GNG2101

Design Project Progress Update

Group B 3.4

Submitted by:

Sam Spencer, 300297084

Kymani Watson, 300232330

Marc-Antoine Larouche, 300291297

James Roberts, 300290460

Sharif Hasan, 300327995

10/12/2023

University of Ottawa

Table of Contents

List of Figures

List of Tables

List of Acronyms and Glossary.

Table 1 - Acronyms

Acronym	Definition
ADHD	Attention-Deficit/Hyperactivity Disorder
OCD	Obsessive-Compulsive Disorder
MS	Multiple Sclerosis
UE5	Unreal Engine 5

Table 2 - Glossary

Term	Acronym	Definition

1 Introduction

Many people live their lives without ever thinking about how different and diverse life experiences can be. Many don't consider that a lot of people with physical or non-physical disabilities sometimes cannot do or experience the same experiences as them. Of course, this causes some empathy issues between people and might create barriers and hurdles in our societies. That is why it is important that there exist some way or method to get people to understand what others go through. Our client, is seeking an immersive experience tool (a VR experience) that would allow people to "get to be in another's shoes" and most importantly educate individuals about the difficulties and implicit biases that some people have to experience.

Obsessive-Compulsive Disorder (OCD) and Attention-Deficit/Hyperactivity Disorder (ADHD) are two often misunderstood and ignored mental health conditions. People experiencing these mental issues go through relentless intrusive thoughts, rituals, and impulsivity. Unfortunately, as a society we often might fail to empathize fully with these individuals and their challenges. To foster a more inclusive, supportive, and compassionate society it is crucial to help and offer support through empathy and other means. To take part in this, our team decided to make our project about these issues.

This document serves the purpose of tracking our progress in this project through the formats of project deliverables conveying our journey and achievements with all the necessary information.

2 Business Model Canvas and DFX

2.1 Business model and sustainability report

Value Proposition:

We help companies, schools, and organizations to educate their members on the implicit bias of physical disabilities by providing an immersive experience from the perspective of people with physical disabilities. We provide all the required equipment and technologies needed and require very little to no existing infrastructure from the client's side.

Business Model Canvas

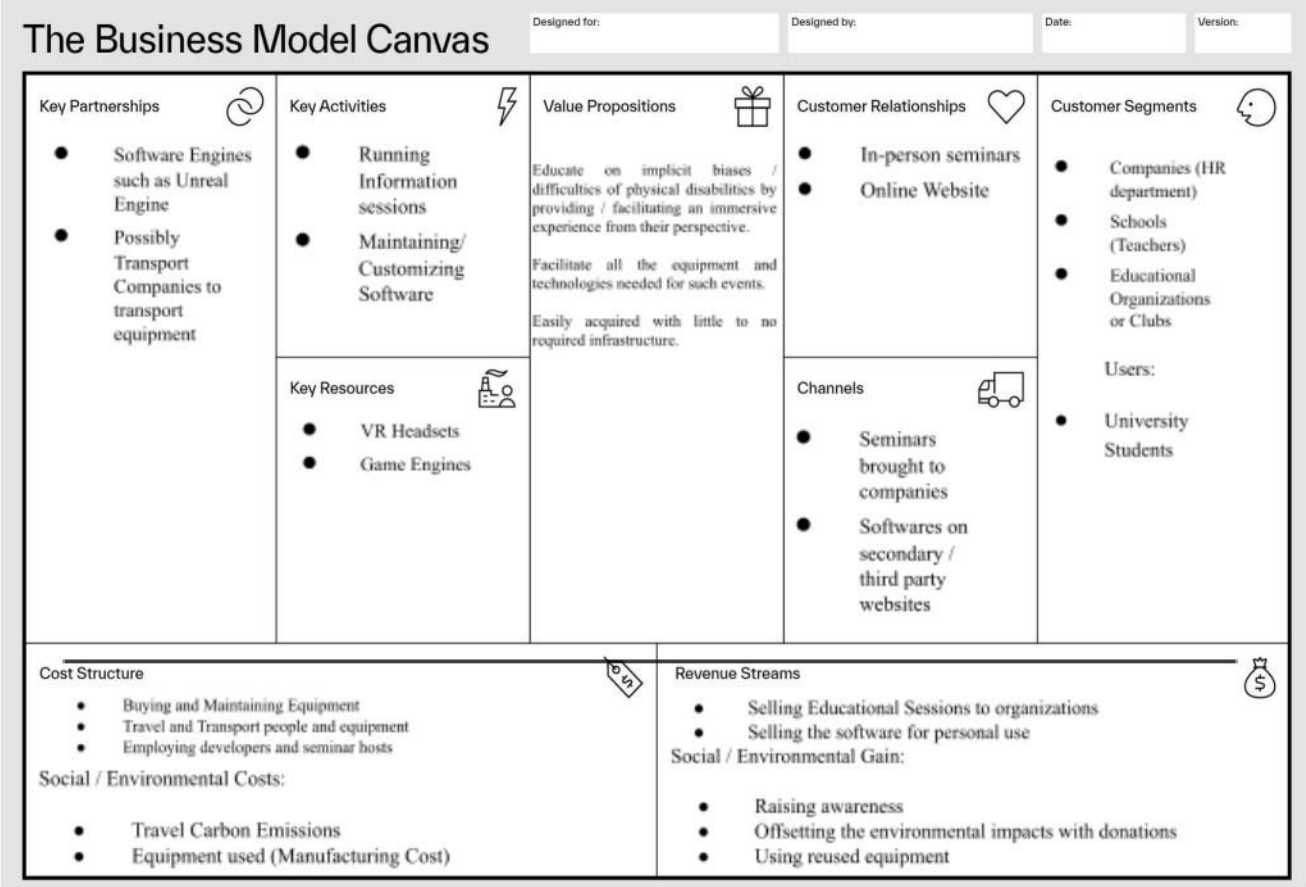


*Figure **1** Business Model Canvas*

Assumptions and Feasibility:

We've assumed that we'd be approached by or that we would approach clients that would / might want to hire us to perform informative seminars for them. Also, that we would be at a point where we would be able to easily and effectively transported our equipment and be provided a

location to work with by the clients. Another assumption was that we would be able to secure certain partnerships (i.e., some transportation agencies, and some software engine companies). Lastly, we would be able to get our hands on a supplier of reused equipment for environmental purposes.

We'd like to believe that all of this would be fairly feasible especially with the increase of awareness of the importance of such services and products in companies and educational bodies. Moreover, we would not be tied back with any physical products' restraints as our core services are purely software.

Sustainability Report:

Raising awareness for equality is one of our major, positive, social impacts as our product is designed to give an immersive experience from other people's points of view. However, we might run the risk of generalizing people's experiences in a negative way.

Our business will refurbish used headsets to help offset the economic and environmental impact of the manufacturing of these products. Since our business includes travelling to organizations, this will count and contribute to carbon emissions. Travelling and transportation of equipment will account for a considerable piece of our company's expenditure which would be a negative financial impact.

2.2 Design for X

Usability – Ensuring Usability means that users can easily traverse / interact with the experience, leading to better user engagement. This would also allow us to cover a bigger range of users by being more inclusive. All this would help us in our goal of fostering empathy between people.

User Experience – Focusing on User Experience allows us build experiences that emotionally connect / resonate with people deeply, which is a must when wanting to impact people and make them feel empathy. This would also ensure a long-lasting impact from the VR experience gained from the insights offered.

Quality – Quality ensures that the experience is reliable and operates properly and consistently. From a business standpoint, this would help the organizations reputation and raise its credibility.

Simplicity – Designing a simple experience would lessen any cognitive demands on the user, therefore making the experience more accessible and user friendly. This would also help maintain clear communication and conveying of our desired message of empathy by eliminating any distractions.

Portability – Designing for Portability entails having a wider user reach and being able to access the experience from a variety of devices or platforms. This would make it more convenient and allow us to spread empathy to a lot of more people.

Note: *ChatGPT was used here to help generate bullet point justification ideas for each DFX, that is all it was used for.*
Prompt: *"My team and I are creating an immersive VR experience tool where people get to experience and empathize with people who have physical or mental disabilities, and we've decided choosing 5 DFXs (Design for Xs). But we need to justify choosing these DFXs, so could you give us some bullet points of justification for choosing design for Usability, User Experience, Simplicity, Quality, Portability?"*

3 Problem Definition, Concept Development, and Project Plan

3.1 Problem Definition

User Needs:

Table 3 - User Needs Identification

#	NEED	Importance Low = 1 High = 5
1	The experience is brief enough to retain information.	3
2	The experience conveys the message of empathy to the user (The experience sparks empathy in the user).	5
3	The experience runs smoothly.	3
4	The experience represents real people's struggles accurately.	4
5	The experience is easy to use by anyone.	3
6	The experience is fully developed / storyboarded.	5
7	The experience is interactive.	2
8	The experience should appeal to students.	2

Problem Statement:

Our client wants to create an immersive virtual experience for university students and alike that helps them empathize and understand the difficulties of people that suffer from OCD. That will be by getting them to experience some of the OCD symptoms through a constructed storyline.

Metrics and Units:

Table 4 – Metrics and Units based on User Needs

Metric #	Need #	Metric	Imp	Units
1	1	Simulation Length	3	s
2	2	Amount of people that respond with empathy	5	%
3	3	The frames per second performance optimization	3	FPS (Frames per second
4	4	Accuracy to real experiences	4	%
5	5	Amount of people able to use the experience with little to no instruction	3	%
6	6	Coherence and quality of story	4	Scale (1-5)
7	7	Number of interactive events	2	#
8	8	Theme appropriate to students	2	Scale (1-5)

Benchmarking:

Table 5 – Benchmarking Previous Attempts

Metric #	Metric	Units	InMind	Language Barriers	Schizophrenic experience
1	Simulation Length	s	3:27	1:40	2:39
2	Amount of people that respond with empathy	%	75%	65%	85%
3	The frames per second performance optimization	FPS (Frames per second)	>30	30	<30
4	Accuracy to real experiences	Scale (1-5)	3	3	5
5	Amount of people able to use the experience with little to no instruction	%	80%	90%	80%
6	Coherence and quality of story	Scale (1-5)	5	2	3
7	Number of interactive events	#	~4	0 (Just next button)	~5
8	Theme appropriate to students	Scale (1-5)	3	5	4

Specifications:

Table 6 - Specifications of Metrics

Metric #	Metric	Units	Marginal Values	Ideal Value

1	Simulation Length	s	<5:00	3:00
2	Amount of people that respond with empathy	%	>75%	100%
3	The frames per second performance optimization	FPS (Frames per second)	>30	>60
Metric #	**Metric**	**Units**	**Marginal Values**	**Ideal Value**
4	Accuracy to real experiences	Scale (1-5)	>4	5
5	Amount of people able to use the experience with little to no instruction	%	80%	100%
6	Coherence and quality of story	Scale (1-5)	>3	5
7	Number of interactive events	#	>3	>5*
8	Theme appropriate to students	Scale (1-5)	>3	5

3.2 Concept Development

Themes:

1) **Sam Spencer's Concept:**

MS:

Common symptoms experienced by patients with MS, such as tremors, arm numbness, and double vision, can be effectively highlighted. In the context of the VR experience, it is crucial to incorporate a straightforward motor task accessible to all users. I propose a scenario where an individual is tasked with setting a table. Initially, they demonstrate the task with normal control, not only to instruct users but also to emphasize its simplicity. Subsequently, the individual attempts the same task with trembling hands, struggling to place objects. In the following phase, one of their hand's experiences numbness, compounding the challenge of shaking hands. Finally, they face the additional obstacle of double vision while setting the last table. To illustrate the progressive difficulty, the various table-setting attempts can be compared. Throughout this experience, an accompanying audio narrator can describe the emerging symptoms. Conclusively, it can be noted that while treatments and adaptation strategies exist for MS, many individuals must confront and manage these ongoing challenges.

