GNG1103

Final Design Report

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Submitted by

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Abstract

This report is an outline of the entire three-month long project. From the first client meeting and the needs identification up to the design of the final solution. Product specifications have been assigned through the help of benchmarking various designs which lead to each member coming up with a conceptual design. From there, the group decided on one idea to proceed with. From this point forward a project plan was established in order to achieve a result by the deadline.

As for most projects, prototyping and testing took up the most time and resources, these were done on a weekly basis in order to see what to change to have a fully function project. Through the prototyping phase, a final solution emerged, a solution that satisfies most of the client’s needs and maybe even more.

Finally, a conclusion and recommendation for future work can be read for anyone who’d like to improve this current design and take it even further as the capabilities and potential for such a design are limitless.

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List of Acronyms

Acronym	Definition
VR	Virtual Reality
.exe	Executable file
.cs	C Sharp script file name

1 Introduction

The point of this project is to create a simulation type experience using virtual reality technology to use for patients who are having trouble coping with the idea of getting some form of cancer treatment. The group will be looking at creating a menu type program which will be interactive and will allow patients to select whichever video simulation they would like and allow them to experience what their real procedure will be like. This simulation is used to ease patients who are very nervous and scared of the machines but this will also help them educate them on the process, because through the various procedures, the nurses need for the patient to be completely still and if the patients are not one hundred percent comfortable they will be moving around and affect the end results of the procedure.

A problem exists for the patients who need to undergo a CT scan/radiation treatment. This need is to experience the entire procedure. Patients lack the basic understanding of how CT scans and radiation treatment works its procedure. The plan is to create a virtual reality experience that allows the patients to overcome fears, uncertainties, and to gain knowledge of the treatment beforehand. After we have fully identified all the needs of the client we have decided to prioritize them accordingly. First, the main priority of the task is to create a realistic experience so that the patients can fully grasp what it's like to undergo an actual procedure. The second priority is that the program is bilingual. The reason is because the Ottawa hospital accommodates a very large amount of people every day that speak many different languages. This means that if the program cannot be adapted to their language it will be hard for them to understand what is being said so they know what to do during the virtual experience or the actual procedure. These procedures are new to the patients and they are unfamiliar with the whole experience. Finally, an important feature available through this menu, is to have it adaptable to all ages and technological capabilities.

2 Need Identification and Product Specification Process

This section will go through the problem statement developed, the benchmarking process as well as the needs and target specifications identification.

2.1 Problem Statement

A need exists for a virtual environment in which patients can access simulation videos in order to feel more at ease during their treatments and reduce stress and anxiety.

2.2 Need Identification

Priority*	Customer Needs	Specifications
5	Realism	To make it feel as real as possible (video/audio), and does not induce nausea
5	Bilingualism	Have an option for English or French (audio/subtitles)
4	Audio and Subtitles (Educational)	Provides information of what's going on and what is being said.
1	Options of controllers	Giving the user the option to interact with menu/surroundings or have the clinician chose for them.
2	Patient or Clinical Control	Allowing the option between giving the patient or medical staff control of the sequence of videos and features of VR experience.

2	Pause and play	Giving the option to the user to pause or play the video whenever they would like.
1	Age related Menu	Have a menu for different ages (adults vs kids menus)

**Priority Number: 5 - Very Important, 1 - Less Important*

Table 1 Need Identification and Priority

The needs were divided into functional and non-functional requirements, alongside a list of constraint that this project faces.

Functional Requirements:

- Environment is to be used as a menu to access simulation videos to get familiar with medical procedures
- Interactive environment
- Ability to play a list of videos back to back
- Ability to choose the person in charge of controlling the environment and video playback (Patient vs Medical Staff)

Non-Functional Requirements:

- Realistic environment (no nausea, no dizziness)
- Available in both official languages
- Closed Captioning (Subtitles mainly for the deaf and hearing-impaired patients)
- Menu tailored to different age groups (Having a menu with less control for the patients who are as technologically advanced vs having a menu with complete control for the patients familiar with a VR environment)
- Disclaimer for video static (static is seen on camera but not during actual procedure)
- Controllers not visible while video playing
- Having the program user friendly so it is easier for the clinician to control what will be going on throughout the VR procedures.

Constraints:

- Cost ($)
- Excessive head movement (patients get a warning when head is being moved around)
- Excessive body movement (patients get a warning when they move out of the designated zone)

Specifications	**Importance Factor Number**	**Benchmark#1: CHARIOT** [1]	**Benchmark#2: Bird simulator** [2]
Educational	4	4	0
Interactive	2	0	3
De-Stresser	5	5	5
Video Playback	5	0	0
Message Prompts	3	0	0
Helps Overcome Fears/Phobias	5	5	3
Multiple Access to controls	3	0	1
Age Diversity	2	5	5
Final Score:	N/A	**76**	**59**

**Importance Factor Number: 5 - Very Important, 1 - Less Important*

***All Scores are based out of 5 and then multiplied by the importance factor number*

Table 2 Benchmarking Process

Using the functional and non-functional requirements and the constraints, the benchmarked products helped realize a table of target specifications that should be achieved by the end of this design process.

Design Specifications	Relation (=,>,<)	Value	Units	Verification Method
Functional Requirements				
Environment used to access Videos	=	Yes	N/A	Testing
Interactive	=	Yes	N/A	Testing
Ability to play Videos back to back	=	Yes	N/A	Testing
Choose person in charge of controlling environment	=	Yes	N/A	Testing
Non-Functional Requirements				
Audio & subtitles	=	Yes	N/A	Testing
Realistic environment	=	Yes	N/A	Analysis, Final Testing
Available in both official languages	=	Yes	N/A	Testing
Closed Captioning (Subtitles)	=	Yes	N/A	Testing
Menu tailored to different age groups	=	Yes	N/A	Testing
Disclaimer for video static	=	Yes	N/A	Testing

Controllers not visible while video playing	=	Yes	N/A	Testing
Constraints				
Cost	<	100	$	Estimate, Final check
Excessive head movement (shouldn't be more than)	>	±20	degrees	Testing
Excessive body movement (shouldn't be more than)	>	1	meters	Testing

Table 3 Engineering Design Specifications

3 Conceptual Designs

After empathizing with the client, the next step in the engineering design process is the ideation and design stage. Project deliverable D's goal is to outline the steps the team took to create an initial conceptual design of the interactive VR menu. This started with conducting a team brainstorming session. Then, each member created 3 unique concepts which were analyzed under the selection criteria. Ultimately, the concepts who scored the highest were chosen as part of the primary conceptual design. A new final design was then created by combining the best elements of the highest scoring concepts.

Each group member came up with three unique concepts that aimed to meet as many of the client's needs as possible. The designs are shown through figures and short descriptions.

3.1 Antonio's Designs

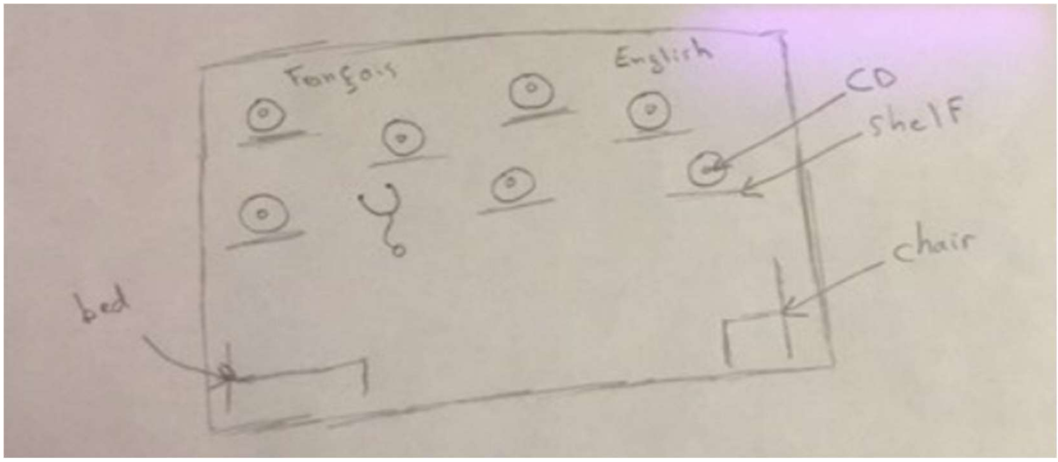


Figure 1 The Breakable CDs

The environment starts off by looking at a numerous number of shelves which each hold a different CD that represent a different Video. The wall is split in 2, on the left side the French versions of the videos and on the right side, the English version. The user starts off by looking for the video they want to view. Once found, the user picks up the CD and breaks it and a prompt comes to either sit or lie down and then the video starts. The stethoscope hanging on the wall can also be selected for closed captioning.

