicholas Jacobs- I plan to finalize the testing of the transmitters and receiver, making sure all components are performing as expected. I'll continue refining the signal processing by testing different operational amplifiers and filters to see how they impact performance. I'll adjust amplifier settings and filter parameters further to reduce noise and improve detection accuracy. I also want to start integrating the improved components into the radar system and run system tests to evaluate the changes.

Jonathon Madden - Continue working on multiple transmitters code, also look into how the display with python will work.

Nathaniel Clarke - Continue to develop object detector display in Python, and work on object grouping and other helpful features. Test if the initial delay is necessary in the MCU code once the circuit is available to test.

Baoshan Liang - The next task is to implement the band-pass filter to reduce unwanted noise and ensure signal clarity. After filtering, the signal will be amplified to achieve the desired strength. Finally, the output will be evaluated to verify improvements in signal integrity.

Summary of weekly advisor meetings

Discussed using the receiver for single-directional scanning by detaching the receiver from the general assembly and placing it across from the transmitter assembly at the intended angle and distance to determine signal strength at various angles and distances. We also discussed potentially adding near-field scanning.