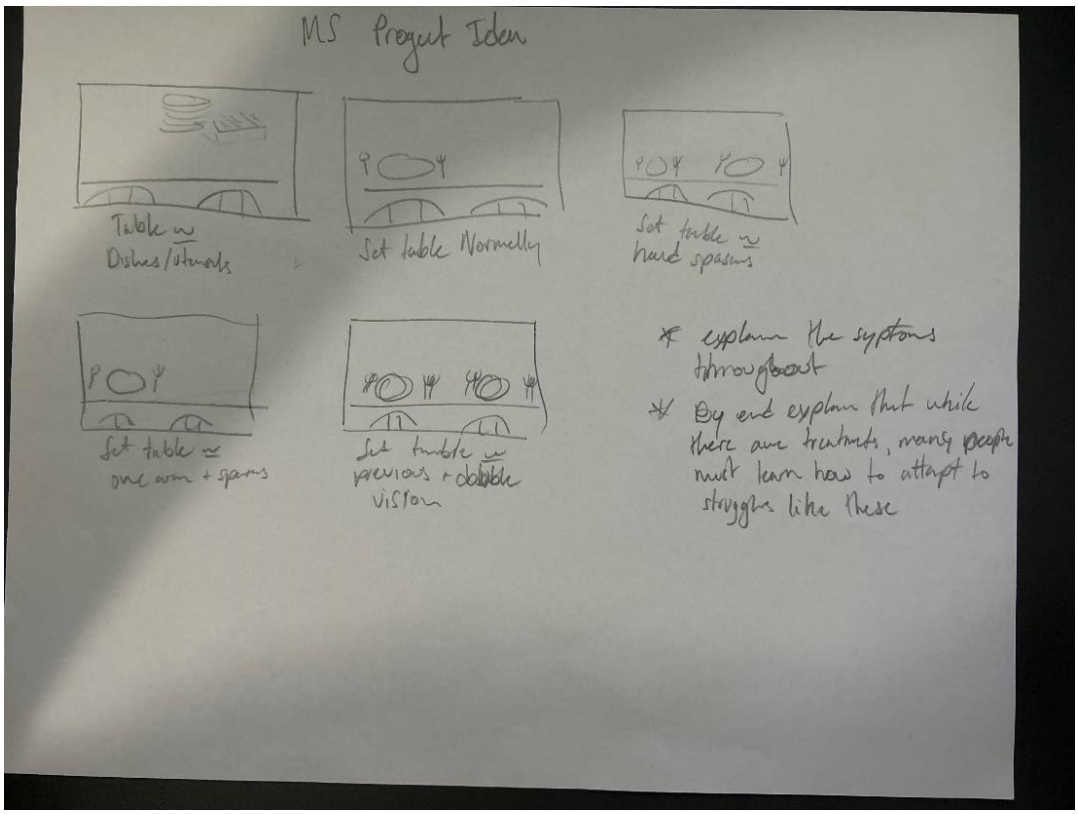


Figure 2 - MS Concept Sketch

2) Sharif Hasan's Concept:

Sensory Overload

Two possible situations.

- **Situation 1**: Meeting friends at a busy mall.

A person suffering from sensory overload reunites with their friends within a bustling shopping mall. They would navigate a series of specific "events", including maneuvering through dense crowds, engaging with store employees, and placing food orders, all while contending with an overwhelming sensory stimulus, such as loud noises, bright lights, and feelings of claustrophobia, among other stressors.

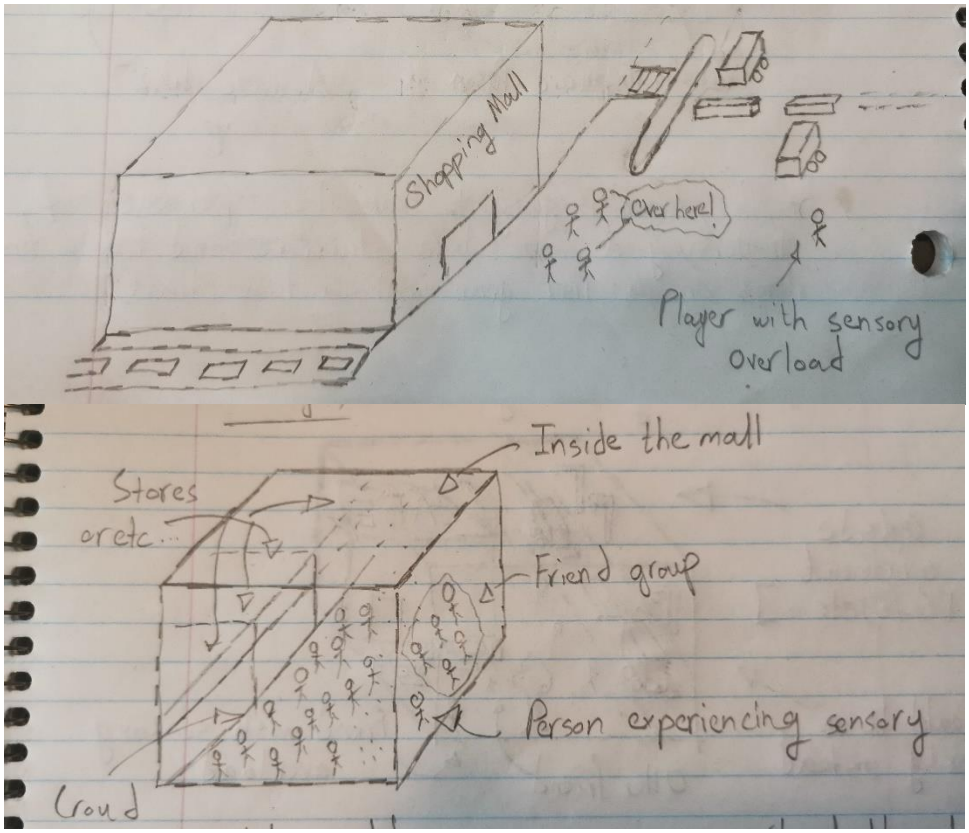


Figure 3 - Sensory Overload Concept 1 Sketch

- We could convey sensory overload in the form of flashing lights, high pitch sounds, heavy breathing, zooning out, etc.
- Would be “story + events” driven and not like a “game” experience.
- In each of these “events”, we could create mini-interactive parts where you get to experience the effects mentioned above.
- This would need to be implemented in 3D, and could be optimized by creating mini-enviroments instead of full ones.

- **Situation 2**: Meeting a friend at an “outside” busy environment.

A person is going to meet their friend at an "outdoor" setting, like a café, and engaging in a conversation amidst a wave of sensory stimuli, including bright lights, bustling crowds, and various sounds. The conversational element can incorporate interactivity, such as pop quizzes inserted during the discussion about the ongoing topics. These quizzes may require participants to respond with essential comments chosen from a provided list of options, with one correct answer being the key to progress.

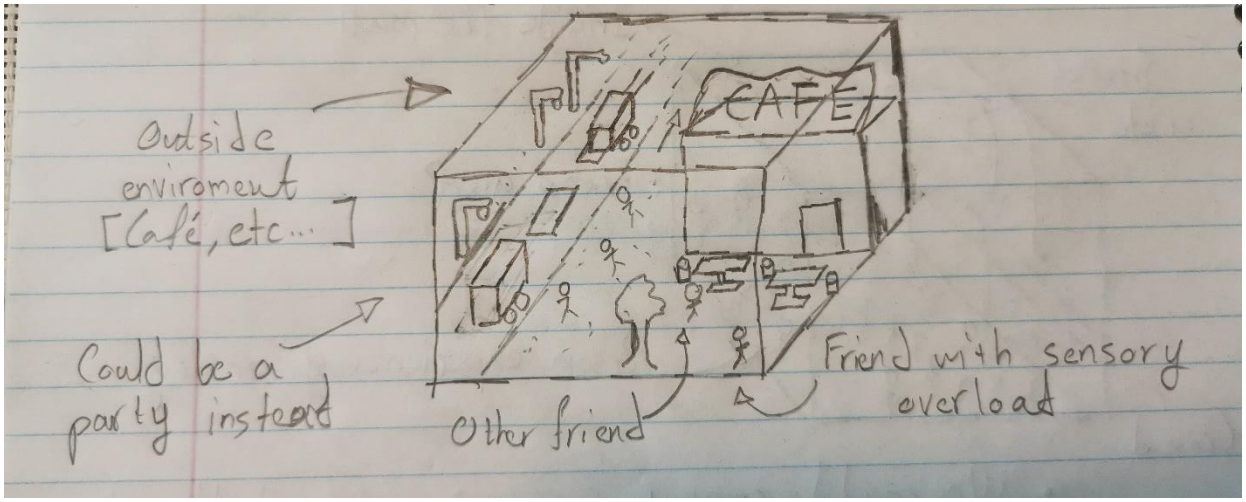


Figure 4 - Sensory Overload Concept 2 Sketch

- While trying to hold a conversation [which could be of significance], the user experiences the same mentioned effects [Sound, Lights, zooning out, etc.].
- Would be a mostly linear "story" experience.
- This would be implemented in 3D.
- We could add a quiz at the end about what went on in the conversation.

3) Kymani Watson's Concept:

OCD

Seated at a school desk, the primary objective involves a central task with additional, increasingly challenging subtasks. The user is required to maintain focus on the ongoing lecture while simultaneously managing these miniature challenges. Examples of other situations could include setting a dinner table, where the utensils keep becoming misaligned, or washing hands, during which the user perceives imaginary germs and feels forced to wash for an extended duration.

4) Marc-Antoine Larouche's Concept:

ADHD

Maintaining concentration during a classroom lecture involves self-regulation and active efforts to stop fidgeting while keeping hyperactivity in check through controlled breathing. Sometimes, they have to resort to ask the teacher for clarification or to repeat themselves multiple times, even if it might lead to moments of embarrassment. Similarly, tackling a list of household

chores requires consistent focus to avoid drifting off to other tasks. At bedtime, the nightly they have to actively ignoring distractions to ensure a restful night's sleep.

5) James Roberts' Concept:

Wheelchair

After being discharged from the hospital following leg surgery, the user is unable to walk and relies on a wheelchair. Arriving home, they encounter a challenge as the entrance to their house has steps, having them to maneuver to the back door for access. The situation becomes even more complex when they realize the fact that they are missing a lot of groceries and necessaries, prompting a trip to the store. Their mobility limitations prevent them from reaching an item they need, and they have to make a choice: either ask a passing customer for assistance, risking potential belittlement or rudeness, or just skip the item altogether. The challenges persist during the journey back home when they board a crowded public transit bus, with people occupying the designated wheelchair area.

Analysis and Target Specifications:

Table 7 - Analyzing Design Concepts and Target Specifications

Metric #	Metric	Units	Theme 1	Theme 2	Theme 3	Theme 4	Theme 5
1	Simulation Length	s	N/A	N/A	N/A	N/A	N/A
2	Amount of people that respond with empathy	%	70%	70%	85%	70%	80%
3	The frames per second performance optimization	FPS (Frames per second)	N/A	N/A	N/A	N/A	N/A
4	Accuracy to real experiences	Scale (1-5)	4	3	5	5	4
5	Amount of people able to use the experience with little to no instruction	%	90%	75%	80%	80%	85%
6	Coherence and quality of story	Scale (1-5)	2	4	4	4	3

Metric #	Metric	Units	Theme 1	Theme 2	Theme 3	Theme 4	Theme 5
7	Number of interactive events	#	7	5	5	2	5
8	Theme appropriate to students	Scale (1-5)	3	4	5	5	4

Analysis Overview:

To note, simulation length and FPS were left as N/A as they both can be adjusted to any scenario later, so they are not a great metric for comparing concepts. For metrics 2 and 5, they were all put in a scale of 1-20 on what we thought was reasonable and for them to all add up to a 100. For metrics 4, 6, and 8, the team came to a consensus to use the provided scale. For metric 7, the team analysed the scenario and came up with a number estimate based on how many events we could have in that particular scenario.