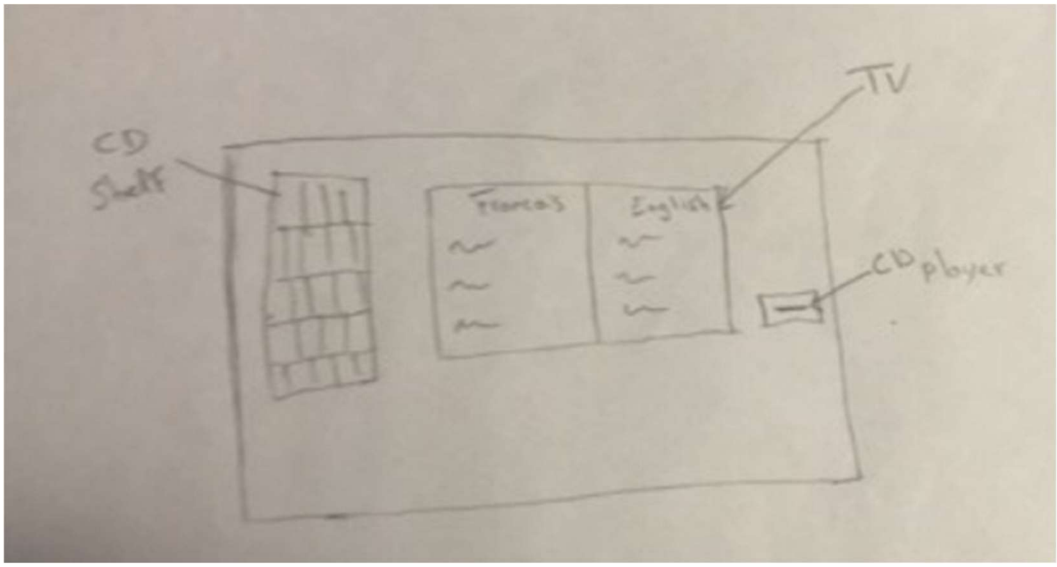


Figure 2 TV with CD Player

Here, the user sees a CD shelf, a TV and a CD player. They start off by selecting the CD corresponding to their video, putting it in the CD player. Once in, a menu will show up on the TV prompting them the choice between French and English and different options such as subtitles. Once everything is selected, the video starts playing.

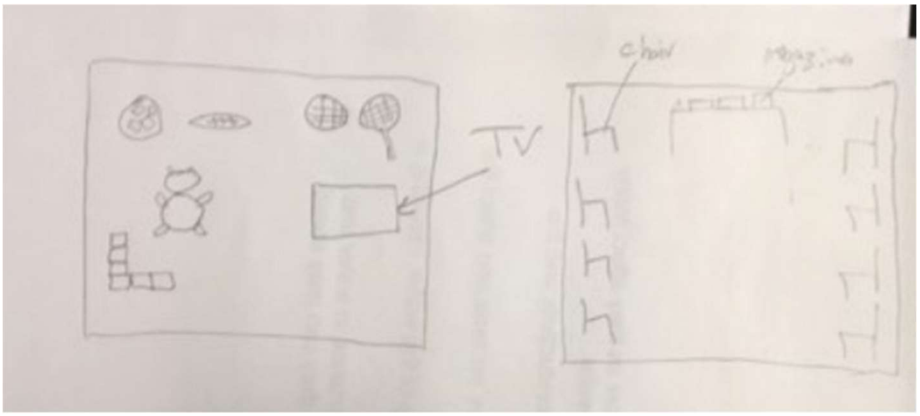


Figure 3 The Age Diverse Environment

First thing, the user sees a prompt asking for the age. 0-14 years old users would see the left side of the sketch, while the 15+ years old users would see the right side.

Left side: The user is in a playroom, with a few interactable objects such as the building blocks, the sports balls or for the younger users, a teddy bear. Once the video is ready to be played, it will appear on the TV as a countdown and once done, the video will start playing.
Right side: the user is in a waiting room, with a table on which are magazines. Each magazine represents one of the videos. Once they open the magazine, first page will contain a summary of the video they are about to see, and once they flip the page, the video will start playing.

3.2 Liam's Designs

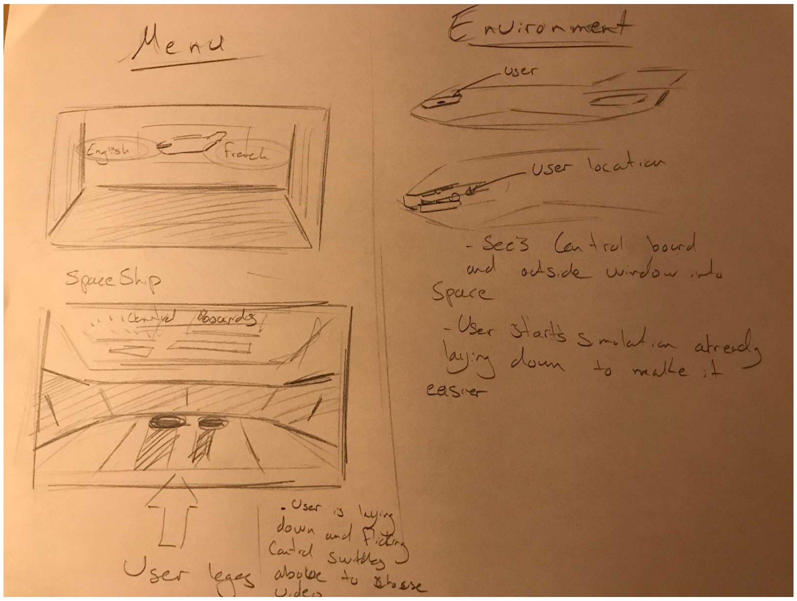

Menu
Environment
English
French
user
User location
- See's Control board and outside window into Space
- User starts simulation already laying down to make it easier
Space Ship
Control boards
- User is laying down and flicking Control switches above to choose video
User legs

Figure 4 The Spaceship

In the sketch above, to be more suited for children hence the spaceship environment. For the simulation the user will start by laying down and they will appear in the cockpit of the spaceship being able to see the window showing outer space but have the control board of the ship right in front and above the user. With this control board they will be able to select the different types of videos and even select different preferences. This will make the simulation more interactive for the user.

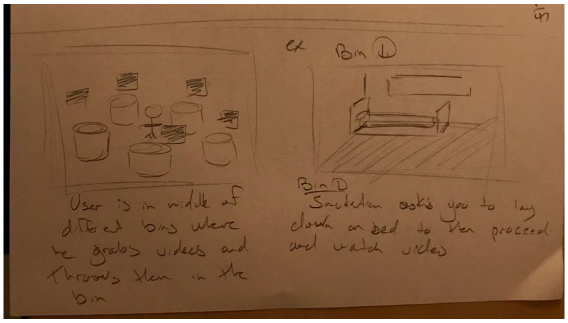

ex
Bin ①
User is in middle of different bins where he grabs videos and throws them in the bin
Bin ①
Simulation asks you to lay down on bed to then proceed and watch video

Figure 5 The ball and bin selection

In the sketch above, a simple but interactive environment that would not be too hard to recreate. It simply contains bins and rectangle object with the video tiles on them and certain options. To either select the video or different options the user will have to grab the object and throw it in the according bin. For the videos, it will bring them to a different room and then ask them to lay down which then the video will play.

