GNG1103

**Final Design Report**

**VR XIII**

Submitted by

**The Last VaiR Bender, B13**

Justin Cheng, 300122560

Kaleigh Ionadi, 300112110

Humza Muhammad, 300135666

Bjorn Viebrock, 300118186

Akif Ahmed, 300138540

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University of Ottawa

**Abstract**

At the start of the semester our group, B13 (also known as *The Last VaiR Benders*), was tasked with designing a virtual reality application to be used by the Ottawa Hospital. The patients at the Ottawa Hospital have some fear, and anxiety when doing certain procedures such as CT scans, Surgery etc. The way the doctors solved this is by letting their patients use VR headsets. The goal for this project was to help ease and calm down patients who are scheduled to go into a C.T scan but are to scared to do so. Our group's task was to help by giving the patients a first hand VR experience of the CT scan before the actual CT scan takes place so that they can feel assured and ready for the upcoming procedure.

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**List of Acronyms**

|  |  |
| --- | --- |
| **Acronym** | **Definition** |
| VR | VR also known as Virtual Reality is the use of computer technology to see and create a certain environment, video, video game using a simulation. VR places the user inside a 3-Dimensional experience. |
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# Introduction

In the GNG 1103 course, our group, B13 (also known as *The Last VaiR Benders*), was tasked with designing a virtual reality application to be used by the Ottawa Hospital. Our client, Justin Sutherland, came into our lecture back in october ad presented us with a challenge. We were told that many cancer patients enter their treatment filled with anxiety and fear, as they don’t really know what to expect. The hospital expressed interest in using Virtual Reality to solve this problem. They want their patients to be able to experience their treatment through VR during teaching sessions with their doctors.

Our group approached this challenge using the Design Thinking process. First, we empathized with the users of the product. We asked our client questions about the people that would be using the application, like what age range they would be, what the environment they were going to be using it in was like, and what are some common problems they face with patients entering treatment. We learned that the patients are often fearful of the large machines they encounter during their treatment, and it is difficult for them to remain perfectly still during the administration of their treatment.

After our interview with the client, our group was able to define the problem. We interpreted needs based on quotes and hard data from our client. With this, we developed a problem statement. We deduced that *A need exists for patients being treated for cancer to experience their treatment process through VR before undergoing the procedure to reduce stress and anxiety*.

With our newfound empathy for the patients of the hospital and definition of the problem, we moved on to the ideation phase. Each member of the group brainstormed their own ideas for what they envisioned our product to look like. We also each came up with our own ideas for cool extra features we could incorporate into the design. After individually brainstorming, we got together as a group and shared our ideas, then finalized our conceptual design for our product.

We began our prototyping phase by making a list of all the tasks that needed to be accomplished for which dates in order to achieve our desired design. We then split up each of those tasks evenly among the members of our group and got to work. Our main priority when working on the prototypes was functionality. We knew that, above all, we wanted to make sure we ended up with a product that worked. Our prototyping and testing phases merged together, because as we continued to add and fix things on our prototypes, we would keep testing and looking for improvements to make.

Our final step in this project was preparing for design day. We were satisfied with the app we created, but we had a lot of work to do in order to properly present it and sell it to the judges. We did lots of research on the best presentation methods, and worked to come up with an engaging introduction and conclusion to show people why our product was special. We worked tirelessly the night before, completing our display board and practicing our presentation again and again. We were filled with nerves the morning of design day but once we got over the hump and presented our project a couple times, we were comfortable with it and were easily able to talk to people throughout most of the day. Though we may not have won design day, we created a great product, learned a lot, and had a ton of fun.

## What?

Our Virtual Reality treatment experience presents users of the application the opportunity to partake in a virtual simulation of their cancer treatment before having to experience it for real. It functions with the goal of relieving patients’ anxieties and worries about entering an unknown treatment process for a life-changing illness.