Comparison [Scale is 1-5, 5 being highest]:

Table 8 - Comparing Design Concepts against Metrics

Metric #	Metric	Weight	Theme 1	Theme 2	Theme 3	Theme 4	Theme 5
1	Simulation Length	0.125	3	3	3	3	3
2	Amount of people that respond with empathy	0.2	3	3	4	3	4
3	The frames per second performance optimization	0.125	3	3	3	3	3
4	Accuracy to real experiences	0.15	3	2	4	4	3
5	Amount of people able to use the experience with little to no instruction	0.125	3	1	2	2	2

Metric #	Metric	Weight	Theme 1	Theme 2	Theme 3	Theme 4	Theme 5
6	Coherence and quality of story	0.15	3	5	5	5	4
7	Number of interactive events	0.0625	3	2	2	1	2
8	Theme appropriate to students	0.0625	3	4	5	5	4
Total			3	2.9	3.5875	3.325	3.225

Global Design Concepts:

Following a team discussion, we have decided to incorporate two ideas as well as including another.

The OCD theme seems like a great idea that can potentially resonate with people very well and can is suitable for a VR implementation. This will be combined with the simple interactions and narrative of “setting the table” idea from the MS theme. This could include setting the table, completing a small task, returning to set another part of the table, washing hands, and ensuring that the table is set straight and perfectly. We believe that this concept can be conveyed clearly and quickly in VR as well as offering a great story to foster empathy in the user.

The second chosen idea would be the ADHD theme relatively unchanged. It would have someone in the classroom trying to complete tasks however the user would have their vison or hearing unfocused so that they don’t “pay attention” to certain tasks. The experience would be to try and focus while also possibly being mistreated for not being able to. This story would have a great impact, but also have less interactions since it is more story-based.

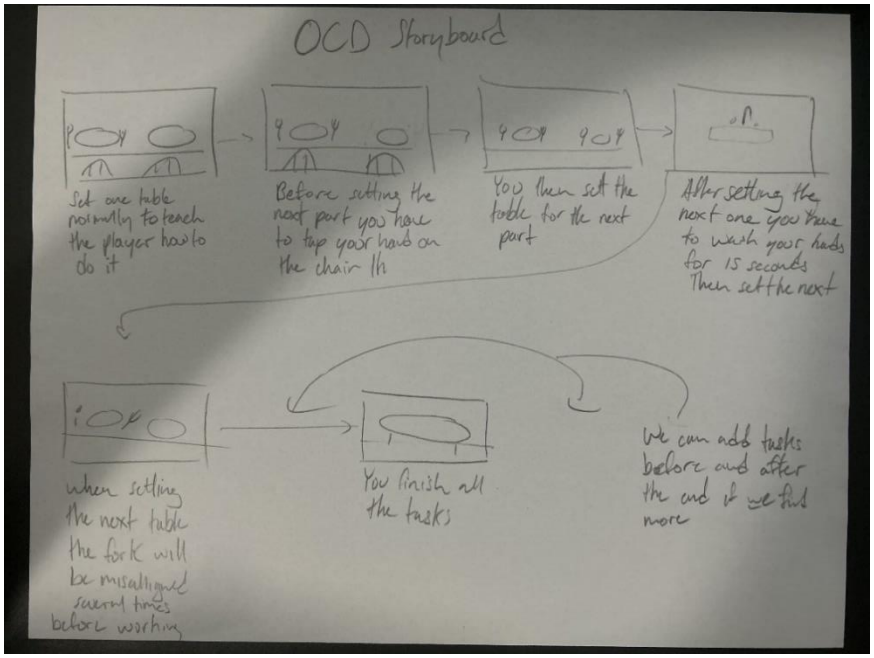


Figure 5 - OCD Global Concept Storyboard

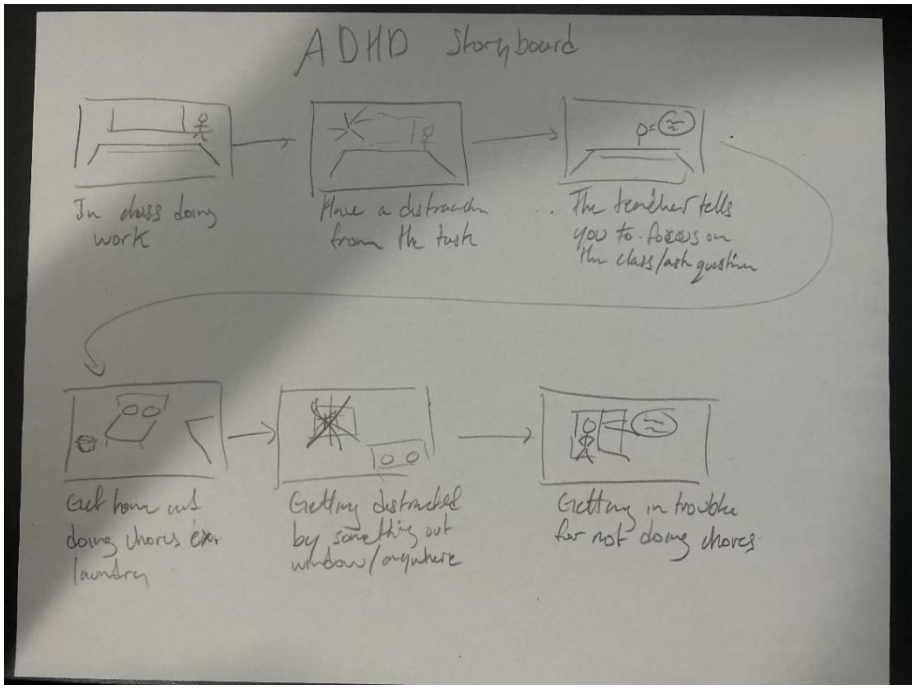


Figure 6 - ADHD Global Concept Storyboard

The topic of OCD and the scenarios that we have associated to it present us with some benefits and drawbacks. One great benefit would be related to the development portion of things. Since the scenarios take place in only one setting, that would mean more effort can go into the setting and story that the user will be immersed in. Another benefit of having a single scene is that the user can become more familiar with it during the playthrough, without having to switch to other scenes, which will make it less likely that the user gets stuck at a certain step or has to refamiliarize themselves with another scene within the experience, saving them time and effort. However, there is one main downside with this theme. It is that there will be a lower number of interactions/events that the user gets to experience compared to some other proposed ideas.

The topic of ADHD also presents some benefits and drawbacks. The main benefit lies in the relatability ("trueness") of the scenarios as they all closely mirror the experiences of university students. Another benefit is that the scenarios offer high interactivity as the user will need to control aspects of the character, they are playing such as having to pay attention in class and much more. However, there is a clear drawback to this idea, and that is it being very hard to attach a clear/easy story to it. Therefore, it may come across as less immersive which is a huge playing factor when conveying empathy.

3.3 Project Plan

https://www.wrike.com/frontend/ganttchart/index.html?snapshotId=95GjxxdTxHSJhIzVweJMpekZq5mHYgl9%7CIE2DSNZVHA2DELSTGIYA

4 Detailed Design and BOM

4.1 Detailed design

Client Feedback:

Presenting our two themes and early concepts (OCD & ADHD) for the client, she expressed that she did like both of them without choosing one over the other. She also made sure to comment on how important the storyline and storyboarding is for her. Our initial storyboarding did catch her attention, but she insisted on investing most of our time on creating a story with "gory details" since "the devil is in the details". Of course, she did make it clear not to simply ignore the technical side of things, how like in movies, the story captivates, and the technology helps.

Taking all the feedback from the client meeting into consideration, we decided to invest more time in the storyboarding aspect and update/improve on it, as well as making our initial technical breakdown of this project. We've decided to analyze how our Flow Chart of the diagram would be, including the story, equipment, and the resources part of it as well. On top of that, we've also decided to create an early/initial flow chart of our user interface.

Updated and Detailed Design:

- **Flow Chart Diagram**

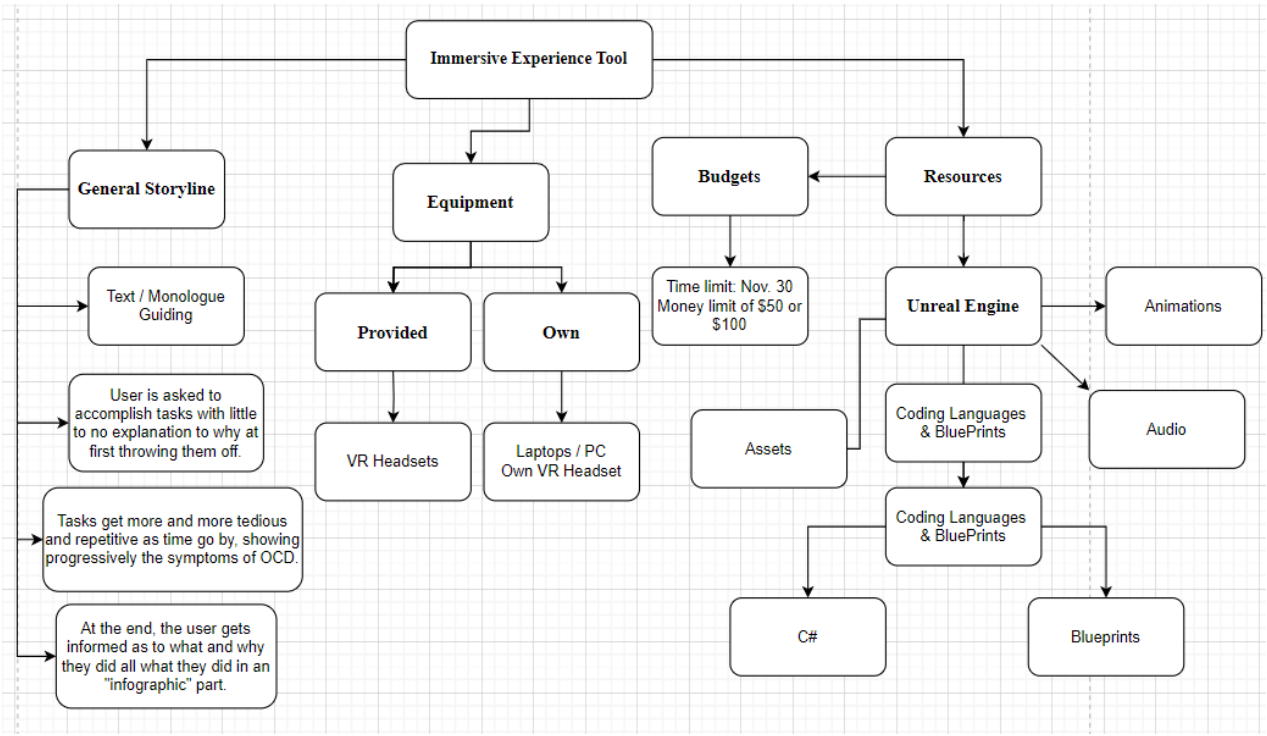


Figure 7 - Flow Chart Diagram

- **User Interface Diagram**

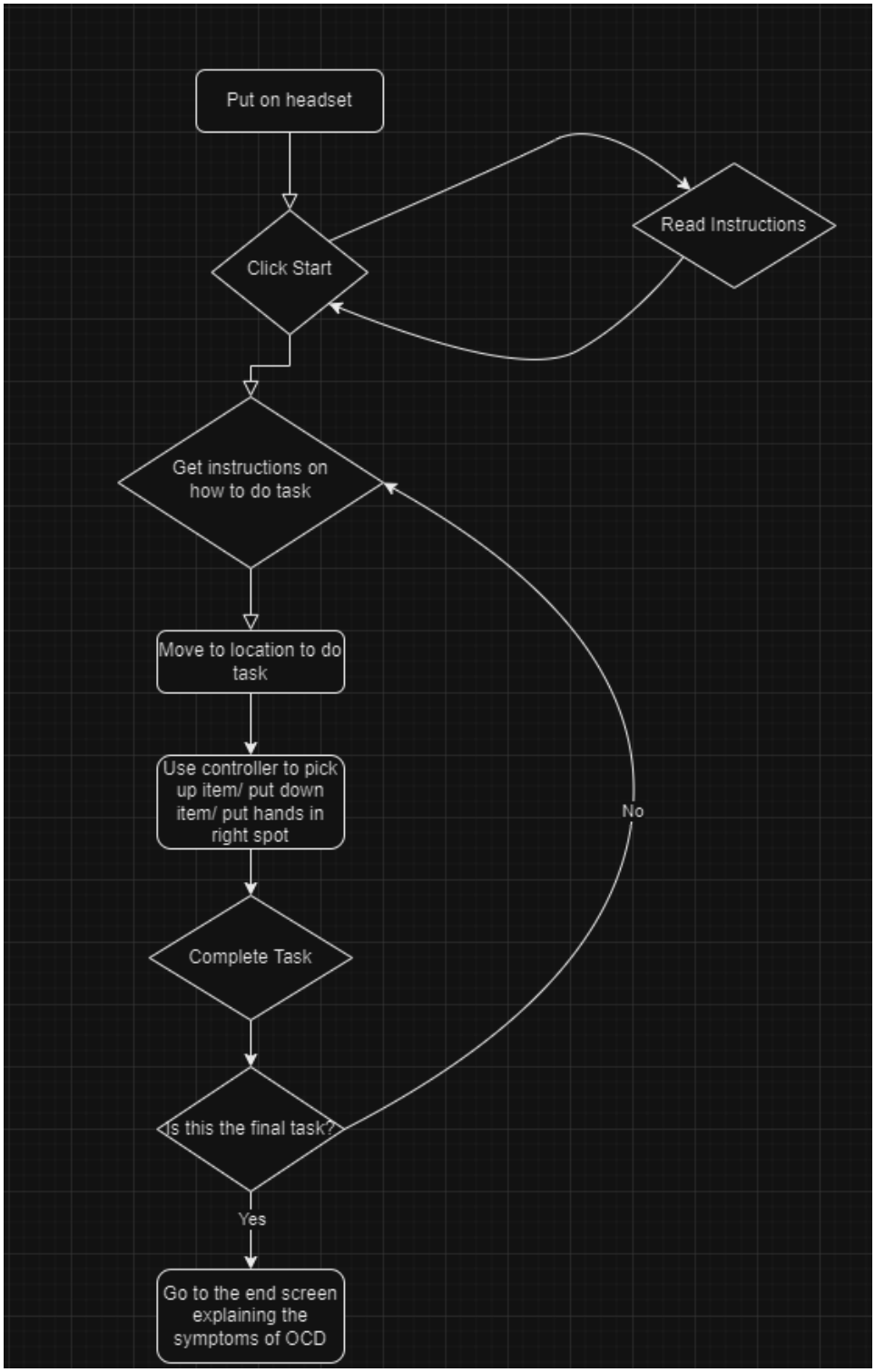


Figure 8 - User Interface Diagram

- **Storyboard Reference:**

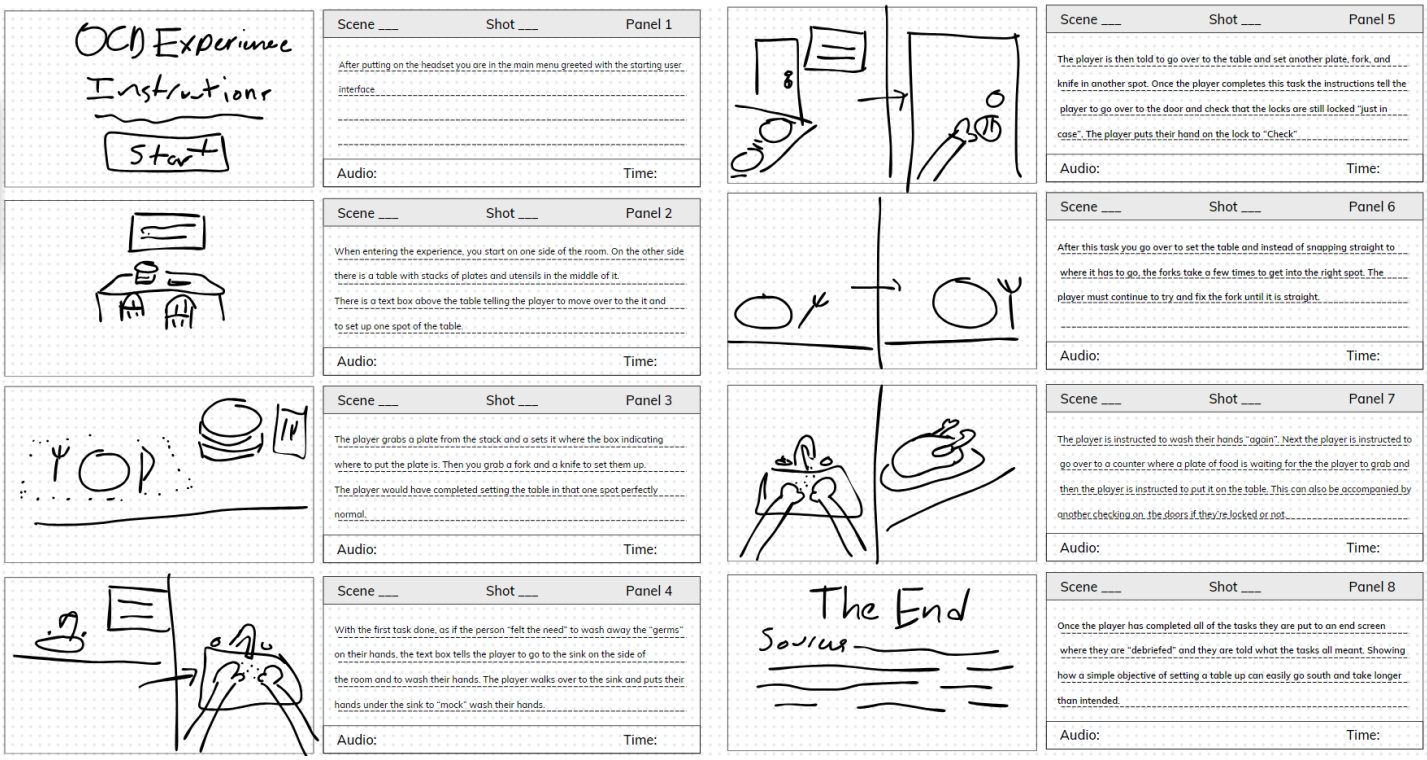


Figure 9 - Storyboard Diagram

Skills and Resources:

When it comes to skills that are needed or will come in useful when creating the product, an important one would be proficiency in VR development using tools like Unreal Engine 5. At the moment the team is not well versed at using those tools; however, there are many free resources and tutorials available online that can be followed to help understand how to use such software and its features. Other resources that we will be using and have access to include free 3D assets, free audio clips and possibly some other open-source tools.

Moving to non-technical skills, time management and tasks allocation would very much come in handy when working with team projects. Seeing the scale of this project, team members will have to time manage to the best of their ability, which includes what we are currently following by using management tools like Wrike. Tasks would have to be given to the team member best versed in what they entail, while outside help from other members would always be encouraged.

Time Assessment:

We believe that there should be enough time to get this project complete by the assigned date for Design Day given we follow our structured plan exactly. Having our product be fully software would greatly help in saving time avoiding physical "difficulties" (prototyping and such). Also, having a huge library of developed code, tutorials, and examples available freely online should save us time in that regards too.

Next week's deliverable (PD E) is about Prototype 1, which will include a running experience with features such as moving, grabbing, picking, and placing objects. Next, we will create the rough "play" area to start in, with the room and table, chairs, and all items we need, which should be done by the deliverable after that. After that would be getting the "gameplay features", such as: the "level" progression through completing tasks, adding the tasks themselves and the text boxes and more. At this point, we will also have had some tasks members to fully develop and write the story and dialog and have people record voice overs. Then we bring all this together by putting the text and voiceover in the correct "spots". Finally, we add the title and end screens and any other last addition tasks before Design Day. With each task we should have enough time allocated between the group members, and we all have agreed to make the most effort to complete the assigned tasks.

Critical Product Assumptions:

For our VR experience, we are assuming whoever is going to run it is going to have the minimum requirements of hardware specifications to run both the experience and the headset itself (Oculus Quest 2). The minimum requirements being:

- **CPU**: Intel i5-4590 / AMD Ryzen 5 1500X or greater
- **RAM**: 8 GB+
- **VIDEO CARD**: NVIDIA GeForce GTX 970 / AMD Radeon 400 Series or better
- **DEDICATED VIDEO RAM**: 3 GB
- **PIXEL SHADER**: 5.1
- **VERTEX SHADER**: 5.1
- **OS**: Windows 10

Note: These requirements are the official minimum requirements to run an Oculus Quest 2 Headset.

When it comes to the development aspect of the project, we are assuming that all of our needed assets are available in the Unreal Engine 5 Asset Store (Audio, Textures, Blueprints, etc.). We are also assuming that all the needed tutorials / help manuals for any aspect of the project related to Unreal Engine 5 are provided. Moving to the user aspect, we are assuming that the average user will be able to follow all the instructions, interact with their surroundings and finish the whole experience in under 5 minutes.

4.2 Preliminary BOM

Table 9 – Preliminary Bill of Materials for the Development of the Project

Item	Description	Source	Cost
Unreal Engine 5 (UE5)	Game engine	https://www.unrealengine.com/en-US	$0
VR Headset	VR headset to run	University	$0
GitHub	Software Version Control	https://github.com/	$0
Assets			
Plates	Plates for the player to stack	UE5 Quixel Bridge	$0
Forks	Forks for the player to organize	UE5 Quixel Bridge	$0
Table	Table where the player interacts	UE5 Quixel Bridge	$0
Chairs	Chairs to put around the table	UE5 Quixel Bridge	$0
Sink	Where the player will wash their hands	UE5 Quixel Bridge	$0
Door	Where the player will check the lock	UE5 Quixel Bridge	$0
Misc.	Any other random decorations	UE5 Quixel Bridge	$0

Note: This BOM will constantly be updated as the project keeps developing.

4.3 Project plan update

https://www.wrike.com/frontend/ganttchart/index.html?snapshotId=zggsTm33EJcgwn1uTLEfotQy5rYz497Q%7CIE2DSNZVHA2DELSTGIYA

5 Prototype 1, Project Progress Presentation, Peer Feedback and Team Dynamics

5.1 Prototype 1

Prototype Test Plan

For prototype 1, our team decided to make an initial, low fidelity, focused concept VR experience to test the feasibility and how well some of our main functionalities and mechanics perform. We'll be testing this by creating the concept experience on Unreal Engine 5 and running the experience on an Oculus Quest 2 VR Headset. We'll measure and record all the needed specifications, and we'll know if we need to refine and adapt our design if needed from the results of our testing. We've decided to host all of our files on GitHub for ease of use and access.

When it comes to the storyline aspect of this project, we also refined our storyboard with the feedback gained from the In-Class Review and include it as a part of our prototype 1. This way we can measure some of our non-technical specification by estimating how well they perform under our defined metrics. Unfortunately, due to the time constraints we had, we won't be able to test those metrics with a bigger sample population. That will be considered part of prototype 2.

Implementing functionality

- Basic Functionalities:

Mechanics like motion, picking and dropping items are built in most development tools including Unreal Engine 5. What our team did was make sure that how these already functioned fits with what we needed for our project.

- A Barbone Progression Tracking System:

Our design includes a lot of progressive tasks that need to be tracked. Therefore, our team experimented with a barebones progression tracking system, so that we could improve on it in the next prototypes. This can be seen in the testing demonstration provided, where the game recognized the movement of the plate and it being placed in the right spot, counting it as progression.