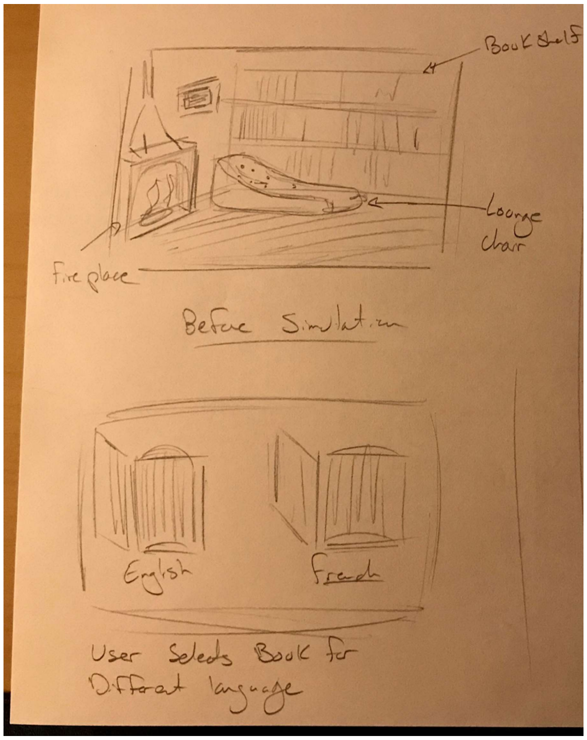


Figure 6 The Fireplace

In this sketch, a more calm and soothing approach. The environment contains a nice living room with a burning fireplace and a bookshelf with a lounge chair in the middle. For this the user will need to select the book that they want to view(video) and then proceed to lay down in the lounge chair where the video will proceed to play. Beforehand the user will have the option to select two different books which are the different languages of the simulation. After selecting the certain book, it will bring them inside the book and proceed to show them inside the room I was explaining at the beginning.

3.3 Zach's Designs

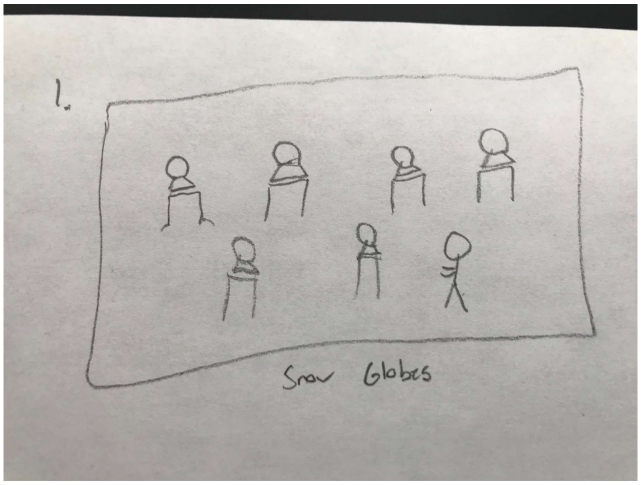


Figure 7 The Snow Globes

In this sketch, a kid friendly, soothing environment. It contains a room of any design full of snow globes. The snow globes playing trailers/images of the videos within can be chosen by the patient. Looking into the snow globe allows you to see little snippets of the video, and the title/specific area the video is covering. Smashing the snow globe/selecting it allows for the video to be played.

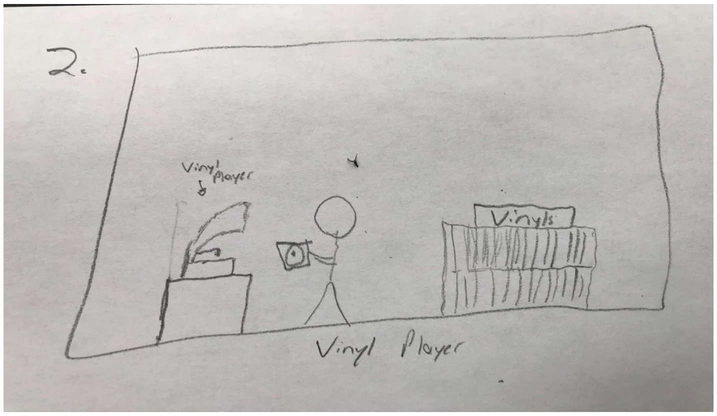


Figure 8 The Record Player

This sketch of a vinyl selection system. The menu has a vintage record player, and selection area. Each vinyl has a cover art of the video that it plays. A lounge chair can be added to the background so they can lay down after playing the disc. The vinyl placed on the player, they then proceed into the required position, and the video starts playing, starting with sound, with video fading in.

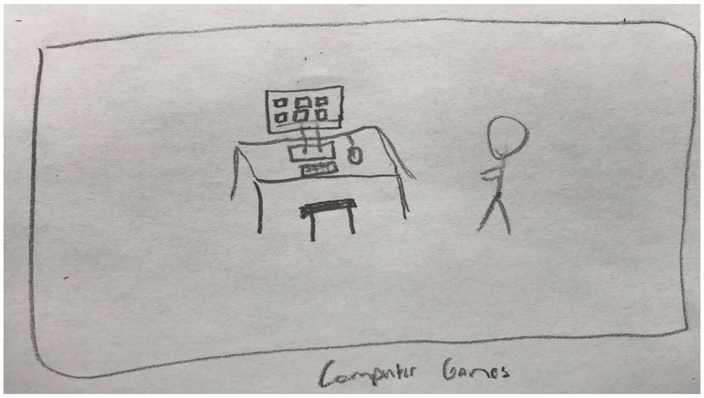


Figure 9 Computer Games

My last sketch is good for all ages. It is a computer monitor with game icons put on the screen. The user moves the mouse around in order to select the videos that they want. Previews can be selected by right clicking and selecting the “Preview" button. Launching the game starts up a loading screen that tells the player what position is needed, and a small explanation of the video.

3.4 Sebastien’s Designs

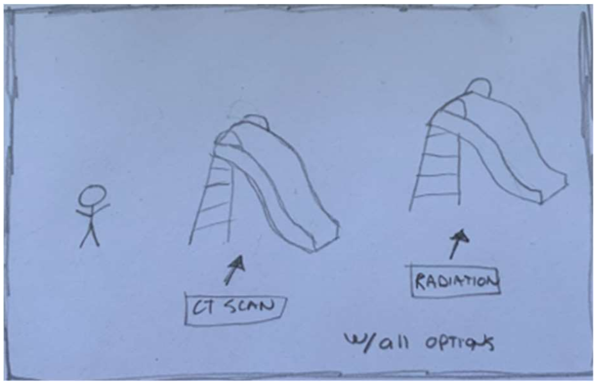


Figure 10 The Playground

For the sketch above, I decided to create a fun and exciting environment for kids. This VR menu will have a big playground with multiple slides that lead them to a video explaining their future treatment. Once down the slide, a new window will pop up with instructions and information about the chosen procedure.

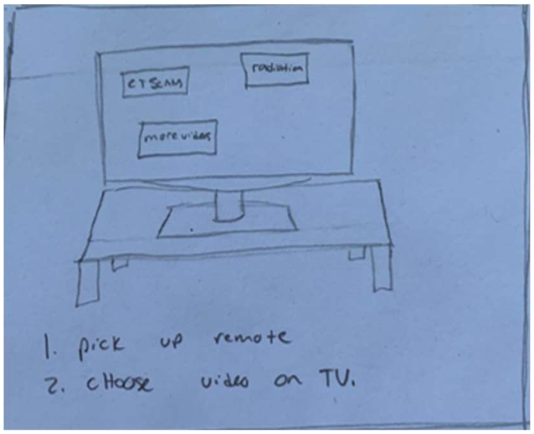


Figure 11 The TV

For this sketch, I decided to have an environment that a lot of people have in their homes. This design is simply a living room. To access the informational videos, the user must pick up the TV remote and choose a video on the TV screen. The TV will then list instructions for the user to follow.