# Need Identification and Product Specification Process

**Problem Statement:** A need exists for patients being treated for cancer to experience their treatment process through VR before undergoing the procedure to reduce stress and anxiety.

|  |  |  |
| --- | --- | --- |
| **Category** | **Need** | **Design Criteria** |
| Primary needs | low cost (100$ budget) | * School provided software/materials |
|  | Reliable for 20 minutes or more | * Not Applicable |
|  | Bilingual | * The menu and interface is in French and/or English |
|  | Audio as-is in video | * Audio heard in the headset is sync with the video and sounds as it does in the original video |
|  | User-Friendly | * Application is easy to navigate and control it doesn't require any prior experience with the software |
|  | Remote Controls | * Ability to Pause, Play, Fast Forward, and Rewind |
|  | Reduce Anxiety | * Any voice over should be calming (morgan freeman voice) * Disclaimers for loud and/or sudden noises |
|  | Provides realistic treatment experience | * 180-degree clear video and fluid transitions |
| Secondary Needs | Engaging and Interactive | * Option available for patients to choose the next video |
|  | A different experience for different ages | * Different menu visuals for different age groups * For older patients with less technology experience have the option to play all videos in order automatically * Varying complexity of interactive menus |
|  | Sleek, clean-looking Application to be used in a professional environment | * Consistent Theme * Reduces opacity slider for the resolution of text |
|  | Automated video playback triggered by orientation | * The program can automatically play the video when the patient changes position. (ie lying down, standing up, upside down etc.) |
|  | Educational Video portion about how the treatment works | * Client may provide powerpoint or educational video about the machine and equipment |
|  | Subtitles | * Bilingual Subtitles in the line of the patient * Ability to turn them on and off |

**Table 1: This is a table of design criteria**

|  |  |  |
| --- | --- | --- |
| Category | Need | Importance |
| Primary Needs | low cost (100$ budget) | 1 |
|  | reliable for 20 minutes or more | 3 |
|  | bilingual | 3 |
|  | audio as-is in video | 4 |
|  | user-friendly | 5 |
|  | remote controls | 4 |
|  | reduce anxiety | 3 |
|  | provides a realistic treatment experience | 3 |
| secondary needs | engaging and interactive | 4 |
|  | a different experience for different ages | 2 |
|  | sleek, clean-looking application to be used in a professional environment | 5 |
|  | automated video playback triggered by orientation | 3 |
|  | opened on all platforms | 2 |
|  | modular interface and application | 3 |
|  | educational video portion about how the treatment works | 4 |
|  | subtitles | 3 |

**Table 2: This is a table of needs identification**

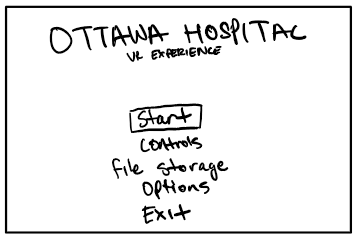
|  |  |  |
| --- | --- | --- |
| **Functional Requirments** | **Non-Functional Requirments** | **Constraints** |
| * Interactive * User-friendly * Audio works * Subtitles * Bilingual * Easy to navigate * Pause play fast forward and rewind * Calming voice-over/disclaimers for loud noises * Fluid transitions * Menu visuals * Automatic playback | * Reliability * Sound quality * Playtime liability * User-Friendly * Video clarity * The complexity of interactive menus * Educational portion | * Battery life * Available materials * Memory * Graphic Constraints * Interactions * Navigations * Spatial audio * Health and safety |

**Table 3: This is a table of target specifications**

# Conceptual Designs

## 3.1 Main Menu

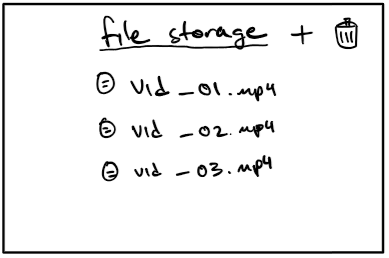
We decided when the application is opened, the first thing that will appear is the option to select a language (English or French). After selecting the language, it will fade directly into a menu screen where the user can select any of the following: start, settings, controls, file storage, or exit. Once selected, the start button will provide the option to automatically play all videos from start to finish, or to select any specific video in VR experience. The settings menu will contain the following: language controls (the ability to change the language initially selected), brightness settings, volume controls, subtitle options (turning them on or off and possibly selecting where on the screen they will be displayed), and video screen size (to allow for enlargement/zoom for more visually impaired patients).