- Text Boxes:

The user guidance is going to be mainly through text boxes. That means that our team had to figure out how to handle working with them. In the prototype demonstration, it is shown that we can display text using them and connect them to our preliminary progression tracking system making them dynamic.

- Preliminary Textures and Graphics:

We decided to add some basic and preliminary textures and models to base our concept on. These can be easily replaced and upgraded in the coming prototypes.

Pictures and Recordings

- Basic Functionalities Testing Demo:

https://youtu.be/glGD8cjd-ck?si=4JYzXn-ckizM6yX6&t=1

- Basic Interior Design:

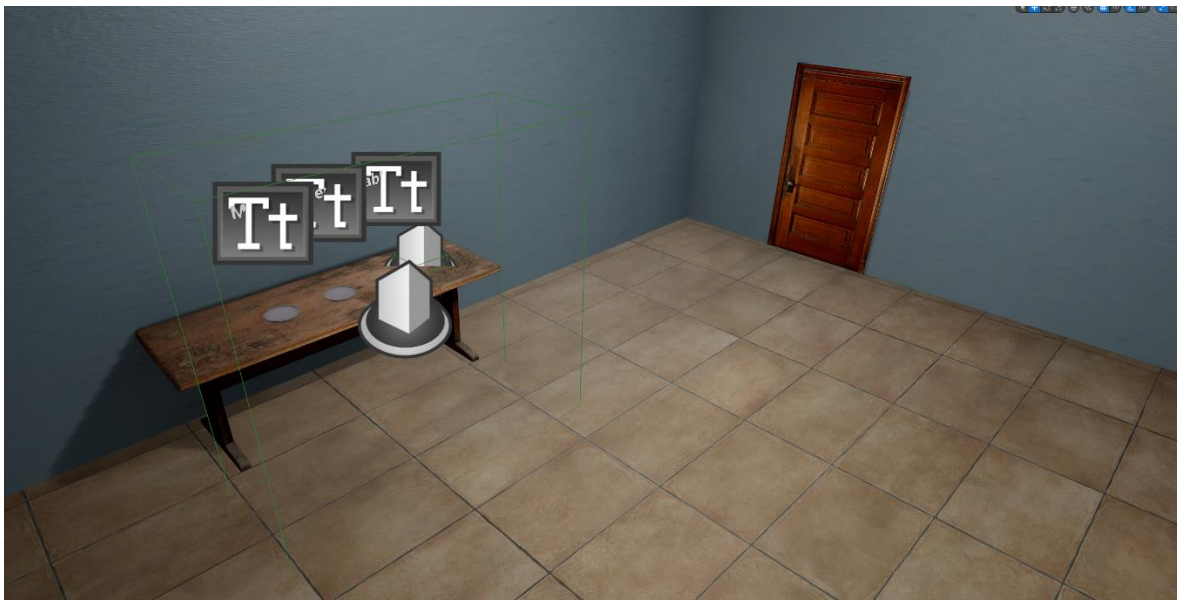


Figure 10 - Basic Interior Design 1

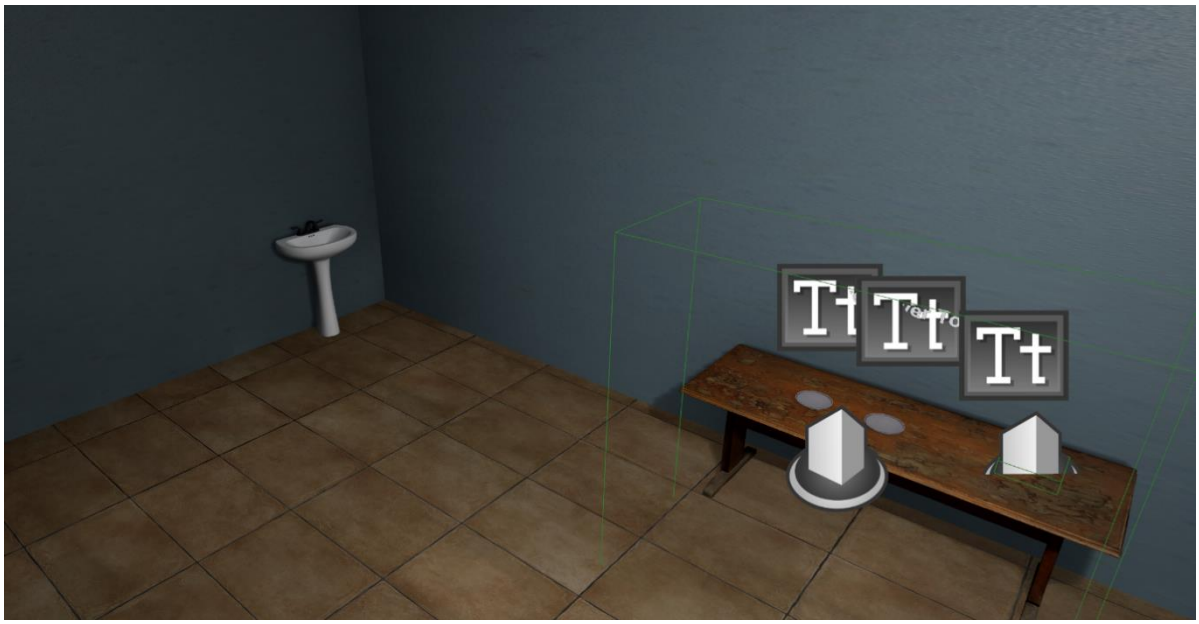


***Figure 11** - Basic Interior Design 2*

Refined Storyboard

We've refined the storyboard with the feedback given in the In-Class Review.

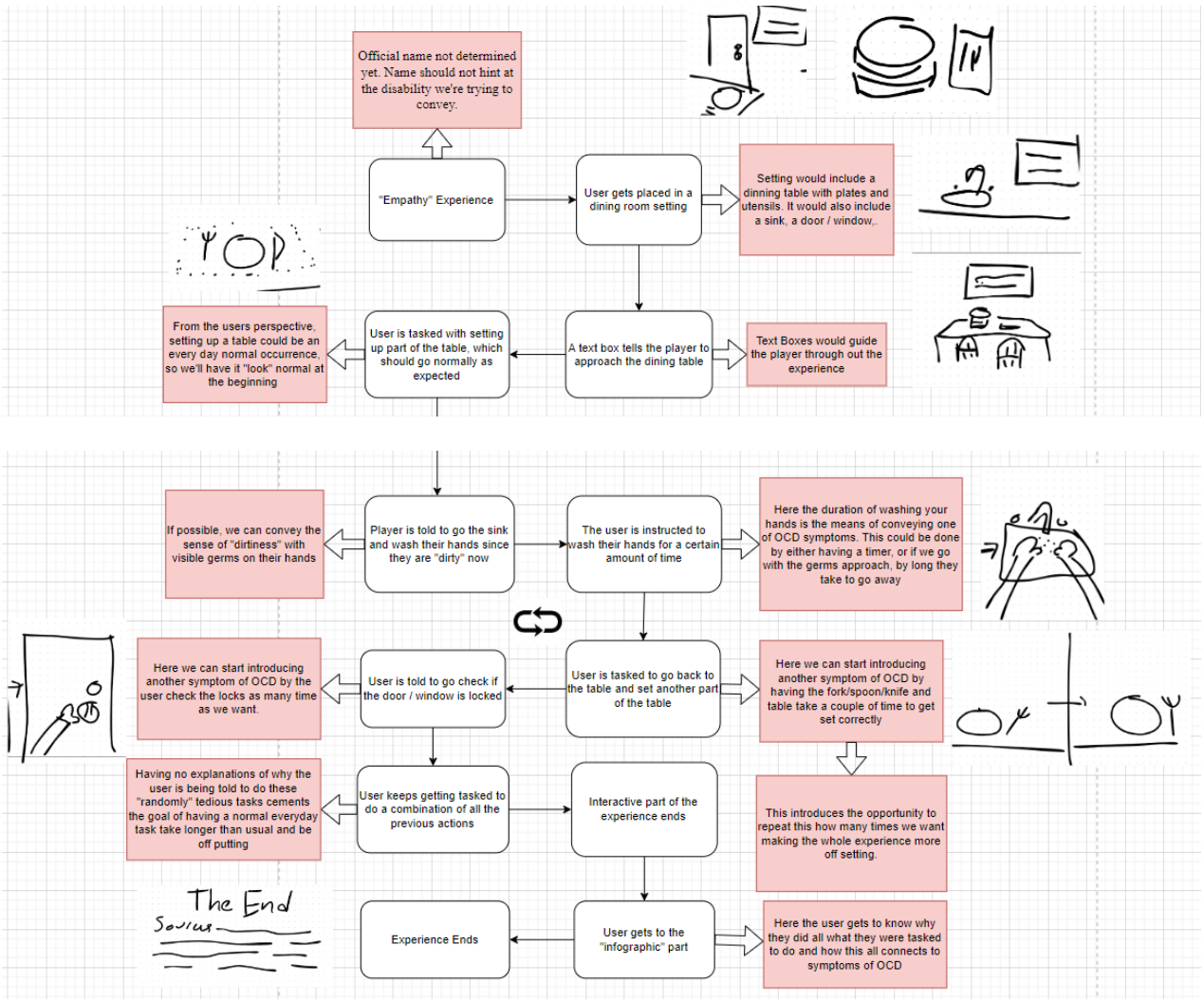


Figure 12 *- Refined Storyboard Diagram*

Testing, Analysis, and Performance Evaluation

The prototype and refined storyboard will be tested against our chosen target specifications to ensure that we meet the minimum requirements of our design. Note that since this prototype focuses more on functionality implementation, therefore some of the target specifications can not be tested yet. Therefore, we included additional target specifications and functionality table with what could be tested.

Table 10 - Benchmarking Prototype 1 against Target Specifications

Metric #	Metric	Units	Marginal Values	Ideal Value	Prototype 1 Values
1	Simulation Length	s	<5:00	3:00	N/A
2	Amount of people that respond with empathy	%	>75%	100%	N/A
3	The frames per second performance optimization	FPS (Frames per second)	>30	>60	60
4	Accuracy to real experiencesA	Scale (1-5)	>4	5	4
5	Amount of people able to use the experience with little to no instruction	%	80%	100%	N/A
6	Coherence and quality of story	Scale (1-5)	>3	5	4
7	Number of interactive events	#	>3	>5	5
8	Theme appropriate to students	Scale (1-5)	>3	5	4

Table 11 - Benchmarking Prototype 1 against Newly Added Target Specifications

Metric #	Metric	Units	Marginal Values	Ideal Value	Prototype 1 Values
1	Effectiveness of Basic Functionalities	Scale (1-5)	>4	5	5
2	Effectiveness of Progression Tracking System	Scale (1-5)	>=3	5	3

Metric #	Metric	Units	Marginal Values	Ideal Value	Prototype 1 Values
3	Effectiveness of Text Boxes	Scale (1-5)	>=4	5	4
4	Effectiveness of Preliminary Textures and Models	Scale (1-5)	>=3	5	3

Assumption Veifications

Working on this first prototype allowed the team to verify some critical assumptions that were made during the development of the detailed design.

Running the initial prototype experience on a device with the specifications mentioned below gave us a satisfactory result for our required “Frames Per Second”.
Device Specifications:

- **CPU**: Intel i9-10900K
- **RAM**: 32 GB
- **VIDEO CARD**: NVIDIA GeForce RTX 3060
- **DEDICATED VIDEO RAM**: 12 GB
- **OS**: Windows 10 Pro

Note: These specifications meet or are higher than the minimum requirements

We were also able to confirm the fact that all the assets, graphics, and blueprints are available from within Unreal Engine 5. Which would also include all the needed tutorials and examples.