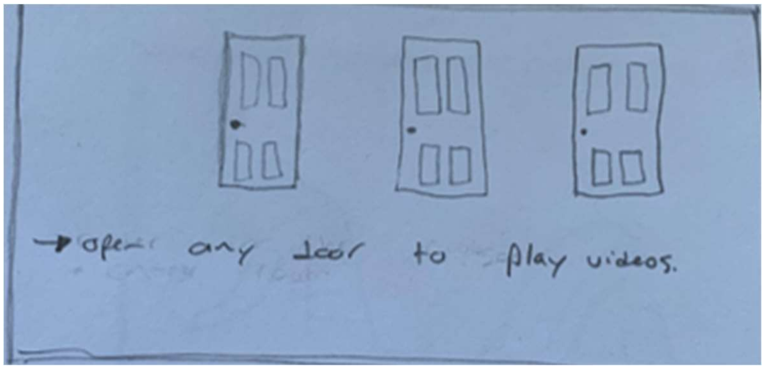


Figure 12 The Doors

This VR menu has a waiting room feel with couches and chairs etc. Also, this room has multiple different coloured doors. Each door represents a different video. The user will be able to open any door and enter the room where the procedure takes place.

3.5 Zak's Designs

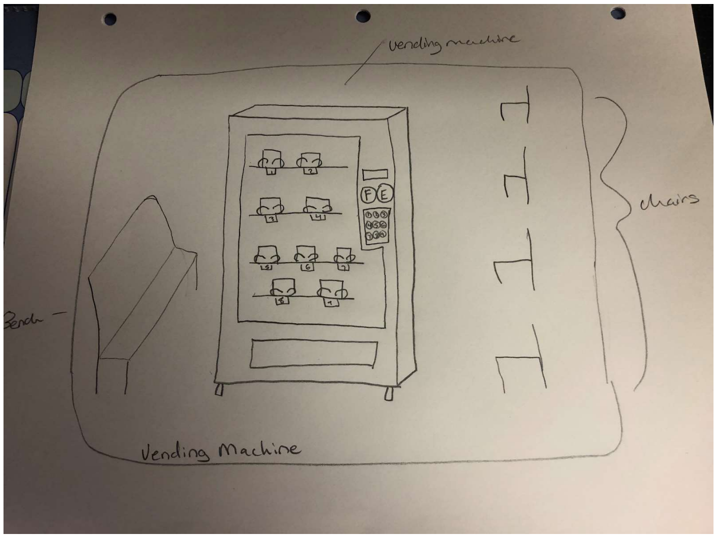


Figure 13 The Vending Machines

In this sketch, the patient is in a lounge/waiting room environment that includes chairs, a bench and a vending machine. This will be an interactive environment that appeals to younger ages as kids love snacks and candy, but also includes older ages. The patient will be able to get up and go to the vending machine whenever they feel comfortable and ready. When they get to the machine, instead of paying (like in real life), they must choose their preferred language (French or English). From there, the patient can select the video they would like from the numbering system on the side (more than one can be selected if needed). The video is dispensed as a bag of chips, and when they return to their seats, they can open the bag and the video begins, directing the patient to lie down and do the other necessary steps prior to watching the procedure.

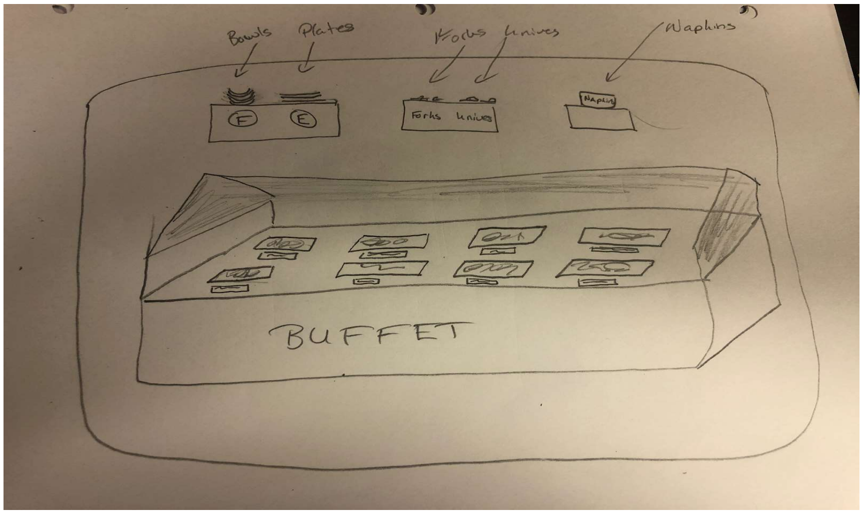


Figure 14 The Buffet

In this sketch, the patient is in a buffet restaurant. This interactive menu allows the patient to select a plate or a bowl. By selecting a plate, the patient has chosen the English option and by selecting a bowl the patient has chosen the French option. Once this is done the patient proceeds to the buffet where each type of food represents a different video, which are clearly labelled in front of the food items. Once the patient has chosen the correct food (video) they need, they are seated, and the video begins (more than one food can be selected if needed). From there they are instructed to lie down and do the other necessary steps prior to watching the procedure.

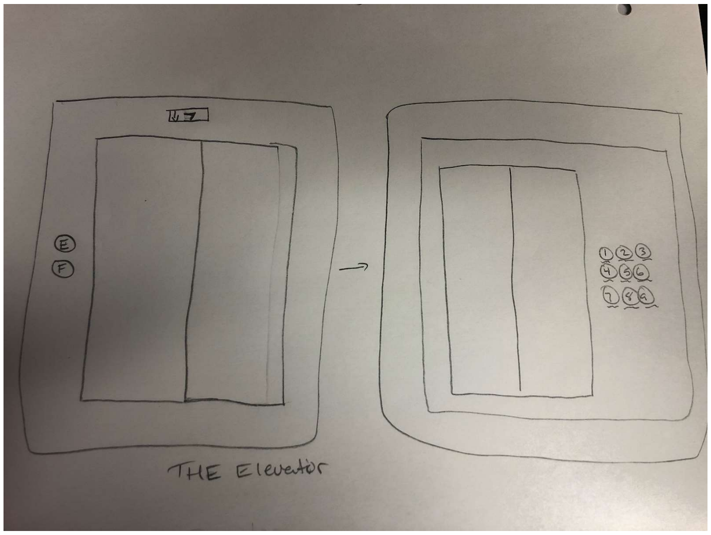


Figure 15 The Elevator

In this sketch, the patient will be standing outside of the elevator. Instead of choosing up or down, this interactive menu allows them to choose French or English. Once this selection is made, the elevator doors open and the patient walks inside. Now they are to pick a number as if they are choosing a floor, but these numbers are all labelled as types of videos. Once they select the video they need, the elevator takes them to that floor and the doors open (more than one floor can be selected if needed). The patient then walks out into a doctor's room where they are told to lie down, and the video begins.

4 Project Plan, Execution, Tracking & Bill of Materials

This section will outline the various tasks that our team needs to accomplish in order to move forward with our project. First, we discussed the steps that we need to take, assign each task to a specific member of the team and made a Gantt diagram representing what was discussed. Given each task, we discussed the risks that may rise from it and developed a contingency plan in order to stay on track. Finally, we talked about what we could possibly need in order to achieve our goal and estimated the price for each component making sure we stay under budget.

4.1 Tasks and Assignments

4.1.1 Creation of Environment using Unity

This task was assigned to Liam and Sebastien. They will be in charge of using Unity to assemble and create an environment for the patients who will be using the program in order to interact with during their session. This task should take around 4 hours. The reason for why this task will only take a few hours is because it is not complex or difficult to create small environments using the user friendly and easy to use software in Unity. Many of the objects we will be using are already downloaded and are ready to use to create our environment meant for the patient. In the case where something is not available at our current disposal, the asset store is there to help.

4.1.2 Creation of Additional Assets

This task was assigned to Zak and Zach. They will be in charge of creating objects and assets in Solid works in the hopes of reducing the cost of our project and avoid buying 3D objects or assets. We can easily create them in this software. This will help us create a more detailed appearance to our environment and have a more user-friendly interface. The duration of this task is hard to be estimated specifically, because at this point it has not been fully decided on whether we will need to build our own asset instead of buying one with our given budget. In addition, we are still unsure of the size of the asset we would need to create so it could either take a few minutes or a few hours using the Solid works software.

