EE/CprE/SE 4920 Status Report 4

10/04/2024 – 10/31/2024

Group number: 1

Project title: Heimdall

Client &/Advisor: Matthew Nelson

Team Members/Role:
Brandon Beaver – Project Manager
Alec Sutton – Design and Power Team Lead
Branden Buhler – Communications and Controls Advisor
Cullen White – Power Systems and Logistics Manager
George Cleaver –Communications and Program Team Lead
Lex Somers – Programming and Software Advisor

- **Status Summary** *Finally, real progress has been made. Brandon, Branden, and George could transmit a legible signal over a coaxial line to a spectrum analyzer, reading a continuous video signal. The signal could be distinguished as a QPSK ¼ encoded video signal on the receiving side, though the weak output of the HackRF continues to be an issue. Implementing an amplifier circuit of some sort will need to be done if this signal is capable of long-range transmission. With that, the antenna work has also begun since the parts ordered have arrived. The build is simple in theory, though more math needs done to see how it will be oriented on the craft. There will be upcoming tests in Coover sometime in the next couple of weeks to test the loop antenna's capabilities. Documentation-wise, the design document has been updated to prepare for the next check-in meeting, implementing the data found up to the current point and the research paper created by Brandon Beaver.*

- **Past week accomplishments**
    - **Brandon Beaver:**
        - Located previous GNURadio test plots to compare to the current design
        - Reached out to some of the faculty who may have more information on how the antenna could be oriented to optimize reception, starting with Professor Jay Kim, who referred me to another professor specializing in antenna design.

- Reviewed the work Alec, Cullen, and Lex have done on the design document and suggested some changes to be made/made changes personally.
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- **Lex Somers:**
  - Researched how to boot Ubuntu from USB and attempted to install it onto the M2I lab desktop computer.
  - Installed SDRAngel on the M2I lab desktop computer that Heimdall will use to receive transmissions. Checked the GNURadio installation and dependencies.
  - Read through introductory documentation and use case examples for SDRAgnel to become familiar with the UI and prepare for testing.
  - Installed SDRAngel on a personal laptop and downloaded use case examples to run a simple GNURadio integration test, passing input files through a GNURadio flowgraph to the SDRAngel receiving end.
- **Branden Buhler:**
  - Worked on SDRAngel to recover noisy signal, and verified that the signal is being received but with low power.
  - Ran gain tests by transmitting a signal to identify how much power was transmitted on the line-to-line test.
- **Alec Sutton:**
  - Began research on potential amplifiers to be implemented once we reach wireless transmission testing so we can boost the signal
  - Updated out-of-date diagrams and updated documentation to reflect current technology being used on the project
- **George Cleaver:**
  - Started wired transmission testing
  - Received as DVB-S2 QPSK signal
  - The signal was too weak to recover any video
- **Cullen White:**
  - Updated technical specs, objectives, and design details, incorporating team feedback for clarity and alignment with the project scope within the Design document
  - Adjusted timelines, task dependencies, and resources to reflect current progress within the new Gantt Chart
  - updated citations within documents

o **<u>Pending issues</u>**
  - **Brandon Beaver:**
    - Find the issue or replace the desktop for testing the transmission, likely in hardware.
    - Move the current GNURadio plot to a new or fixed desktop to begin testing
    - Test loop antenna with reflector
    - Continue GNURadio transmission tests
o **<u>Individual contributions</u>**

NAME	Individual Contributions *(Quick list of contributions. This should be short.)*	Hours this period	HOURS cumulative
Brandon Beaver	- GNURadio plot investigation - HackRF module testing - ATTEMPTED to boot Ubuntu onto the desktop and encountered an unknown boot issue again.	9	27
Branden Buhler	- The recovered noisy signal inside SDRAngel and verified a successful transmission and reception system. - Tested gain and power on the transmission side and found that amplifiers or filters must be applied to improve the signal.	6	14
George Cleaver	- Worked on a cable test between the desktop and Raspberry Pi module - Researched methods of signal boosting to clear up received signal	6	15
Alec Sutton	- Searched for a suitable coax cable for wired connection testing of the plot. - Found something that will work fo - r testing but will need something better for actual transmission - Revised goals with the faculty advisor to better solidify goals for the semester.	7	12
Cullen White	- Updated Design document - Created a new Gantt Chart - updated citations within documents	4	9
Lex Somers	- Installed SDRAngel onto personal laptop & lab desktop. - Read usage documentation & use case examples for SDRAngel - Experimented with basic GNURadio & SDRAngel integration	3	6

○ **Plans for the upcoming weeks**

- Brandon Beaver
  - Continue troubleshooting over-the-line transmission to clear up the received signal
  - investigate options that can reduce Raspberry Pi's consumed resources on the transmission end, including testing the switch from Raspberry Pi 5 OBC and checking Pi "Hat" options
  - Aid the design team in antenna building and testing via on-campus resources
  - Edit Design Document per suggested notes from Professor Fila

- Branden Buhler
  - Since line-to-line communication has been confirmed, antenna construction can begin for the loop antenna. I still raise questions about the gain the antenna will bring and the signal's power.
  - Test digital filters in GNURadio and see if the gain can be improved.
  - Potentially, look at an analog amplifier.
- Lex Somers
  - Fix the desktop computer Ubuntu boot issue
    - Likely requires resetting the BIOS to factory defaults and wiping the desktop.
  - Test GNURadio flowgraph on Pi and lab desktop and make adjustments for the HackRF instead of PLUTO if needed.
  - Start SDRAngel receiving end flowgraph.
- Alec Sutton
  - Help acquire more testing data from wired testing that can be better documented.
  - Continue searching for options for amplifiers
  - Look into how best to power HackRF, Pluto, and the amplifier
    - develop/find/buy power source or use the HABET Power Source
- George Cleaver
  - Continue to revise the flowgraph and SDRAngel to work on signal reception to achieve a live video feed from the transmitting PI module.
  - Start Antenna construction
- Cullen White
  - Help where help is needed for constructing the new antenna.
  - Continue updating our design document to create a final product.
  - Continue Making our past documents in IEEE format.

- **Summary of weekly advisor meeting**

  Now that the team has tested transmitting directly from one device to another, the major issues have been revealed to the team. The Raspberry Pi 4 doesn't have the processing power to properly handle the demand GNURadio needs to send an entire broadcast. The video received was at an incredibly low framerate. Professor Nelson advised switching to the Raspberry Pi 5 and investigating a computing hat or module that will improve the processing power. In the meantime, move the primary transmitter to the desktop computer to test the signal capabilities. If this doesn't improve the signal, boosting transmit power may help.