5.2 Project Progress Presentation

ImmersiveExperienceTool_ProjectProgress_B3.4.pptx

5.3 Project plan update

https://www.wrike.com/frontend/ganttchart/index.html?snapshotId=UsBO5jRZwyjBEcLfJU6eMJYGcFaHJDOR%7CIE2DSNZVHA2DELSTGIYA

6 Design Constraints and Prototype 2

6.1 Design Constraints

Non-Functional Design Constraints:

Ease of use is the first non-functional constraint, meaning specifically how easy it is to progress in the experience. This is important as if it were difficult to progress, playthrough speeds would be inconsistent between users, leading to possible failure to meet specifications. In this scenario, the progression difficulties would stem from possible bugs and the tasks given to the user within the experience.

A second non-functional design constraint that plays an important role in the development of our project is the accuracy of the condition we have chosen, such as OCD. This condition is talked about a lot these days, and we have found plenty of research to describe this condition. However, we have not been able to find an individual with OCD who we could interview and experience our virtual experience for us to obtain feedback. This constraint limits us to the accuracy of our experience and affects our ability to give real experience.

Satisfying the Constrains

A change that would help satisfy the ease-of-use constraint is open playtesting of experience at every stage of completion. With many people testing, playthroughs could be examined to find any common, and/or critical bugs, as well as difficulties that the users may have with any of the tasks. This would bring to light areas of the experience where changes need to be made.

The changes that we will make to satisfy our accuracy of this condition is by finding an individual with OCD. They will then be able to criticize and improve our experience. If we are not able to do this the alternative will be doing more research and listening to interviews and to people talk about living OCD. This will allow us to add details to our design and improve the accuracy of our message.

Analysis and Proof

For the ease-of-use constraint, the number of bugs found could be represented as an equation. For example, the chance to find a bug while in the experience is 1% (0.01) the number of bugs found would be represented by the equation (0.01)(x) where x is the number of run-throughs. The number of bugs found scales with the number of playtests therefore more bugs will be found. As for the difficulty of the tasks, feedback on the difficulty from all the playthrough tests would give us insight on what to and what to not change.

The proof of the effectiveness of these solutions will be determined by feedback from users. We will ask people with and without OCD about the accuracy, quality of the story and theme. To compare feedback from prototype 1 and measure our progression.

Modified Detailed Design:

- Main Ideas / Message:

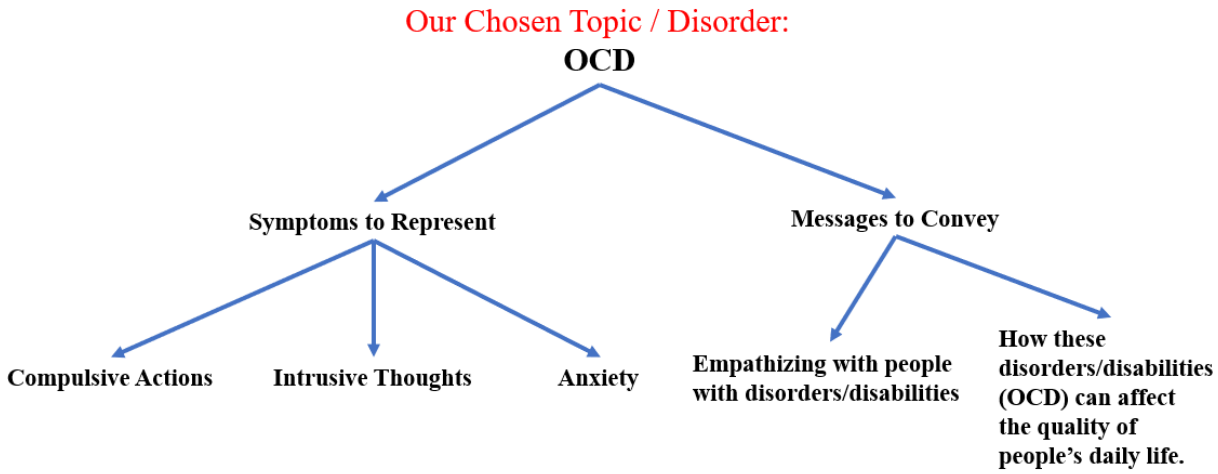
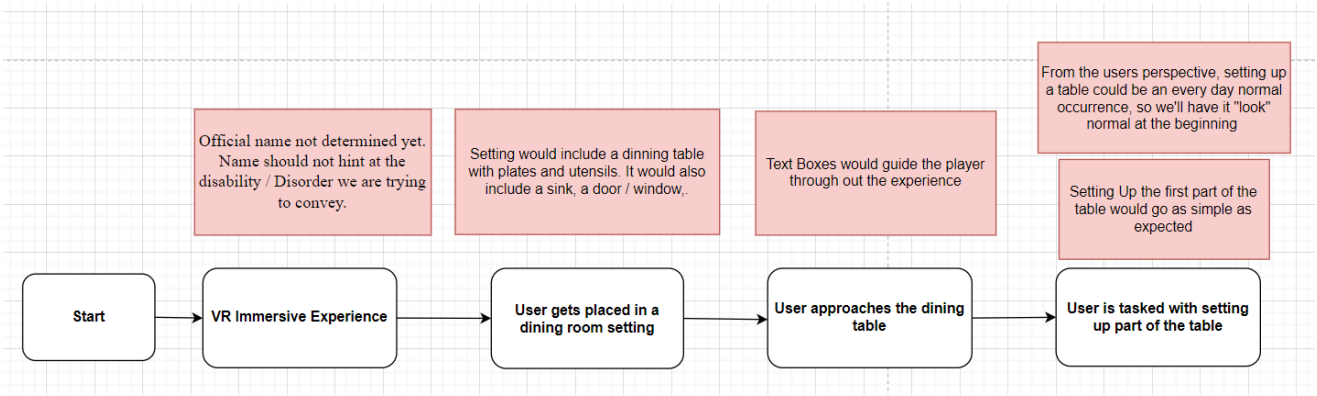


Figure 13 *- Main Ideas / Message*

- Experience Storyboard / Flow Chart:



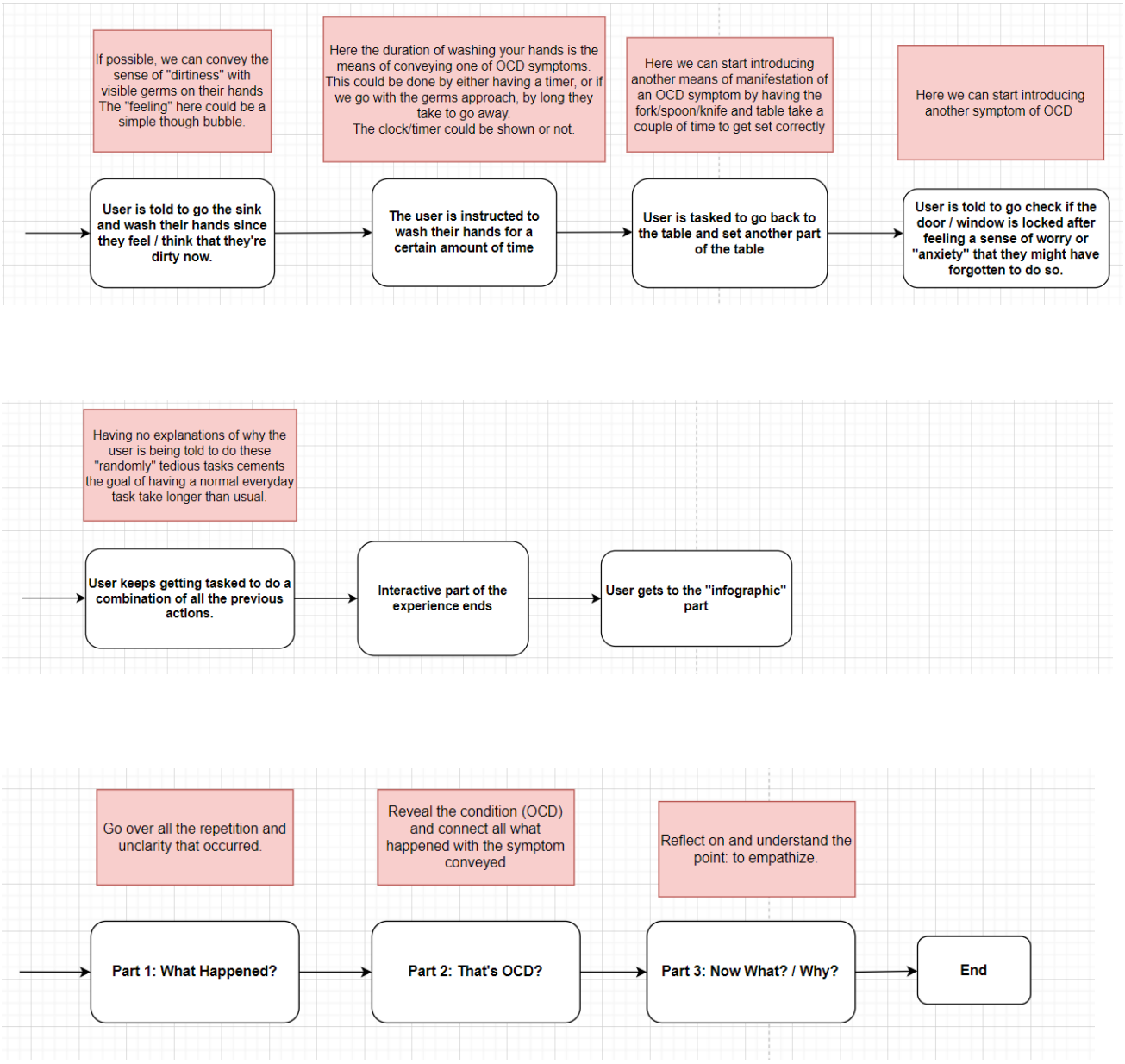


Figure 14 - Newly Modified Experience Storyboard

- General Flow Chart:

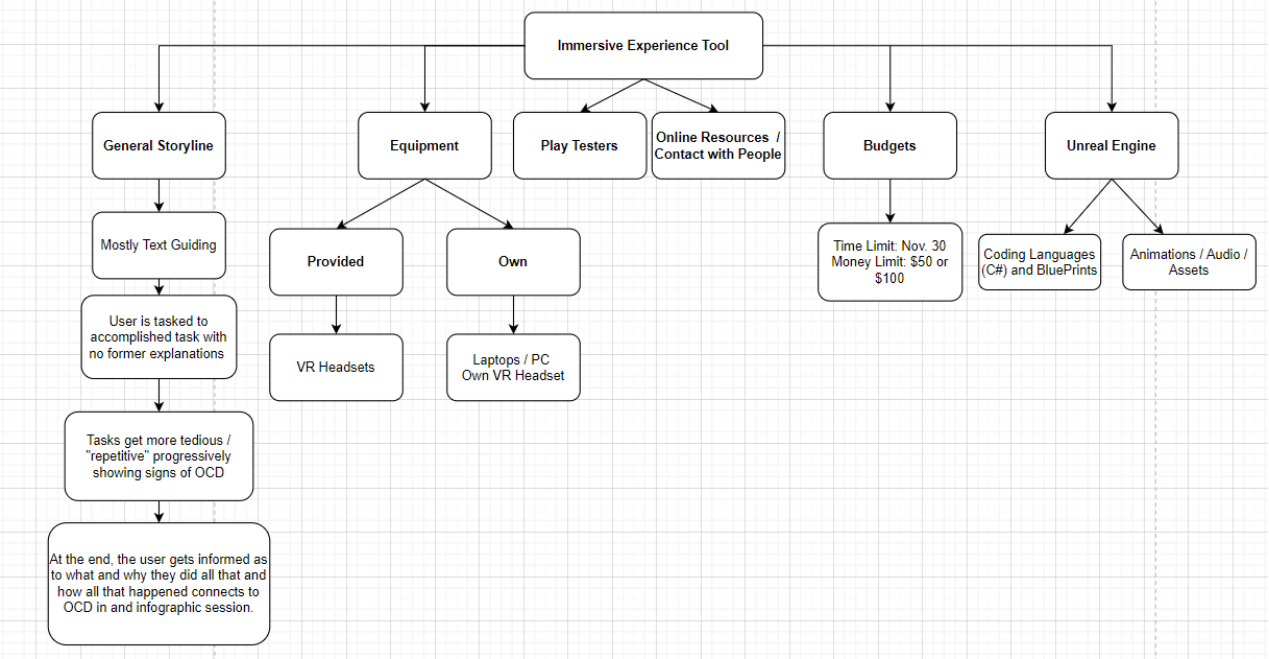


Figure 15 - Newly Modified General Flow Chart

6.2 Prototype 2

Testing Results:

Using a slightly updated version of our first prototype, we have been able to test our product in it's initial stage by having some participants try the experience and tell us their what they thought of our story and how we decided to convey it so far. The detailed breakdown of the results is shown in the graph below. As a summary, we can conclude from the results that 71% of the participants thought the accuracy of representation is at least accurate [4 on the scale], and 71% of the participants thought that the topic importance for students was at least important [4 on the scale].