4.1.3 Script and Unity Coding

This task was given to Antonio. He will be in charge of coding inside the Unity software making sure that the patient will be able to interact with certain objects in our given menu and make sure nothing crashes in use. In addition, he will be coding the physics of the objects, for example our idea is for when the patient grabs a hold of the video/object and try to place it in a virtual bin. First, once the object is grabbed it will be moved around and have some physics and weight to it. Second of all, when the patient places it in the bin, the video will be activated and if they miss the bin a code will be activated to discard the object and replace it at its original starting point where the patient can grab it again and try to replace it in the bin to play the creation video. The duration of this task is once again undetermined, because of the complexity behind it. For example, on certain codes it could take a few minutes and on others it could take hours. Really depending what we are coding and its complexity, such as coding for the physics of the ball. That type of code will take much longer than coding for the simple playing of the videos once dropped in the bin.

4.2 Risks and Contingencies

There are multiple risks associated with the creation of a VR application. The biggest risk for our project is a failure due to coding, when it comes time to the prototypes and final app. Many things can go wrong with coding, errors, bugs, physics problems, and the entire application not working overall. Our best method to fix this is through debugging, constant testing, and making sure that our code won't break in almost every type of scenario that can occur. Another risk is the compatibility of our program. Going into a reveal of both prototype and final product, our application must be compatible with the companies' hardware, if not many problems may arise including starting from scratch. The best way to stop this from happening is researching what is compatible with what, and through multiple testing phases with different hardware/software. The last risk would be not being on time, with an application it is hard to determine how long each phase will last. Conflicting schedules, amount of work put in, and procrastination are all factors that affect the completion time. As a group our contingency plan is to produce a well thought out schedule in order to always be on time and to not fall behind, and risk having a bad/faulty application.

4.3 Cost Estimation

Given the nature of this project, the cost will be split into different aspects. The first estimation will be for Unity Team subscription (uncertain as of yet if we are using it or not but we will take it into consideration in order to organize our budget), at $9 per month + $7 per extra member, taking us into a total of $23 per month for 1 month (November). Other areas for money spending include the asset store and ready made 3D Objects, these costs vary and therefore we want to make sure as to not spend over $50-$60 on those parts. With that being said, realistically, it would be possible to create our prototype without spending any money. There are a vast amount of items that can be acquired for free in the asset store on Unity, also, we can make our own items on Solidworks. When it comes to real, tangible, items we will not need to spend any money as we are being provided with the VR headsets and all other equipment that is necessary to run the VR system.

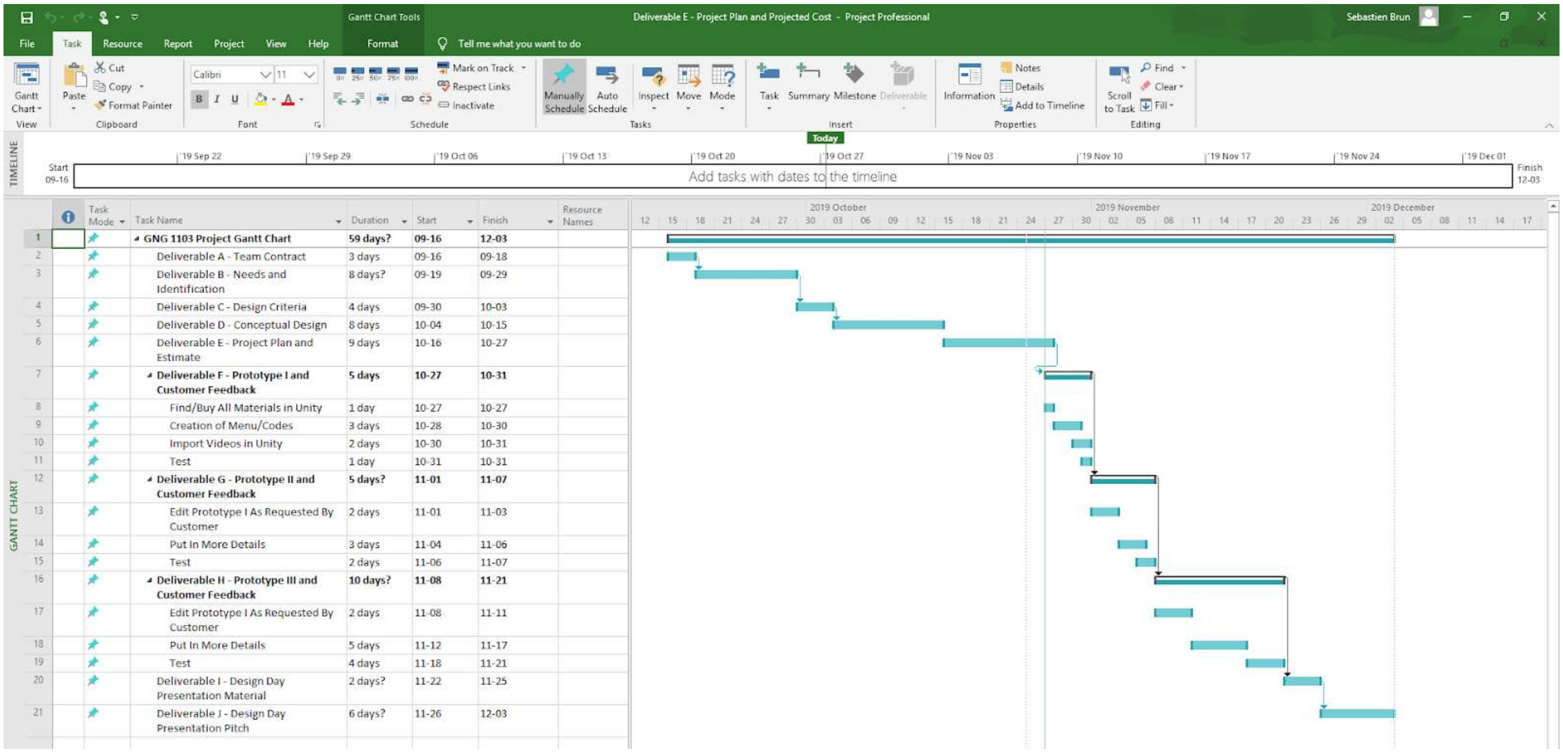
Table 4 Cost Estimation

Part Name	Description (identify prototype #)	QTY	Unit Costs ($CAD)	Extend Costs (Qty x $)

Unity Team Subscription	Used to have a cloud in order to facilitate the code sharing process so everyone can work on it.	1	9	9
Unity team extra members	Additional members to be added to unity team cloud since the base subscription is only for three people	2	7	14
Various Assets	Various assets found on the asset store in order to facilitate environment building	*	*	*
Various 3D Objects	Various 3D objects that we can find and buy in order to facilitate environment building	*	*	*
Total			16+*	23+*

* *These assets and 3D objects have an undetermined quantity and cost and therefore can be properly estimated for the bill of materials as of now, but at the end of the project once we know what we will be using, this table can be accurately modified in order to represent how our budget was spent.*

4.4 Project Plan



	Task Mode	Task Name	Duration	Start	Finish	Resource Names
1		**GNG 1103 Project Gantt Chart**	**59 days?**	**09-16**	**12-03**	
2		Deliverable A - Team Contract	3 days	09-16	09-18	
3		Deliverable B - Needs and Identification	8 days?	09-19	09-29	
4		Deliverable C - Design Criteria	4 days	09-30	10-03	
5		Deliverable D - Conceptual Design	8 days	10-04	10-15	
6		Deliverable E - Project Plan and Estimate	9 days	10-16	10-27	
7		**Deliverable F - Prototype I and Customer Feedback**	**5 days**	**10-27**	**10-31**	
8		Find/Buy All Materials in Unity	1 day	10-27	10-27	
9		Creation of Menu/Codes	3 days	10-28	10-30	
10		Import Videos in Unity	2 days	10-30	10-31	
11		Test	1 day	10-31	10-31	
12		**Deliverable G - Prototype II and Customer Feedback**	**5 days?**	**11-01**	**11-07**	
13		Edit Prototype I As Requested By Customer	2 days	11-01	11-03	
14		Put In More Details	3 days	11-04	11-06	
15		Test	2 days	11-06	11-07	
16		**Deliverable H - Prototype III and Customer Feedback**	**10 days?**	**11-08**	**11-21**	
17		Edit Prototype I As Requested By Customer	2 days	11-08	11-11	
18		Put In More Details	5 days	11-12	11-17	
19		Test	4 days	11-18	11-21	
20		Deliverable I - Design Day Presentation Material	2 days?	11-22	11-25	
21		Deliverable J - Design Day Presentation Pitch	6 days?	11-26	12-03	