**Figure 1.1: This is an image of an ideal menu screen**

## 3.2 File Storage

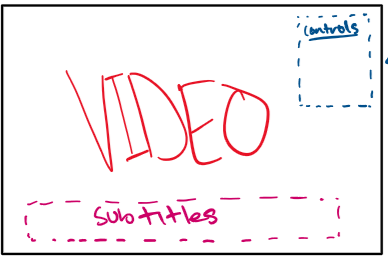
The file-storage portion of our menu will show a list of videos that are available in the VR experience and an option to upload or delete existing files. They will be shown in a “list view” and we are aiming to have the option to create folders on this page as well for better organization of files or so that each department using the experience can have its own folder full of video files. The doctor or assistant should only be able to access this section.



**Figure 1.2: This is an image of an ideal file storage menu**

## 3.3 Video Playback

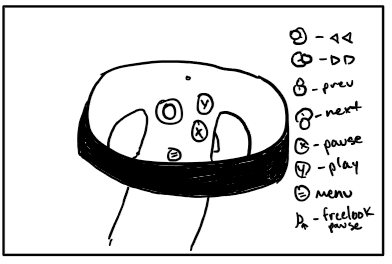
The control bar will be a pop-up menu where when you press pause on the video, a control bar will appear and the user is able to select the following: pause, play, fast-forward, rewind, skip to the next video, return to the previous video, and adjust the volume of the experience.

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**Figure 1.3: This is an image of an ideal control bar and video player**

## 3.4 Controls

In the main menu, Joystick will allow the user to scroll through and select menu items. During the VR experience, Joystick controls will be as follows: Quick right/left to fast forward/rewind, hold right/left to skip to the next/previous video, and up/down to control volume. In the main menu, the buttons will work as follows: y to select, and x to return/go back. During the VR experience, the buttons will work as follows: y to play and x to pause, menu button to open the menu. The trigger is used to freelook pause which lets the user explore.

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**Figure 1.4: This is an image of an ideal controller buttons**

# Project Plan, Execution, Tracking & Bill of Materials

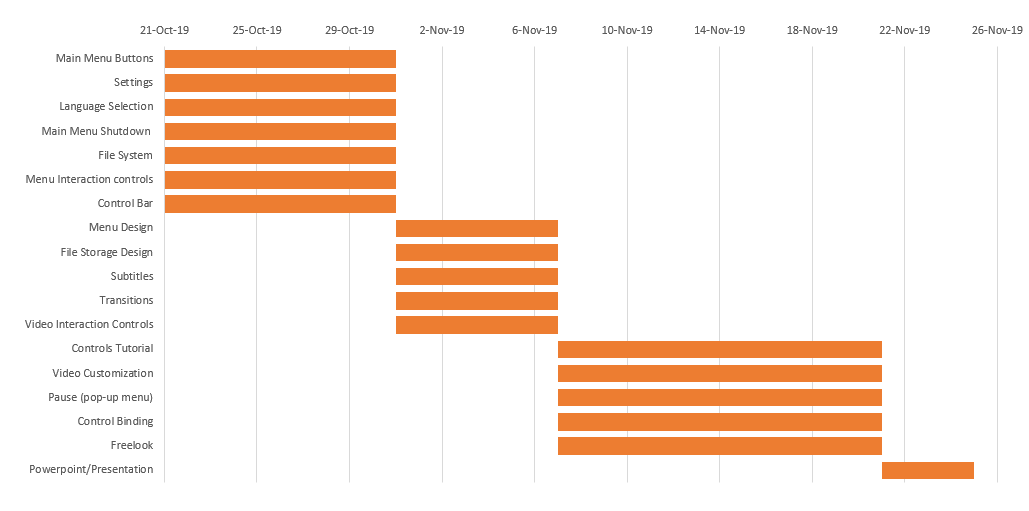
|  |  |  |
| --- | --- | --- |
| **Task** | **Duration** | **Member(s)** |
| Main menu - Settings | 2 week | Justin Cheng |
| Main menu - Control Tutorial | 1 week | Justin Cheng |
| Main menu - Buttons (start, options, language etc) | 1 week | Kaleigh Ionadi |
| Main menu - Language Options (Right at the beginning) | 1.5 week | Humza Muhammad |
| Main menu - Design/Theme (aesthetics) | 1.5 week | Humza Muhammad |
| Main menu - Shut Down | 1 week | Humza Muhammad |
| File Storage - File System | 2 weeks | Akif Ahmed |
| File storage - Design | 1 week | Akif Ahmed |
| Video playback - Video/ Customization | 2 weeks | Akif Ahmed |
| Video playback - Control bar | 2 weeks | Akif Ahmed |
| Video playback - Pause Menu (pop-up menu) | 1 week | Humza Muhammad |
| Video playback - Subtitles | 5.7 days | Justin and Kaleigh |
| Video playback - Fading/Transitions | 5 days | Justin and Kaleigh |
| Controls - Control binding | 1 week | Bjorn Viebrock |
| Controls - Menu Interaction | 1 week | Bjorn Viebrock |
| Controls - Video Interaction | 1 week | Bjorn Viebrock |
| Controls - Free look (Pause video with no menu) | 1.5 weeks | Kaleigh and Humza |