- 17 Participants, one of whom is diagnosed with OCD, were presented with our storyboard, and asked to rate it on a scale of 1 – 5 on the following criteria:

1) With your current knowledge about OCD, how accurate do you feel this representation is?
[1- Completely Inaccurate, 2 - Somewhat Inaccurate, 3 - Somewhat accurate, 4 - Accurate, 5- Completely Accurate.]

2) The experience of being a person with OCD is important to address in the population of university students?
[1- Completely Important, 2 - Somewhat Important, 3 - Somewhat Important, 4 - Important, 5- Completely Important.]

- For Accuracy of Representation, the following results were obtained:

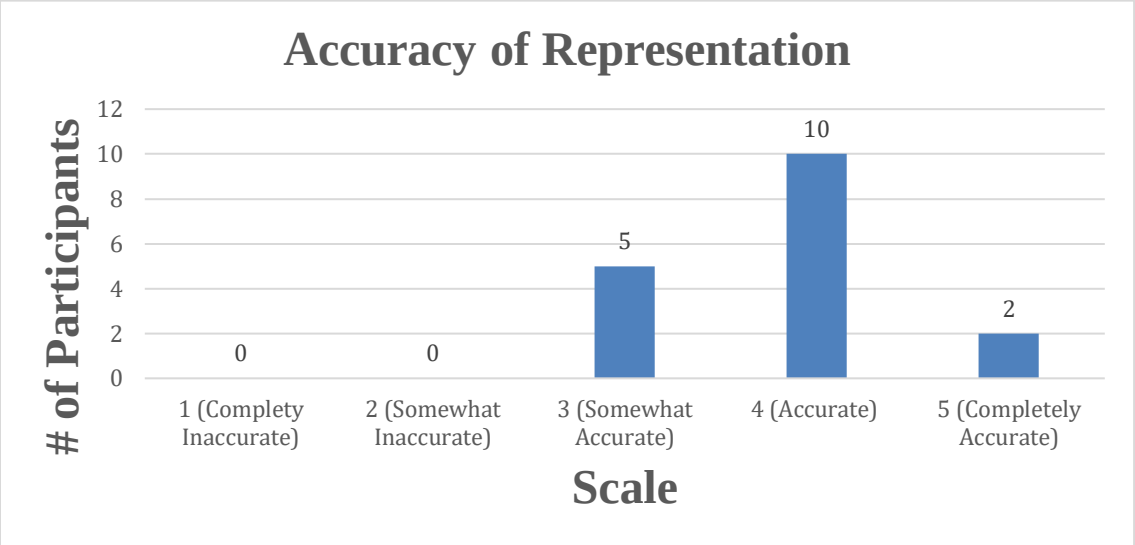


Figure 16 - Accuracy of Representation Bar Chart

We can see that 29% of participants expressed that the accuracy of representation is "Somewhat Accurate", while 59% of participants expressed that it was "Accurate" and the rest (12%) of the participants expressed that it was "Completely Accurate". Making it such that 71% of participants expressed that the accuracy of representation was at least accurate.

- For Theme / Topic Importance for Students:

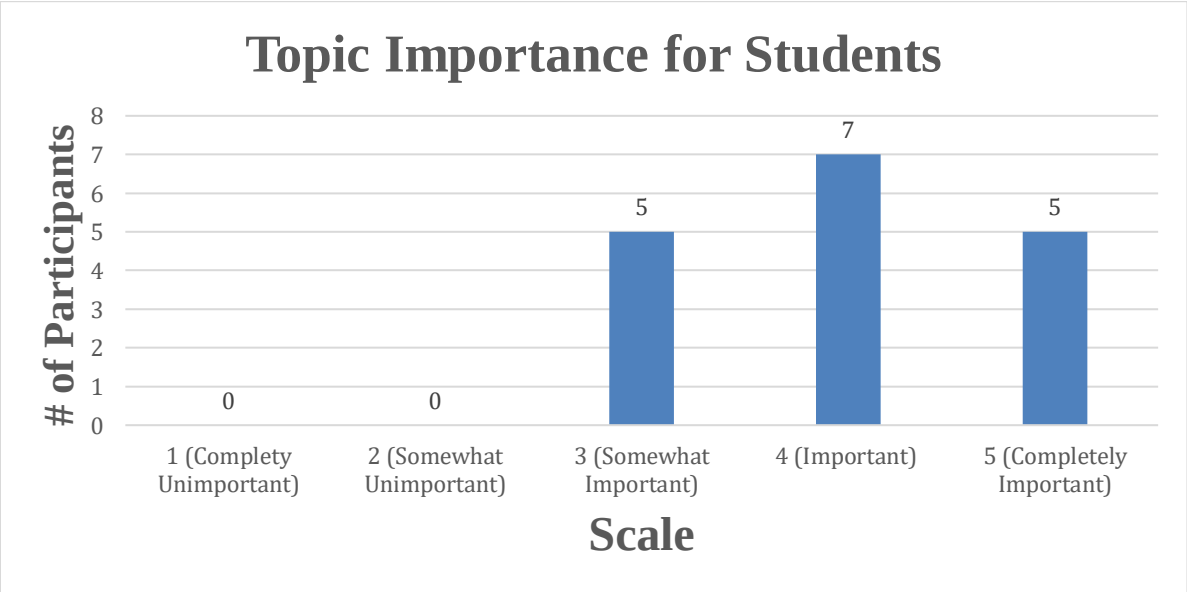


Figure 17 - Topic Importance for Students Bar Chart

We can see that 29% of participants expressed that the topic importance for students is "Somewhat important", while 41% of participants expressed that it was "Important" and the rest (30%) of the participants expressed that it was "Completely Important". Making it such that 71% of participants expressed that the topic importance for students was at least important.

Critical Product Assumption:

We think the most critical product assumption for us would be what the client made sure to emphasize on, that being that our experience conveys the correct message of empathy that we intended. We are still in the process of validating this assumption by conducting research and having the opinions of different people on this subject and our product. Our team is currently still developing our infographic section, which would be the main empathy part of this experience.

For the meantime, our validations regarding the technical aspects and assumptions of the project are conducted through the VR development section.

Second Prototype:

- VR Development:

In this prototype, our team decided to focus on expanding our functionalities and implementing and connecting all features together to construct our experience foundation. This would make it easier to expand on or change any environments, textures, and tasks for future prototypes.

2.1 Expanding on the Progress Tracking System:

The second prototype includes a more robust tracking system in which the game engine knows when and where objects are placed. It also can detect when certain tasks are completed such as how long the user washes their hands, and when they place their hand on the door to check the locks.

2.2 Connecting all Basic Functionalities:

The simulation tracks what tasks the user has done, and in turn knows when to move on to the next step in the story. This allows the engine to change text boxes and move through the experience once each task is completed.

2.3 Added a Pre-Liminary Starting Area and an Ending Area:

The experience now has a distinct starting and ending areas, which includes a set of controls and instructional text.

- Prototype Demo Video and Pictures:

Demo: https://youtu.be/7WZjMVZFaz0?si=6oSuetZbutEY4q_5

Pictures:

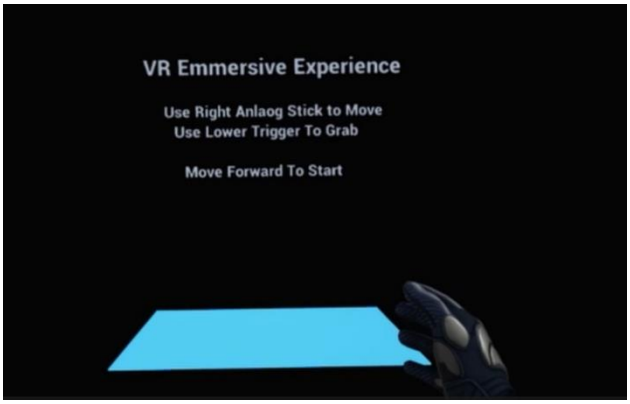


Figure 18 - Preliminary Starting Area

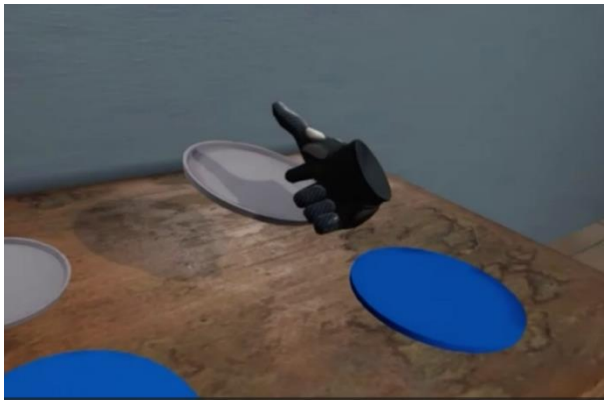
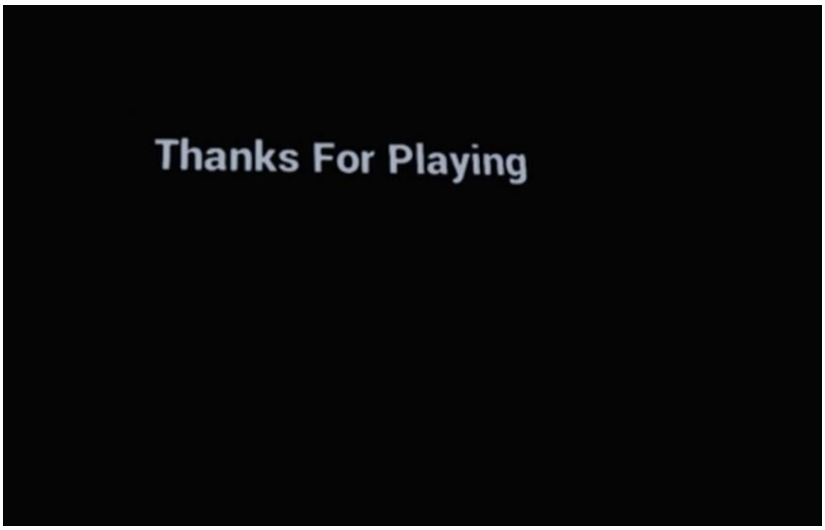


Figure 19 - Handling Plates

Figure 20 - Washing Hands

Figure 21 - Checking Door



22 - Preliminary Ending Area

- Story Development:

For this prototype, we have decided to start developing the infographic part of the experience, where the player get's to clearly know what they just went through and how all what they did connects to real people's experiences and the OCD symptom. Shown below is an initial breakdown and a pre-liminary script for this section.

Initial Breakdown:

- **Part 1:** What Happened?

In this part, we go over what occurred during all the tasks and especially highlight all the repetition and unclarity that happened, which is the main focus of our experience.
Visuals (Text, Pictures): Pictures of mentioned task with any necessary text comments.
Audio (Narration, Audio Cues): Narration starts with explaining the meaning behind some of the tasks the user was instructed to complete.

