

Week 7 and 8 Research Report

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1 Background

This report presents an update on the progress made during weeks 7 and 8 of the research project (week 7 was a short week so I combined them). In week 6, automatic decoding of the signal from the card reader was accomplished, and successful capture of the card signal was achieved. However, decoding the captured signal proved to be a challenge during that phase.

2 Introduction

This week marked a significant milestone in the research project, as substantial progress was achieved in decoding the data from the card signal. Moreover, a comprehensive application with a user interface was developed, effectively integrating various aspects of the project. These include writing to a baseband file, reading a baseband file, decoding a baseband file, receiving real-time data, and decoding data in real-time. The successful implementation of these functionalities represents a notable advancement in the project's overall objectives.

3 Methods

During week 7, significant progress was made in decoding the response from the card. The first step involved passing the captured signal through an "editData" function, which applied a high-pass filter and established threshold values to differentiate between high and low signals. Samples falling within the specified range were marked as 1, while those outside the range were marked as 0.

Following this preprocessing, the decoding process commenced using two crucial functions: "findNextOne" and "findNextZero." These functions systematically searched for the next occurrence of 1 or 0 in the signal, respectively.

Building upon the capabilities of these functions, an additional function was implemented to detect the start of the response frame. Subsequently, the function analyzed each value to determine whether it represented a logic 1, logic 0, or the end of the frame. This process iterated until the end of the frame was identified, resulting in the extraction of the binary sequence.

During week 8, the primary focus was on developing a user interface (UI) to facilitate the analysis and decoding of data received from the USRP. MATLAB's app designer tool was leveraged to accomplish this task efficiently. The app designer tool provided a user-friendly environment for creating buttons, labels, and text fields, enabling the seamless construction of a functional app. To access the files related to this app, interested parties can refer to the GitHub page mentioned in the references section.

4 Results and Discussion

During week 7, two distinct methods were employed to decode the card data, both of which proved to be successful. The first method, as described in the previous section, involved a step-by-step process that took approximately two minutes to return the binary sequence after identifying the start of the frame. While this method was reliable, it required more time for completion.

Conversely, the second method was faster, taking about 50 seconds. However, due to its unreliability and potential for errors, it was decided to prioritize accuracy over speed and continued to use the initial, more time-consuming method.

Decoding the card data requires a critical observation: the card and two antennas must be arranged in a precise configuration. The specific arrangement is crucial as it ensures predictable amplitudes of the card signal, enabling accurate setting of thresholds for digitalization. Failing to adhere to this arrangement can lead to incorrect digital signals and result in inaccurate reading of the card data. Thus, meticulous attention to the positioning of the card and antennas is essential to achieve successful and reliable decoding of the card data.

During week 8, significant progress was made in developing the UI for the research project. The initial framework was successfully established, incorporating essential functionalities such as writing to a baseband file, plotting a baseband file, decoding a baseband file, and real-time reception capabilities.

Moreover, a crucial feature was implemented to ensure a smooth user experience. Upon app startup, it automatically tests the connection to the USRP receiver. In cases where the initial connection attempt fails due to the USRP not being connected at startup, the app provides an option to retry the connection.

For a visual representation of the UI layout, Figure 1 illustrates its design and structure.

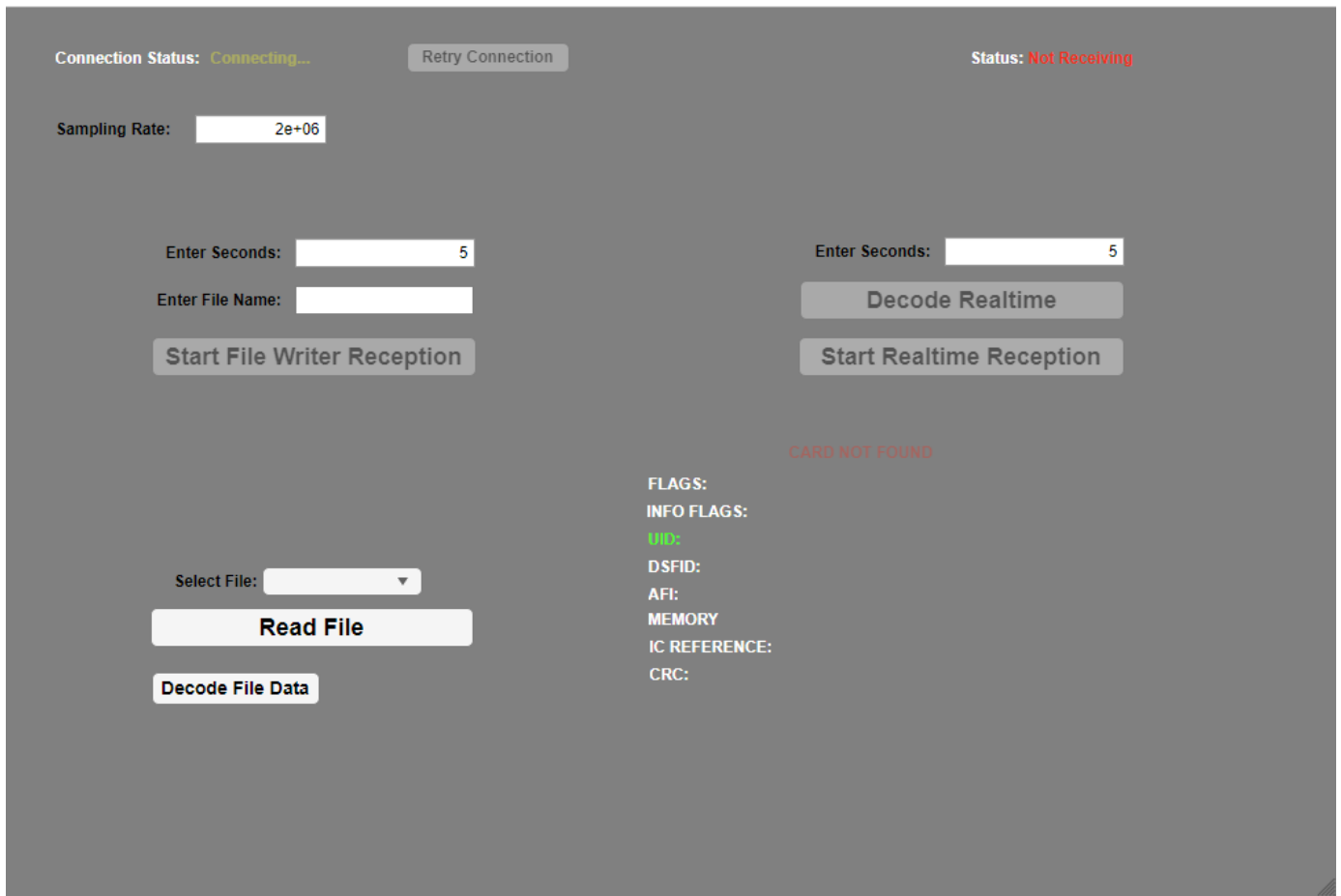


Figure 1: User Interface

5 Conclusion

In conclusion, the past two weeks have witnessed significant advancements in the research project. Notably, successful decoding of the card signal has been achieved, and the newly developed UI provides a seamless and user-friendly approach to access this valuable information. Moving forward, the upcoming week's priority will be centered around the implementation of real-time decoding for the card signal.

6 References

GitHub Page: https://github.com/adam-kamrath/USRP_Research_Summer2023