**Table 4: This is a table of project plan**

# Schedule

|  |  |
| --- | --- |
| **Date** | **Task** |
|  | Main Menu Buttons |
|  | Settings |
|  | Language Selection (at the beginning and in the settings menu) |
|  | Main Menu Shutdown - Exit |
|  | File System |
|  | Menu Interaction controls |
|  | Control Bar |
| **October 31, 2019 - Deliverable F: Prototype I** | |
|  | Menu Design |
|  | File Storage Design |
|  | Subtitles |
|  | Transitions |
|  | Video Interaction Controls |
| **November 7, 2019 - Deliverable G: Prototype II** | |
|  | Controls Tutorial |
|  | Video Customization |
|  | Pause (pop-up menu) |
|  | Control Binding |
|  | Freelook |
| **November 21, 2019, Deliverable H: Prototype III** | |
|  | Powerpoint/Presentation |
| **November 25, 2019 - Deliverable I: Presentation day** | |

**Table 5: This is a table of our schedule**



**Figure 2.1: This is an image of a Gantt chart**

We used a free software called Unity which utilized Microsoft Visual Studio to program scripts. To test the VR simulation, we used Oculus Quest that was provided at Makerspace.

Testing Criteria

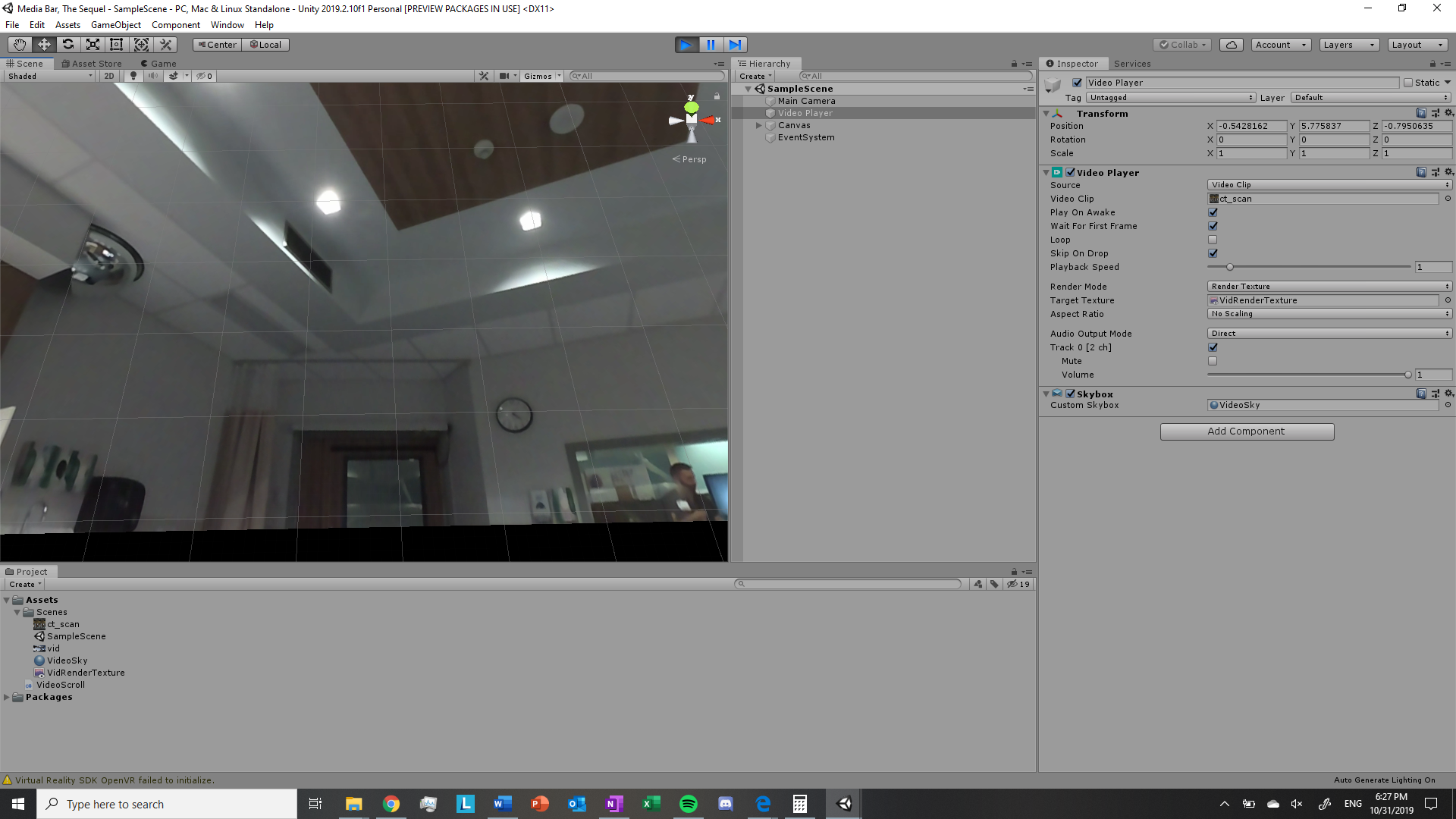
* The game starts up properly
* All buttons are playable (play, settings, file storage, exit)
* When we click the play button the video starts playing
* When we click the setting button all the different settings show up(the settings don’t have to be applicable for this prototype.
* When we click file storage it will send us to a screen with all the possible videos to be played
* The user is able to pause the video and go back to the setting or main menu
* Have a freelook feature to let the user look around and explore
* Have a resume button to go back to the point the video was paused
* And lastly, the exit button allows the user to exit the software safely and easily.