Figure 16 Project Plan Gantt Chart

5 Analysis

Based on the client needs that were obtained during the first client meeting, our group selected the top 3 designs and put them into a decision matrix as seen below in the table. This matrix works by outlining all the design criteria outlined in project deliverable C and each individual concept was given a score out of 5 for each criterion. Afterwards, the scores were added up to determine which designs best met the client's needs. The decision matrix helped narrow down the 3 individual concepts to only 1; each of which stood out from the rest.

5.1 Analysis of Concepts

Table 5 Decision Matrix

Individual Concept Options			
	Design 1	Design 2	Design 3
Selection Criteria (out of 5, 1 being the lowest score)	The Bin (Liam design #2)	Age Diverse Environment (Antonio #3)	The TV (Sebastien #2)
Cost	4	2	2
Aesthetics	4	4	2
Controls	5	4	3
User interaction	5	5	3
Age Diversity	3	5	3
Educational	4	2	4
Total Score	25	22	17

5.2 Selecting a Concept

In order to select a concept that would move forward in the design process, our top 3 designs were evaluated in a decision matrix found in Table #1 and then discussed with regard to feasibility. Feasibility in this case was defined as being, A *concept that could be prototyped and then produced for the client in the appropriate timespan given the team's expertise and available resources*.

5.2.1 Specific Reasons for Selection

We are going to evaluate the top 3 designs, discuss them further and finally reach an agreement as to which concept, we will be pursuing as team. The main reasons being the ones evaluated in the decision matrix above. But also evaluating our skills and experiences in doing such a design as to be able to submit a functioning and up to needs project.

5.3 Final Concept

As a team, we decided to go with Liam's second design, "The Bins". We thought it was a great design as it covers most of the client's needs, it is an interactive environment in which the user has control as to what video they will be watching and give them the ability to interact with various objects surrounding them. Once a video is selected, the user will then be able to follow instructions in order to recreate the environment they will find themselves in in real time.
This design embodies every aspect that is required in order to satisfy the client's needs, all while keeping it visually pleasant, interactive and educational. We will be looking into developing this design, and possibly combining some of the other concepts alongside this one to achieve the ultimate VR Interactive environment.

5.4 Concept, Target Specifications, Benefits and Drawbacks

5.4.1 Target Specification and Requirements of the Final Concept

The target specifications of the design include a cost lower than $100, an interactive non nauseating VR environment, age diverse, education and finally controllable by the patients and/or the medical staff.

5.4.2 Evaluation of the Final Concept Meeting Target Specifications and Requirements

The final concept should have an interactive environment. Currently, the menu has not been developed. As such, it currently can only be stated that the final concept will need to be operated with the interactive menu in mind. Moving forward, the interactive will be developed and designed in a way that the user can interact with various objects in order to achieve their goal.

The final concept should be friendly to most ages. The average age of patients undergoing most of these procedures is unknown. As such, it can only be stated that the final concept must have an age friendly interactive menu in order to accommodate patients of various ages.

The final concept should provide the client with control over the environment and the menu. Currently, the environment has not been developed. As such it currently can only be stated that the final concept will be able to be controlled by the patients and the medical staff in order to play the educational videos.

The final concept should provide the client with a way to reduce stress and anxiety. As the entire project is based on educating the users on certain medical procedures and therefore should be able to reduce stress and anxiety levels that patients may have.

6 Prototyping, Testing and Customer Validation.

In this section, we will be going through our prototyping phases and tests conducted at each phase in order to make sure we are staying on the right track and the results and evaluation concluded once the testing was complete.

First we will go in detail about the first prototype type and then we will analyze and evaluate the results retrieved from the tests and finally we will discuss the client's feedback and talk about how we will plan the second prototype in order to ensure a functioning design.

6.1 Prototype I

This part is separated into two main sections, the prototyping documentation which includes details about our menu systems and the Environment in which the users will find themselves in.

6.1.1 Prototyping Documentation

6.1.1.1 Three Menus

The main functionality of our design is the presence of three different menus that the users will have access to in order to access the treatment simulation videos. First is a menu controlled by the mouse, second menu is controlled by gaze and finally the third menu is controlled by the VR controllers.

6.1.1.2 Mouse Controlled Menu

This menu is the most basic of all three, as it is simple to use and operate. The user, with the help of a computer mouse, will select the button associated to the video they would like to watch, wait for the video to load and watch the video. The mouse will also be used to play and pause the video and switch to another video if needed.

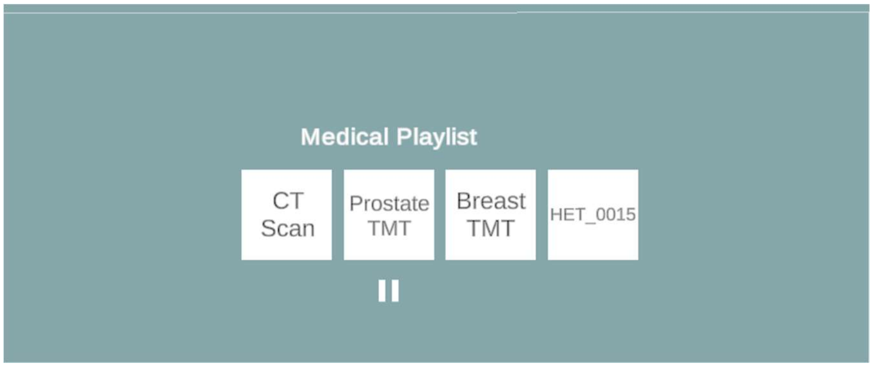


Figure 17 Playlist menu that shows the buttons for the simulation videos

6.1.1.3 Gaze Controlled Menu

This menu will lack the interactive environment as it was designed for the users who are not entirely comfortable with using a VR set and therefore we are making the assumption that the interactive environment is not a necessity because their aim will be to watch the simulations.

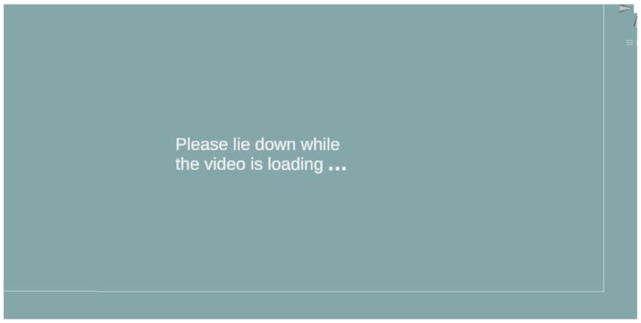
With the same looking menu as the menu in Figure 1, this menu is activated by gaze, meaning the user will see a green dot in the middle of their screen. That dot will be used as a reference point in order to aim their gaze the button desired in order to play the video, once the green dot is on a button for 2 seconds, the video will load.

6.1.1.4 Controller Controlled Menu

This menu is the most interactive and we are assuming will be the most popular. It will be controlled via the controllers by pointing and clicking while also having an interactive environment around the user in VR. The controllers will be used to select the videos for now, but in the future will be used to drag and drop the balls in the bins associated with each video.

With the same looking menu as the menu in figure 1, this menu will be controlled by the controller with the help of a pointer that the user will be able to see, once pointer is aligned, the user will click the button and play the video.

6.1.2 Loading Screen



Please lie down while
the video is loading ...

