4 Design

4.1 Design Context

4.1.1 Broader Context

Describe the broader context in which your design problem is situated. What communities are you designing for? What communities are affected by your design? What societal needs does your project address?

We are enabling the lab to have a device that will be able to test an assortment of different antennas. It will provide insight into how some of the antennas that they have work in a controlled environment. The researchers in the CNDE lab will be affected by the design, and to address their needs we need to develop a reliable system to enable them to be able to test a multitude of different antennas.

List relevant considerations related to your project in each of the following areas:

Area	Description
Research	Increasing the ability of the user to be able to model differing types of antennas in the lab. It allows the research group to be able to study different types of antennas.
Manufacturing	Allowing the researcher to be able to test a number of different antennas that they develop prior to getting them manufactured. A rough draft of an antenna may be designed using something like CST, but if they are able to create a rough draft of the antenna, they can test it and see if it works as described in the CST model.
Quality Assurance	Builds confidence in the antennas around the lab. It also allows the researcher to troubleshoot different antennas in the lab. If one of the horn antennas looks different, it will allow the researcher to test the antenna and see if it is bad.

4.1.2 Prior Work/Solutions

Include relevant background/literature review for the project

– If similar products exist in the market, describe what has already been done

MilliBox - It is a nearly identical system. The main differences is that the antennas sit inside of the anechoic chamber while ours will sit on the side of the anechoic chamber. There system also rolls out with a proprietary UI that we will have to create ourselves.

– If you are following previous work, cite that and discuss the advantages/shortcomings

Advantages:

- MilliBox already has an established procedure for manufacturing the antenna measuring device.

- MilliBox has a Phd working on their team, his knowledge gives them an advantage because there are many things that we will have to learn on our own.

Disadvantages:

- Millibox is not a perfect faraday chamber, its walls, whilst lined with radar absorbent foam, is not metal backed.
- Millibox is expensive, they do not list their price on their website. Our antennas movement design will be roughly 150 to 200 dollars.

– Note that while you are not expected to "compete" with other existing products / research groups, you should be able to differentiate your project from what is available. Thus, provide a list of pros and cons of your target solution compared to all other related products/systems.

Detail any similar products or research done on this topic previously. Please cite your sources and include them in your references. All figures must be captioned and referenced in your text.

4.1.3 Technical Complexity

Provide evidence that your project is of sufficient technical complexity. Use the following metric or argue for one of your own. Justify your statements (e.g., list the components/subsystems and describe the applicable scientific, mathematical, or engineering principles)

Hardware:

This system needs to have an antenna rotating device. To provide a resolution that allows an antenna to be accurately modeled a study must be performed for appropriating the proper gearing ratios for the motor to move the antenna in specific, minute, steps. 3D printed parts will also be used, so the various stresses that will come with mounting with the system will need to be studied.

The mechanical portion of this project will consist of 2 motors, a pulley or gearing ratio, a power supply, a raspberri pi and a motor controller. The challenge of having all of these components operate simultaneously with our UI will be immense. Time will need to be taken to be able to ensure that the data that we are receiving from the antennas is correct.

Software:

This system will also use a UI that will need to simultaneously map a 3D projection of magnitude and phase at a specific angle in relation to the receiving antenna. With that being said, the antenna movement and timing that the software will take measurements will need to be thoroughly investigated**.**

1. **The design consists of multiple components/subsystems that each utilize distinct scientific, mathematical, or engineering principles –AND–**

2. **The problem scope contains multiple challenging requirements that match or exceed current solutions or industry standards.**

4.2 Design Exploration

4.2.1 Design Decisions

List key design decisions (at least three) that you have made or will need to make in relation to your proposed solution. These can include, but are not limited to, materials, subsystems, physical components, sensors/chips/devices, physical layout, features, etc. Describe why these decisions are important to project success.

Hardware:

1. We had to make a design decision about the motor size we will need, we decided to go for a smaller motor due to a larger motor being less practical and more power consuming than a smaller one.
2. We decided to use 3d printing as opposed to other method, such as wood construction, to manufacture our antenna measuring devices hardware. We plan on creating both the box the system will sit in and also the gears that will help control the movement of the system using a 3d printer.

Software:

1. Desktop Application
2. 2d/3d modeling UI
3. Feature to run scripts to interact with the hardware through the UI.

The desktop application is important because we want to be able to get as low as possible to interact with the computers hardware components and run scripts through a corded device. The 2d and 3d model is important because modeling the pattern is a major functional requirement and needs to be done through a modeling library and seen on a UI to be able to be analyzed.