# Analysis:

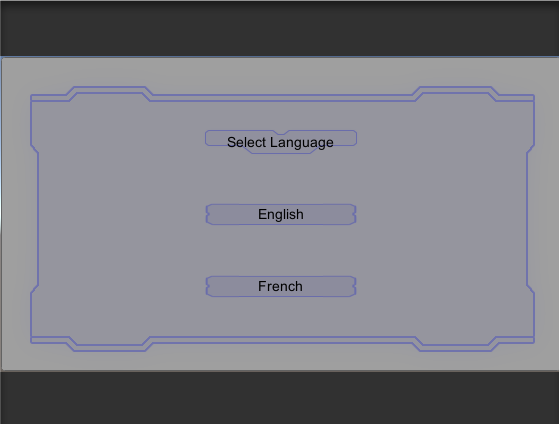
No calculations were needed for this project

# Prototyping, Testing and Customer Validation.

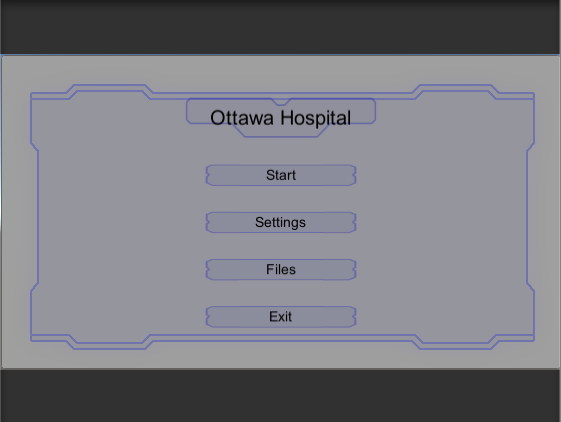
Prototype 1:

For prototype 1, we were able to create the menu screen for language selection, main menu, setting, files and have the video running by making a video player as the skybox. We also made a script that lets the buttons switch to another scene. For our next prototype, we need to research how to make the settings options work such as language selection, volume, brightness, and video options. We also plan to make the file storage design more professional and appealing and start to work on subtitles. In addition, we plan to add video interaction controls and fading for screen changing transitions to reduce motion sickness for the patient****

