Project: Digital Signal Processing Application

In this project you are allowed to group up as 2 students.You are expected to implement a rather detailed (compared to homeworks) DSP application. Following is a list of topics you can pursue:

- Natural vs altered voice identification (For example, you can manually create an altered voice through some process and investigate its characteristics to come up with a method to detect such alterations.)
- Image or audio watermarking. Choose 2 different watermarking methods from literature, explain them and implement it. (Note that methods should be based on signal processing)
- Image or audio compression Choose 2 different compression methods from literature, explain them and implement it. (Note that methods should be based on signal processing)
- Take astronomical observation data and investigate it using DSP methods. (For example, you can take gravitational wave data and turn it into audio, or take James Webb data and filter it etc.).
- Synthesizer design and implementation: Design and implement a software synthesizer capable of generating a variety of sounds. You could experiment with different synthesis techniques such as subtractive, FM, granular, and wavetable synthesis.
- Analyze EEG, FMRI, Tomography or EKG data in frequency domain. Apply filters to it, detect diseases, altered brain states, anomalies etc.
- Image processing: Investigate how digital signal processing can be used to process and manipulate images. You can explore topics such as image enhancement, image restoration, and image segmentation.
- Digital audio effects: Explore how different digital signal processing techniques can be used to create audio effects, such as reverb, echo, chorus, and flanger.
- Speech processing: Investigate how speech signals can be analyzed, synthesized, and modified. You can explore topics such as speech recognition, speech synthesis, and voice conversion.
- Virtual analog synthesis: Create a software synthesizer that emulates the sound of classic analog synthesizers. You could investigate techniques such as oscillator tuning, filter design, and envelope shaping to create a convincing analog sound.
- Audio synthesis for video game development: Create software tools to generate sound effects and music for video games. You could investigate techniques such as procedural audio synthesis, real-time MIDI generation, and interactive music systems.
- Automatic earthquake damage assessment: Develop an algorithm that uses computer vision techniques to analyze satellite imagery and assess the damage caused by an earthquake. You could investigate techniques such as object detection, segmentation, and classification to identify damaged buildings, roads, and other infrastructure.
- Seismic data processing: Develop software tools that process seismic data to extract useful information about the earthquake. You could investigate techniques such as

filtering, deconvolution, and cross-correlation to extract information about the location, magnitude, and duration of the earthquake.

You can see that there are many more possible topics other than these. In case you want to pursue another topic, briefly explain it to me via email and we can discuss.

We are not expecting something very advanced. However, we also expect you to put in some work and do something more detailed than the homeworks. You are allowed to use whatever online resource you can as long as you implement and see the results yourself and be able to explain them in some capacity if you are asked.

In your submissions:

- Provide a single YOUR_STUDENT_ID.zip file.
- Provide a pdf report that contains:
    - Your name, your student id (if you are a group of 2, both of your names and ids)
    - An introduction that briefly explains the application you are pursuing in this project.
    - A section where you share your process, algorithms, results, plots etc.
    - A conclusion section where you reflect on your results and provide some feedback to yourself, comment on shortcomings and exciting points etc.
    - Cite your resources if you've used external resources.
- Provide your code
- If your project produces audio, images etc. please provide a small sample of them so that we can easily see the results.
- If your project file exceeds Moodle upload limit, you can provide a download link in a txt file.
- If you are a group of two, only one submission is sufficient.