4.2.2 Ideation

For at least one design decision, describe how you ideated or identified potential options (e.g., lotus blossom technique). Describe at least five options that you considered.

Desktop application was a design decision. We were contemplating these options. Android app and Ios app because of the GUI being really easy to learn and meanuever. Web application because of the experience we had with building that. And a 3rd party so we could use a modeling service much easier than creating it from scratch.

Our final decision was a desktop application because of the experience we had and the amount of control to being closer to the computer's resources the application gave us and the fact the program only needs to be able to run locally and output locally gives more security benefits and no need for a server and database.

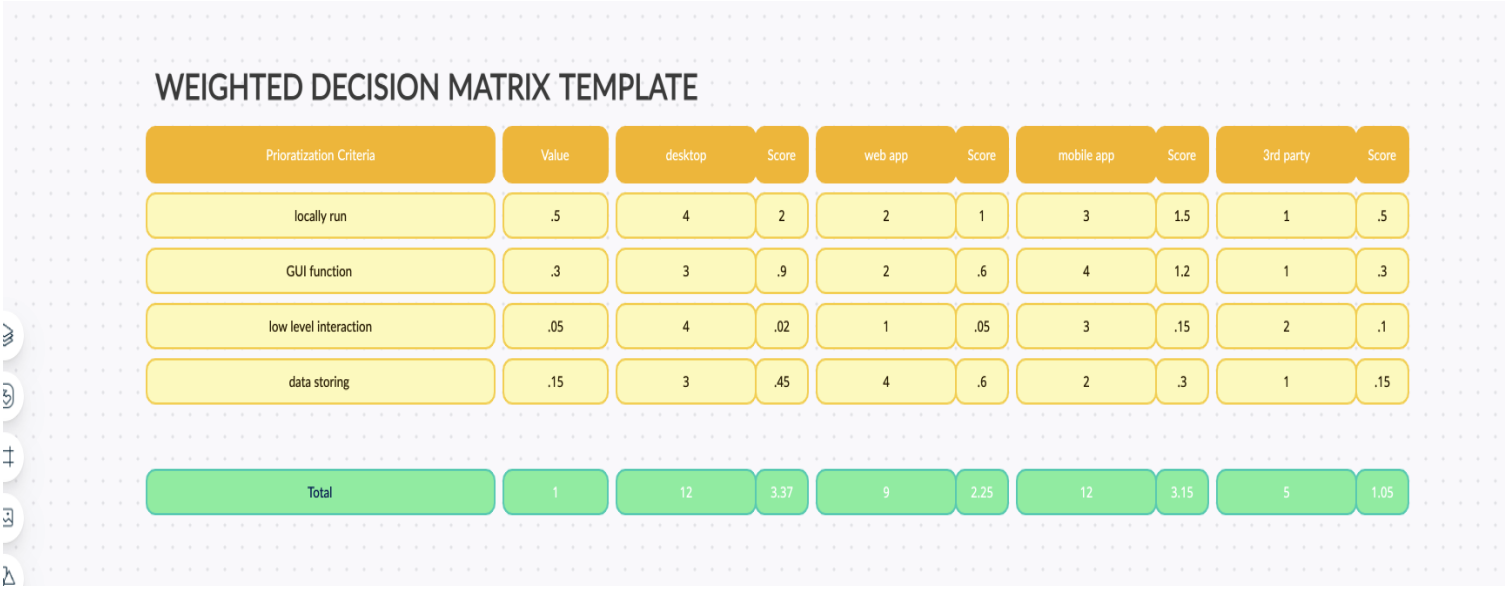
1) Web application
2) Android application
3) Ios application
4) Desktop application
5) 3rd party software

4.2.3 Decision-Making and Trade-Off

Demonstrate the process you used to identify the pros and cons or trade-offs between each of your ideated options. You may wish you include a weighted decision matrix or other relevant tool. Describe the option you chose and why you chose it.

Software:

We chose desktop application because in the most important area which was being able to be locally run it had led and in other important areas like gui design it was still top 2 of the list. So considering the weights we put on the categories, desktop application made the most sense.



WEIGHTED DECISION MATRIX TEMPLATE

Prioratization Criteria	Value	desktop	Score	web app	Score	mobile app	Score	3rd party	Score
locally run	.5	4	2	2	1	3	1.5	1	.5
GUI function	.3	3	.9	2	.6	4	1.2	1	.3
low level interaction	.05	4	.02	1	.05	3	.15	2	.1
data storing	.15	3	.45	4	.6	2	.3	1	.15
Total	1	12	3.37	9	2.25	12	3.15	5	1.05