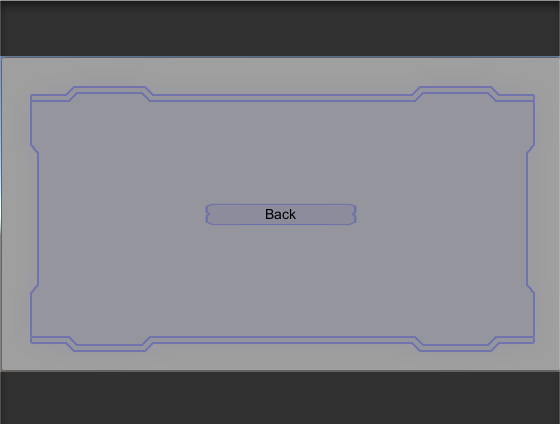
**Figure 3.1: This is an image of the unity software for the project**



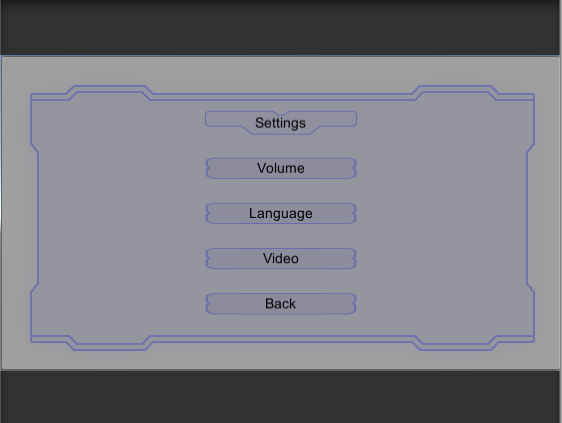
**Figure 3.2: This is the language selection screen**



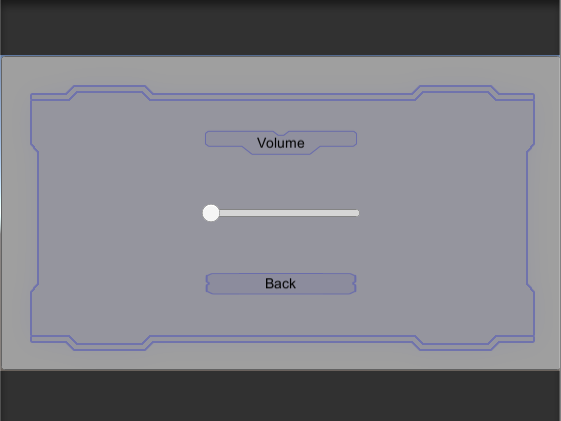
**Figure 3.3: This is the main menu**



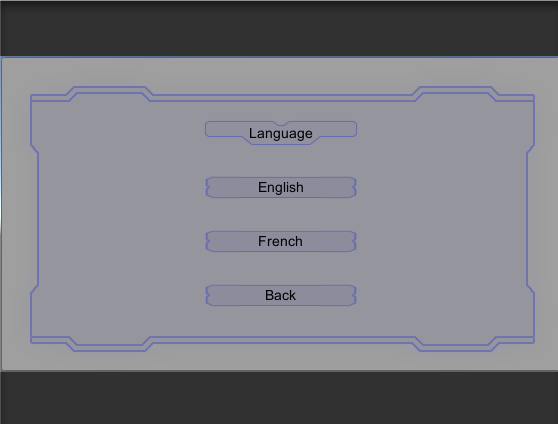
**Figure 3.4: This is the back button**



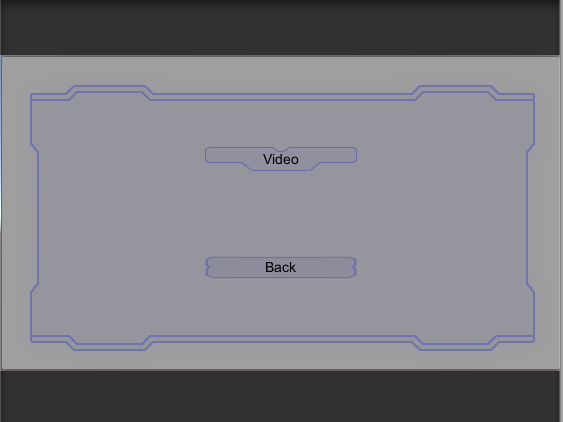
**Figure 3.5: This is the settings menu**