Figure 18 Loading screen prompt before loading the video

The figure above is what the user will see once the button to play a video has been clicked in order to load the video. Once they decide on what video has to be played, the video will start loading and a prompt asking them to lay down will appear in order to start the simulation.

6.1.3 Environment

As of now, the environment has not been integrated with the menus but we have the baskets and balls designed. The balls will be grabbed and dropped into the baskets by the mouse and controller users in order to play the videos in question.

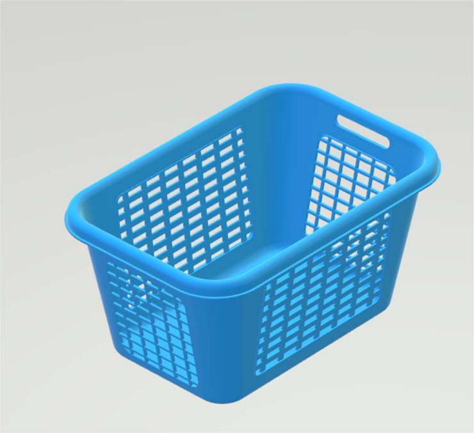


Figure 20 3D Basket

Figure 19 3D Ball

These baskets will each be associated to a video. Once the balls are dropped into the corresponding basket, the associated video will start loading and then play.

6.1.4 Testing and Analysis

First test: Making the videos play in stereoscopic form

This test was 90% successful, the videos play perfectly fine in stereoscopic form but for the future, we need to find a way to change the starting point of reference of the video in order to get as real a simulation as possible.

Second test: Making the buttons start the videos.

Once the buttons were made and associated to each, we tested to see if the buttons call the correct videos. That test was successful for all 3 menus.

Third test: Making the play/pause button.

This test was successful. The play and pause button successfully fulfilled its purpose.

6.1.5 Customer Feedback

We presented what we have so far and our future plans to the client who expressed admiration for our Gaze menu saying it is a good idea for the users who are not comfortable or familiar with using the VR set and environment. The client also approved of the direction we are taking with our design so far and said that we are on the right track. There is not much else we can take from the feedback as there was nothing negative to what we have so far and therefore will stay on track with our schedule and keep doing what we are doing in order to achieve the best possible design.

6.2 Prototype II

6.2.1 Results from Prototype I

What Worked

From prototype I, our three menu systems seemed to work fine.

- The mouse menu:
    - This system had no issues loading the initial menu. User was able to select the video desired with the use of the computer mouse and the video loaded as was required.
- The Gaze menu:
    - This menu had no issues in the initial menu scene. User was able to gaze over the button for the desired video and the video will load as was required.
    - Without leaving the scene, the user was able to hover over another button in order to switch from one video scene to another.
- The Controller Menu:
    - This menu had no issues loading the main menu.

What did not work

- The mouse menu:
    - Once in the video scene, the user was unable to select another video from the buttons, buttons were useless in that scene and unclickable.

- The Gaze menu:
    - With the rotation of the video in the first prototype, the XYZ coordinates got messed up and the gaze eyecaster was messed up as the green dot was not following the camera as it should have been.
- The controller menu:
    - Controllers were not visible.
    - No pointers were shown.
    - Controller button not properly assigned.

6.2.2 Iterations from Prototype I

6.2.2.1 Three Menus

The main functionality of our design was the presence of three different menus that the users will have access to in order to access the treatment simulation videos. First was a menu controlled by the mouse, second menu is controlled by gaze and finally the third menu is controlled by the VR controllers. All three menus underwent some changes in order to make them more efficient and appealing.

6.2.2.1.1 Mouse Controlled Menu

After further evaluation, we decided to scrap the menu idea as we believe it defeats the purpose of having a VR based environment. The user would be unable to control the mouse while having the headset on, it would make the whole process inefficient and take it further from reality.

6.2.2.1.2 Gaze Controlled Menu

Same as prototype I, this menu will lack the interactive environment as it was designed for the users who are not entirely comfortable with using a VR set and therefore we are still making the assumption that the interactive environment is not a necessity because their aim will be to watch the simulations.

From prototype I, we fixed the orientation of the video as well as the orientation and the positioning of the menu once in the video scene.

6.2.2.1.3 Controller Controlled Menu

Just like the assumption made in prototype I, this menu will be the most interactive and the most popular amongst all three. The controllers will be used to interact with the environment.

The addition in prototype II will be the pointers and controller models that will be seen in the VR environment. As of now, the controllers can select the videos on the menu used in prototype I, each controller has a laser pointer coming out of it that will be used to point to the desired video and select it since the environment hasn't been implemented with the menu system.

We are also looking to add the teleport script in order to move around the room to be able to interact with the different objects.

6.2.2.1.4 Environment

In prototype we did not have an environment yet. So, for prototype II we bought a package from the asset store that contains objects that one could find in a hospital room. We used those objects to build the environment. On top of the hospital objects we also added the baskets and the balls in order to satisfy our design for the controller menu.

6.2.3 Testing and Analysis

For our first test, we made sure that the gaze menu had the right orientation for the video as well as the ray cast pointer to be aligned with the camera. This was done by trial and error in adjusting the x,y coordinates on the camera and the video itself making sure they match so that the ray pointer follows the camera as it should be.

For our second test, we tried to make the controllers work by putting the pointer scripts and the models for the controllers as well as making the appropriate key bindings to make the buttons interact with the menu. For this test, the controller models show fine, but we seem to be facing issues with the pointers and the buttons. This would be our main focus in the coming week.

Our third and final test involved the addition of the environment and making sure we are able to see it, and everything is up to scale. The test was successful in the way that we are able to see the room but since the teleport script has not been introduced yet, we were not able to test the objects. For the coming week we should be able to make every object a rigid body, meaning we have to give object a physical attribute in order to make it interactable, so we don't teleport into the object.

6.2.4 Customer Feedback

For this prototype, a client meeting was not scheduled so we had to find other ways to get feedback. Here, our main feedback came from our project manager and teaching assistant. We showed them what we built so far and explained how it should work. From there, they suggested how we should edit the orientation and how to add the teleportation mechanism into our project while also giving all objects a rigid body in order to not move into them, so to basically emulate how real-life objects would block our trajectory.

Other feedback has come from group member's own family and friends. We made them try to see how intuitive it is for someone who has no idea what our project is about. The feedback received from them was positive. In general, they suggested that the menu should be hidden from the main view (put in the black part of the video) and most also suggested that we add a "return to main menu" button.

7 Final Solution

In this deliverable, we will be going through our prototyping phases and tests conducted at each phase in order to make sure we are staying on the right track and the results and evaluation concluded once the testing was complete.

First we will discuss the second prototype and analyze what worked during testing and what did not in order to make the correct changes for the second prototype to be able to achieve our desired design.

Then we will talk about our third phase of prototyping by iterating our initial and second prototypes by talking about the changes we made to our menu system, our environment as well as how we tested each component and what we can conclude from the tests.

Finally we will evaluate what other people's thoughts of our project and how well they react to our design and finishing it off by talking about the steps we need to take in order to complete our design in time for design day.

7.1 Results from Prototype II

What Worked

From prototype II, our menu systems were good.

- The Gaze menu:
    - This menu had no issues in the initial menu scene. User was able to gaze over the button for the desired video and the video will load as was required.
    - Without leaving the scene, the user was able to hover over another button in order to switch from one video scene to another.
- The Controller Menu:
    - This menu had no issues loading the main menu.

What did not work

- The Gaze menu:
    - With the rotation of the video in the first prototype, the XYZ coordinates got messed up and the gaze eyecaster was messed up as the green dot was not following the camera as it should have been.

    - The menu was showing in the middle of the video and was in the wrong orientation which can cause dizziness.
- The controller menu:
    - Controller button not properly assigned.
    - Grab and drop not assigned.
    - Teleportation not assigned.

7.2 Prototype III

This part is separated into two main sections, the prototyping documentation which includes details about our menu systems and what changes have been done to each one, and the Environment in which the users will find themselves in and how they will be able to interact with it.

