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**EE/CprE/SE 4920 Status Report 5**

**11/1/2024 – 11/14/2024**

**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**

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- **Status Summary** *The team has been frugal until this very point, making use of leftover equipment in the Make To Innovate lab until the needs became too specific. In order to build the loop antenna and test the capabilities of the antenna, the team needed to submit the first order request of the semester for a proper coaxial cable, the antenna conductive loop, and connectors. The antenna was assembled and is slated to be tested in two separate scenarios: open air, and with a reflective plate. This will determine the orientation of the antenna on the HABET test flight. The Raspberry Pi 5 the team is to utilize shows promising results for computing capabilities based off the documents that were supplied with the device, and thermal issues may be resolved due to an impressive heatsink that came in the kit the HABET team had on hand. While this may help, a proper LNA will decidedly be used during the final test on the HABET spacecraft. With that information, the system is capable of transmission, which is a major step for the design.*
  - **Past week accomplishments**
    - **Brandon Beaver:**
      - Checked some of the previously used SD cards for any documentation that might have been left within with little results. It would appear it was used to upload the OS onto the Raspberry Pi.

- Met with the HABET Engineering team to help Branden Buhler attach the coaxial cable to the loop antenna. The joints came out much better than the previous attempts made with the monopole crafted last semester.
- Installed the PiOS on the Raspberry Pi 5, which can now be used for further testing.
- **Lex Somers:**
  - Missed some time due to a severe case of Pneumonia & taking antibiotics.
  - Tested a transmission from updated Tx flowgraph & hackRF into a receiving HackRF connected to my personal Mac laptop and into the spectrum transmission meter.
  - Discovered a header byte stream error when using input video files from the pi cams and determined it was an issue with the videos' encoding schemes.
  - Researched how to set the encoding scheme for video outputs from the pi cams and recording software.
  - Transferred flowgraph and input files from Pi4 to personal Mac for local testing.
- **Branden Buhler:**
  - Built the wire loop antenna using 8 gauge wire and RG58 coaxial cable.
  - Testing the antenna in Coover anechoic chamber to identify radiation pattern and scattering parameters.
- **Alec Sutton:**
  - Continued looking for options for amplifiers for our system
  - spoke with advisor about amplifier and power solutions.
- **George Cleaver:**
  - researched possible amplifier options to boost HackRF signal
- **Cullen White:**
  - I updated the design document with the suggestions gathered from Dr. Fila.
  - Starting Lighting Talk presentation
- **Pending issues**
  - Amplifier power draw may be too high for desired amplifiers
- **Individual contributions**

<b><u>NAME</u></b>	<b><u>Individual Contributions</u></b> <i>(Quick list of contributions. This should be short.)</i>	<b><u>Hours this period</u></b>	<b><u>HOURS cumulative</u></b>
Brandon Beaver	<ul style="list-style-type: none"> <li>● Installed Raspberry Pi 5 OS</li> <li>● Met with HABET and Branden Buhler to build the loop antenna</li> <li>● Checked old storage devices for documents with no results</li> </ul>	6	33
Branden Buhler	<ul style="list-style-type: none"> <li>● Constructed loop antenna.</li> <li>● Testing the loop.</li> <li>● Suggested designing a power amplifier to boost signal.</li> </ul>	6	20
George Cleaver	<ul style="list-style-type: none"> <li>● researched possible amplifier options to boost HackRF signal</li> </ul>	2	17

Alec Sutton	<ul style="list-style-type: none"> <li>Continued to research amplifier solutions</li> <li>met with advisor on amplifier and power solutions for the amplifier, Hackrf and Pi.</li> </ul>	3	15
Cullen White	<ul style="list-style-type: none"> <li>Updated Design Doc</li> <li>Start gathering information to create a presentation for Heimdalls Advisors</li> </ul>	4	13
Lex Somers	<ul style="list-style-type: none"> <li>Tested Tx from hackRF into spectrum transmission meter, Rx hackRF, and Mac</li> <li>Debugged header stream error from input files</li> <li>Researched required encoding options for input files</li> </ul>	6	12

○ **Plans for the upcoming weeks**

- Brandon Beaver
  - The Raspberry Pi 5 needs to be loaded with the GNURadio software and the diagram builds from the Pi 4. This is a time-consuming task that must be completed, though it is tedious. Then testing the current GNURadio flowgraph for functionality to ensure all drivers are installed correctly.
  - Further test the loop antenna's capabilities to ensure functionality, and observe results of the reflection test. If the test bears fruit, this will be the plan for the final test and design.\
  - Work with Alec and Cullen to calculate the final link budget and design the amplifier circuit. This is a critical component as the signal is far too weak to be received over the air at the current power of 0.001 mW.
- Branden Buhler
  - Finish antenna tests, may need to look for a new cable depending on the results. Ideal values include gain of ~2 dB, VSWR of 1.5, and S11 of about -6 dB. The results from the tests will hopefully be within a 5% range of this.
- Lex Somers
  - Determine required encoding for input video files to the transmission flowgraph & how to output videos with that encoding from the pi cams.
  - Finish researching how to set the proper encoding scheme for input video files and run a test transmission with video inputs from pi cams to spectrum transmission meter.
  - Assist with transition from the Pi4 to the Pi5 and testing.
  - Set up SDRAngel & Ettus N200 receiving end.
- Alec Sutton
  - I will find one (or two if two stage is necessary) amplifier to boost our signal to at least 1 Watt
  - Once amplifier is picked will begin looking at battery options to power amplifier and other devices.
- George Cleaver

- I will install the pi5 software and load GNURadio software and block diagrams to test from the pi4. Then, test the pi5 to ensure functionality and ideally observe more processing power.
- Using the pi5, replicate the line-to-line test with the block diagram and see if there in any performance issues/improvements when compared to the pi4. If no improvements, then a desktop-to-desktop test will be done to localize the source of the issue so it can be addressed.
- Cullen White
  - Start gathering information to create a presentation for Heimdalls
    - Give the presentation to the professors and advisor

- **Summary of weekly advisor meeting**

Advisor gave input on connection types for the antenna as well as different options and places to look for amplifiers to boost the signal from the HackRF. A power amplifier will likely be too heavy for the payload and draw too much current so instead we will begin looking at linear amplifiers. Another set of topics of discussion were minimum input power to look out for when finding an amplifier as well as potential options for power equipment. Ideally these amplifiers will give enough signal boost without introducing noise that will drown out the signal. This can also be accommodated through the filters placed in the receiving end software, though ideally