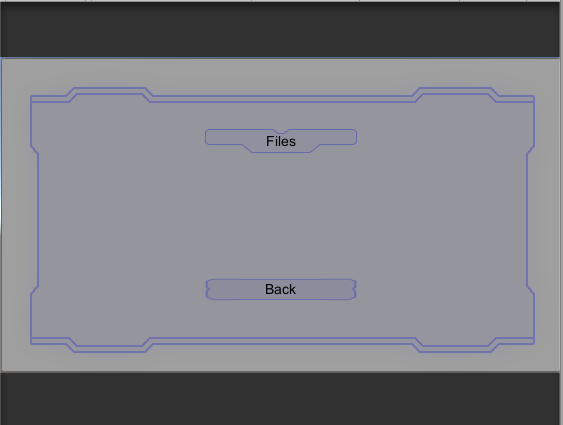
**Figure 3.6: This is the volume slider**



**Figure 3.7: This is the language selection screen inside the settings menu**



**Figure 3.8: This is the video settings**



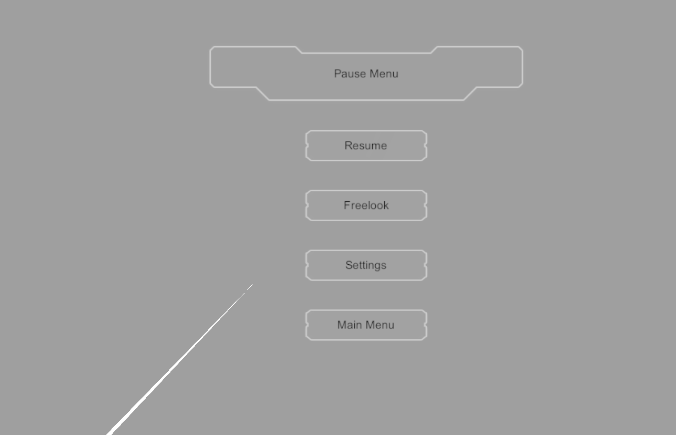
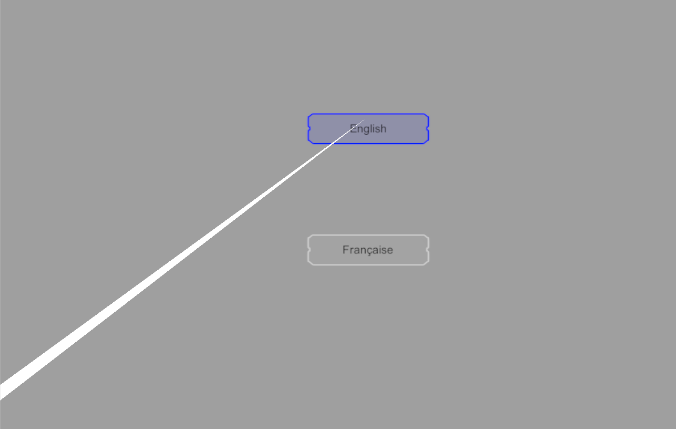
**Figure 3.9: This is the file system**

Prototype 2:

For prototype 2, we encountered problems with not being able to interact with the buttons in VR and that the video orientation is in the wrong way. By prototype 3 we plan on completing the final design and implement everything we wanted by doing research and asking for help when needed. We plan on adding all the videos, subtitles, freelook, and having the settings options working.

Prototype 3:

The main focus of prototype three ways to improve upon our past mistake on prototype 2 and use the criticism from our client to help improve our game by making all the certain main menu feature buttons work as well as play the video properly and fix the video orientation. We implemented a controller and fixed the video orientation. The user will first go through the language selection phase and be brought to the main menu to respect to the language chosen. The user is then able to start the video or explore the interface by going through the settings. When the video is playing, the user is able to pause the video whenever they choose to. The pause function will lead to a pause menu where the user is able to resume, go into freelook mode, go to the settings or go to the main menu. By Design Day, we have added everything completing the final design and implement everything we wanted by doing research and asking for help when needed. We plan on fixing all the small errors that are left such as video lag during playback before design day so we can finish our final product and make the file system work.