7.2.1 Iterations from Prototype II

7.2.1.1 Gaze Controlled Menu

Same as prototype II, this menu will lack the interactive environment as it was designed for the users who are not entirely comfortable with using a VR set and therefore we are still making the assumption that the interactive environment is not a necessity because their aim will be to watch the simulations.

From prototype II, we fixed the orientation of the video as well as the orientation and the positioning of the menu once in the video scene.

7.2.1.2 Controller Controlled Menu

Just like the assumption made in prototype I and II, this menu will be the most interactive and the most popular amongst all three. The controllers will be used to interact with the environment.

The addition in prototype III and that we weren't able to do in prototype II will be the pointers and controller models that will be seen in the VR environment. As of now, the controllers can select the videos on the menu used in prototype I, each controller has a laser pointer coming out of it that will be used to point to the desired video and select it since the environment hasn't been implemented with the menu system.

We are also looking to add the teleport script in order to move around the room to be able to interact with the different objects. As well as adding the grab and drop feature for the balls to be able to be put into the baskets so the patients can play the videos they want.

7.2.1.3 Environment

The environment has been integrated and scaled to appropriate size in order to make the patient feel as if they are in the room. The environment in controller menu will have interactable balls that will be used to access the videos while the gaze menu environment will not have access to these interactable balls.

7.2.1.4 The Main menu

On top of the two menus mentioned, a main menu has been created to be able to access the two sub menus simply by interacting with a hovering button.

7.2.2 Testing and Analysis

For our first test, we made sure that the gaze menu had the right orientation for the video as well as the ray cast pointer to be aligned with the camera. This was done by trial and error in adjusting the x,y coordinates on the camera and the video itself making sure they match so that the ray pointer follows the camera as it should be as well as making sure that the menu had the correct positioning and orientation and this was done by adding a script that would transform the rotation and the position once the video is loaded.

For our second test, we tried to make the controllers work by putting the pointer scripts and the models for the controllers as well as making the appropriate key bindings to make the buttons interact with the menu while also adding the teleportation feature to go around the room.

Our third and final test involved the addition of the environment and making sure we are able to see it, and everything is up to scale. The test was successful in the way that we are able to see the room and since the teleport script as well as the pinch and grab script have been introduced, we were able to test the objects. The orientation of the camera and the menu are also correctly modified as to not cause any disorientation while watching the simulation.

From this point, the program is fully functional in which the user can interact with the ball objects by dragging them inside the appropriate bin and successfully loading the video. The gaze menu orientation has been fixed for every video and the gaze ray caster does not malfunction when swapping scenes.

7.2.3 Customer Feedback

For this prototype, a client meeting was also not scheduled so we used the same ways from prototype II to get feedback. Again, our main feedback came from our project manager and teaching assistant. We showed them what we built so far and explained how it should work. From there, they helped us edit the orientation of the menu once the video is loaded and as well as the camera and how to add the teleportation mechanism as well as the grab and drop feature.

Other feedback has come from group member’s own family and friends. We made them try to see how intuitive it is for someone who has no idea what our project is about. The feedback received from them was positive. In general, they suggested that we add a “return to main menu” button as well as adding instructions for people to follow.

8 Conclusions and Recommendations for Future Work

To summarize, the execution of the proposed project plan was successful. The program is fully functional in every possible way. The controller menu is interactive and fun for all ages, the balls available around the environment are fully interactable and can be played with (ie. Juggling) as well as used to access the simulation videos by throwing them in the appropriate bin. The teleporting mechanism also makes the room explorable. For the gaze menu, the interactions are not there but the user can simply access the videos by looking at them for two seconds and filling up the bar and therefore successfully loading the videos desired.

This project has been a long learning process in which the group has been able to manage and successfully execute a project plan by keeping up to date with all the deliverables while also adapting to any challenges along the way. The group also learned to plan for contingencies in case the original plan fell apart for whatever reason.

For the future, a better system should be implemented to be able to call any video from a specific folder instead of having them all as separate scenes within unity as that would help by making the file much smaller and therefore easier to transport between devices and easier to call any video at any time.

9 Bibliography

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APPENDICES

APPENDIX I: User Manual

Main Features:

- Main Menu to select either of two submenus
  - Controller Menu: Interactable environment involving balls that need to be dropped in bins in order to load videos
  - Gaze Menu: Menu controlled by the gaze from the headset sensors.

Product functions and maintenance:

For this specific product, no heavy maintenance is required. Both menus are fully functional and bug free. Alteration of the scripts however can cause malfunction and therefore need to be revised (please see troubleshooting on how to go about solving this issue).

For the controller menu, the user finds themselves in hospital room surrounded by balls and bins designated for different kind of treatment simulations. The point of this menu is to have the user grab the ball, drop it in the desired bin, and have the video play. But for someone who likes to explore, the balls are fully interactable in way where the user can virtually play with them and even have them explore the room through the teleporting feature. After patient feedback, the main player camera can be changed by either altering the position of the camera in relation to the room, or by changing the scaling of whatever object that could be causing any sort of disorientation.

For the gaze menu, the purpose is for the less VR familiar patients to be able to access videos without struggling. That can be done simply by following a green dot in the middle of their field of vision and use it as aim to hover over the button associated to the desired video. After patient feedback, the position of the camera can be changed in order to better represent the real-life situation in relation to the room and the best on which the user virtually finds themselves in.

Parts, functions and capabilities:

The project file is composed of multiple prefabs created by the group or supplied by free downloadable assets such as SteamVR. Prefabs used in this project were camera rigs, controller prefabs and teleporting prefabs [3].

Alongside the prefabs, the project file contains multiple scripts attached to different objects. [4] These scripts are what makes the project interactable and functional.

The prefabs are the representation of the user in the virtual world and therefore function just like a human being would if they ever found themselves in such a situation.

The scripts are the representations of the objects' physics, meaning how a ball acts under gravity and how tables (or other similar objects) react when touched by a person in real-life.

The product is capable of being a game for someone familiar with VR or can simply be educational for someone who just wants to learn about their procedure.

Installation for Controller Menu

The .exe file has preset scenes for the CT scan treatment, the Breast treatment and the Prostate treatment. But videos can be substituted, this is achieved by these following steps:

- Open the project file through unity
- Copy one of the video scenes (any scene)
- Delete the video from the copied file and add another video
- Drag the video file into the video player component object in the inspector in unity
- Change the scene name to match the video in the scene
- Copy/paste one of the scenes calling scripts called Breast.cs or Prostate.cs and replacing the scene name with the new scene name and renaming the script to match the new scene name
    - Go into the environment and click on the basket that should be associated with new video, and replace the existing script with the newly created script and add the calling method in the object part of the component
    - Or, create a new basket, add a mesh renderer, add the new script to it, and use the calling method in the object part of the component.
- Add name of new scene above basket

Installation for Gaze Menu

- Open Video manager in the hierarchy and increase the size of the number of elements to match how many videos is required
- Duplicate buttons to have exact number of buttons as element size

- Move buttons around to fit it however is desired
- Change scene name in calling method to call new scene

Health and Safety Guidelines

As a safety precaution, as for all VR reasons, make sure there is always enough room space in order to not run into objects and cause self-harm or harm to others. Make sure headset and controllers are secure to the user to make sure that they don't get detached and fall and break.

Troubleshooting

As with all programs, it may crash. In the case where it does, through unity, read the error messages in the bottom left of the unity window. Most errors are associated to the scripts, in that case, read the error message, and double click it to open the corresponding script and fix the error. In other cases, some errors may be caused by the objects in the environment, these errors can be solved by looking at the error messages, finding the corresponding object that is malfunctioning and fix whatever needs to be fixed or adjusted in order for the program to compile and run smoothly.

APPENDIX II: Design Files

The executable file of the project outlined in this report can be found under the name "Antonio VR Menu.exe" in the MakerRepo repository titled "LASZZ Ballz N Binz B20" [3]

For this project, the scripts used were supplied by the SteamVR asset through unity, but all others self-written scripts could not be uploaded through MakerRepo, so a github repository has been created for the purpose of making the scripts public for all to use. [4]