  
**Figure 4.1: Laser pointer selecting english as a language Figure 4.2: Laser pointer on the main menu**

# Final Solution

The final product contains almost all of the desired features. In general, a more simplistic approach was taken with the final product which resulted in a simple point and click system without the confusing control scheme. On start up, the user is greeted with a menu to select both english or french as the language used in the program. Upon selection, the user is brought to a similar styled menu which allows them to select from multiple options such as; a start menu which allows the user to select one of three videos to play, a settings button to allow the user to alter video, audio and language settings, a file button that would allow the user to import and arrange video files, and finally an exit button to terminate the program. As of the final product, the file system has not been completely integrated, and the settings have not been implemented.

When the user plays a video, they are given the option to pause the video to bring up the pause menu. This pause menu allows the user to play the video, exit to the main menu, open the settings menu or enter into a freelook mode. This freelook mode hides the menu and allows the user to observe their environment without it being obstructed or the video progressing.

Final testing results (\*verify\*):

* Video working in stereoscopic 180o
* Audio is messy and does not work fully
* Menus and pointers are accurate and functional

# Conclusions and Recommendations for Future Work

Throughout our time working on this project, our group faced many challenges, overcame obstacles, and learned a lot of new and very interesting practical skills that we can translate to our careers and future upcoming classes.

We learned that even though there is a plan and even though we want a particular feature on our final design, it may not happen. We had many ideas for the project that didn’t get executed, but we simply needed to continue to focus on what was most important, such as the functionality of the product. We also learned how important the presentation of our project was. We were shown how confidence goes a long way and how if we believed in our project, the judges would as well. All the members of our group learned the importance of communication with their teammates so that everyone could stay on the same page and know what was going on at any given time. All of these little things we learned are going to help us be better students and better engineers in the future.

**APPENDICES**

**APPENDIX I: User Manual**

VaiRBender is capable of playing recorded 180° video from .mp4 format using a virtual reality headset. In its current state, it is compatible with any brand of headset provided that it is supported by SteamVR.

This platform has a functional landing selection menu where the user chooses to enter video play scene, file menu, exit button, and settings menu where volume and language can be changed. The exit functions as a platform “off” button.

Play scene requires to patient to select a treatment video to run. This scene is run in a skybox and the video is projected onto a bubble surrounding the viewer. A pause button is presented near the edge of the video play area to prevent interfering with patient immersion. Pause stops the video playback but continues to allow user to look around and explore that particular frame in video should the technician feel the need to explain a particular aspect during treatment.

Our project is unique due to our file system as it is completely automated and only requires the technician to load video into a dedicated folder. No lines of code. No recompilation. No testing. Only dragging desired videos into a folder. A further explanation of this feature is explained below.

Place all video to play on your local desktop under */Videos/vrvideos/.* The script will fill in the disk and user profile name automatically in the directory url automatically. This is handled by *FileLocator.cs*. The *vrvideos* folder is the only folder that is externally read by the unity project. This prevented the need to build and compile the large videos within the project itself.

VR can cause dizziness and nausea for some users which can be a health risk for individuals with a compromised immune system. This project requires the patient to be lying down because much of the treatment is undergone on a bed.

**APPENDIX II: Design Files**

Project MakerRepo location: <https://makerepo.com/kaleighionadi/vr-xiii-b13/>

The entire project is contained within the *TheLastVaiRBender* project folder excluding the desired video(s) to be played.

**Exit:** exists the application (standalone)

**Menu:** uses a script to enter another scene when it is clicked

**Pointer:** built from a script which projects a ray caster and check if it collides with a button

**Video player:** projects a video onto a skybox that is fixed around the viewer

Button prefab is stored in */Assets/Prefabs/* The template in this folder is used to generate buttons dynamically based on the name of videos in vrvideo directory.

*/Assets/Scripts/* contains all scripts used. FileLocator.cs indexes the configured video folder, reads the video name, generates buttons, names it accordingly, and then configures the video player to play the corresponding video button clicked on. To modify the default vrvideos folder change the “pathWithEnv” variable at line 22 and line 66 to desired directory.