- **Part 2:** That's OCD!

In this part, we reveal the condition that was being conveyed and connect all that happened and how the symptoms might manifest through the various means shown during the experience.
Visuals (Text, Pictures): Infographics related to OCD (statistics, pictures, etc.).
Audio (Narration, Audio Cues): Narrator talks about how the tasks relate to some of the known attributes that come with OCD.

➢ Part 3: Now What? / Why?

In this part, the user gets to reflect on and understand the whole point of this experience, and that would the importance of empathizing with people who suffer from the different disabilities all people in general.
Visuals (Text, Pictures): Questions to help reflect on the experience and related emotional figures.
Audio (Narration, Audio Cues): Narrator gives a few questions that will help the user reflect on what they have experienced.

Prototype Testing:

The prototype and story development are tested against our chosen target specifications to ensure that we meet the minimum requirements of our design. Note that some of the target specifications can not be tested yet. Therefore, we included additional target specifications and functionality table with what could be tested.

- VR Development & Story Development:

Table 12 - Benchmarking Prototype 2 against Target Specifications

Metric #	Metric	Units	Marginal Values	Ideal Value	Prototype 2 Values
1	Simulation Length	s	<5:00	3:00	N/A
2	Amount of people that respond with empathy	%	>75%	100%	N/A
3	The frames per second performance optimization	FPS (Frames per second)	>30	>60	60
4	Accuracy to real experiences	Scale (1-5)	>=4	5	4
5	Amount of people able to use the experience with little to no instruction	%	80%	100%	N/A

Metric #	Metric	Units	Marginal Values	Ideal Value	Prototype 2 Values
6	Coherence and quality of story	Scale (1-5)	>=4	5	N/A
7	Number of interactive events	#	>=3	>5	3
8	Theme appropriate to students	Scale (1-5)	>=3	5	4

Table 13 - Benchmarking Prototype 2 against Newly Added Target Specifications

Metric #	Metric	Units	Marginal Values	Ideal Value	Prototype 2 Values
1	Effectiveness of Expanded Progression System	Scale (1-5)	>4	5	4
2	Effectiveness of Connected Functionalities	Scale (1-5)	>=3	5	4
3	Effectiveness of Starting and Ending Areas	Scale (1-5)	>=4	5	2

Upcoming Client Meeting:

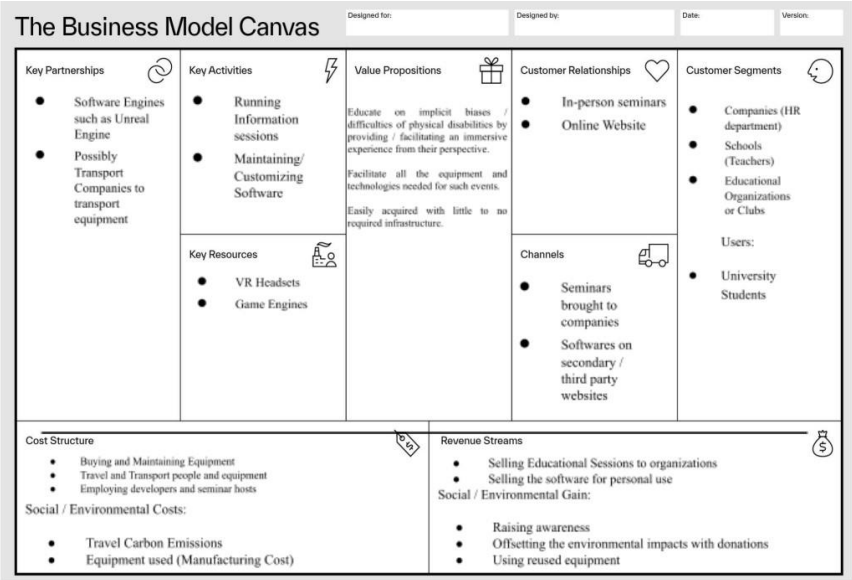
During the upcoming client meeting (client meeting 3), our team will present all new progress which includes a demonstration of our second prototype, our testing results of this prototype and lastly our newly realized infographic section. We would like to gather the client's opinion and thoughts on our infographic section and any criticism / comments on our product progress so far.

6.3 Project plan update

https://www.wrike.com/frontend/ganttchart/index.html?snapshotId=717Ycpe6uWe2XkouY09c5eQasD04Kke0%7CIE2DSNZVHA2DELSTGIYA

7 Other Considerations

7.1 Economics report



Based on our chosen Business Model Canvas, our source of economic factors include Key Partnerships, Key Resources and Activities, Cost Structure, Revenue Streams, and Channels.

The costs associated with our business include:

- Personal Computers (Hardware and Accessories), VR Headsets (Headset and Accessories), Working Stations (Office furniture and Accessories)
- Development Costs: Software, Assets, Presentation Materials, Website.
- Rent / Owning Downpayment, Utilities and Electricity, Salaries, Travel Deals, Transportation, Marketing, Staff Training, Insurance.
- Maintenance Costs: Software, Headsets,
- Overhead Costs.

These Costs can be classified in different ways:

- Cost Classification in terms of Material/Labor/Expense, Direct/Indirect, Variable/Fixed:

Table 14 - Costs Classifications

	Material	**Labor**	**Expenses**
Direct	Presentation Materials, Software Subscription		Staff Training, Transportation

	Material	Labor	Expenses
Indirect	Assets	Salaries	Electricity, Rent Downpayment, Insurance, Hardware Maintenance, Overhead Costs
Fixed	Software Subscription		Electricity, Marketing, Rent / Owning Downpayment, Hardware Maintenance, Overhead Costs
Variable	Assets, Presentation Materials	Salaries	Staff Training, Transportation

- Some Costs can be classified in terms of One-Time and Reoccurring Payments:

One-time costs: VR headsets, Presentation materials (computers, wires) furniture and tech for office

Reoccurring costs: Salaries, Rent, Utilities for office, travel expenses of persons and materials (cost of goods sold), advertising,

- One-time costs

Table 15 - One-time Costs

Development Stations and Server	$15,000
VR headsets	10 x $500 = $5,000
Furniture (small office)	$5,000
Presentation Materials	$10,000?

- Annual costs

Table 16 - Annual Costs

Rent	$25,000
Utilities	$6,000
Maintenance	$12,000
Developer Salaries	3 x $50,000 =$150,000
Advertising	$10,000
Overhead	$20,000
Software Subscription	$2,400
Transportation	Location Dependant

Income statement:

A *3-Year* income statement can be issued by stating all the following information:

- Gross Profit:
  - Unit Price: $10,000 + transportation fees
  - Units Sold Per Year: Year one (development): 0, Year Two: 35, Year Three: 40
  - Cost of goods sold: Transportation fees

    $\rightarrow Gross\ Profit\ of\ 3\ Years =$ $10,000 x 75 = $750,000 - Transport

- Annual Operating Expenses:
  - Marketing: $ 5,000
  - Subscriptions: $2,400
  - Travel and Transportation Expenses: Variable
  - Insurance: $5000
  - Utilities: $5000
  - Salaries: 3 employees x $50,000 = $150,000
  - Overhead: $20,000
  - Rent: $25,000
  - Maintenance: $12,000

$$Operating\ Expenses\ Over\ 3\ Years = 3\ \times\ \$224{,}400\ +\ Transport\ +\ \$45{,}000$$

$$= 718{,}200\ +\ Transport\quad Operating\ Income\ Over\ 3\ Years$$

$$= (\$750{,}000\ -\ Transport\ )-\ (\$718{,}200\ +\ Transport) = \$31{,}800$$

NPV Analysis and the Break Even Point:

$$NPV: C = \frac{R}{(1+i)^t}$$

- NPV for the expenses:

$$NPV_{exp} = \$45{,}000 + \frac{\$224{,}400}{(1+0.02)^1} + \frac{\$224{,}400}{(1+0.02)^2} + \frac{\$224{,}400}{(1+0.02)^3} = \$692{,}143$$

- NPV for the income:

$$NPV_{inc} = \frac{\$0}{(1+0.02)^1} + \frac{\$350{,}000}{(1+0.02)^2} + \frac{\$400{,}000}{(1+0.02)^3} = \$713{,}338$$

- Net NPV:

$$NPV_{inc} - NPV_{exp} = \$713338 - \$692143 = \$21195$$

- Break Even Point:

$$Break\ Even\ Point = \frac{NPV_{exp}}{Unit\ \mathrm{Pr}\,ice} = \frac{692143}{10000} = 70\ units\ sold$$

Cash Flow Diagrams:

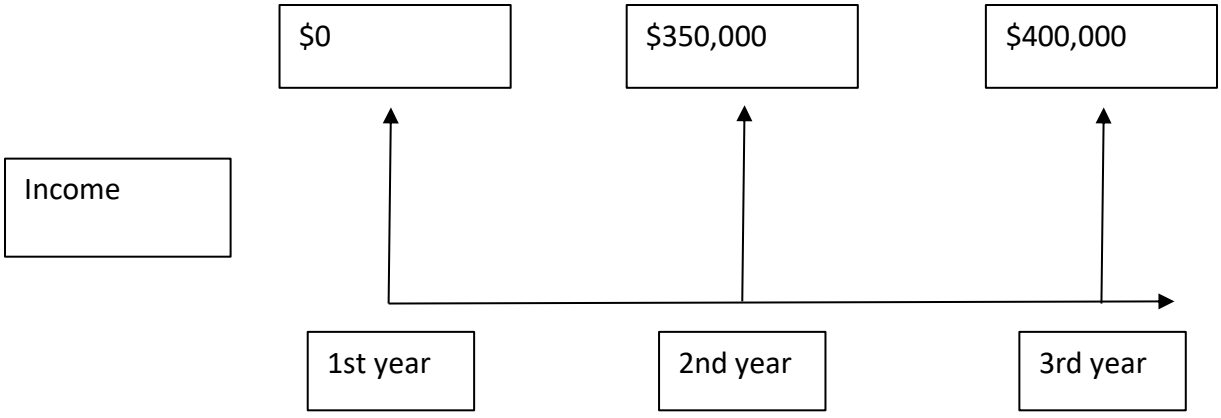


Figure 23 *- Cash Flow Diagram for Income*

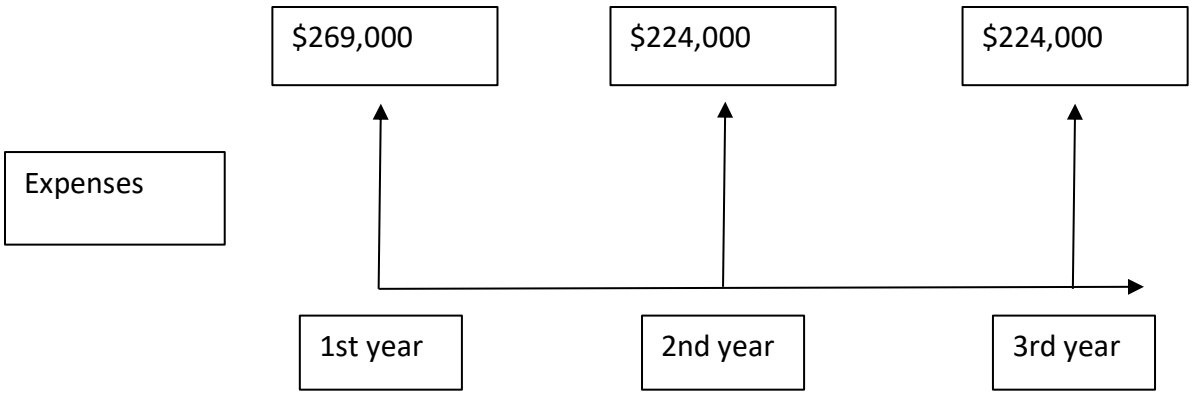
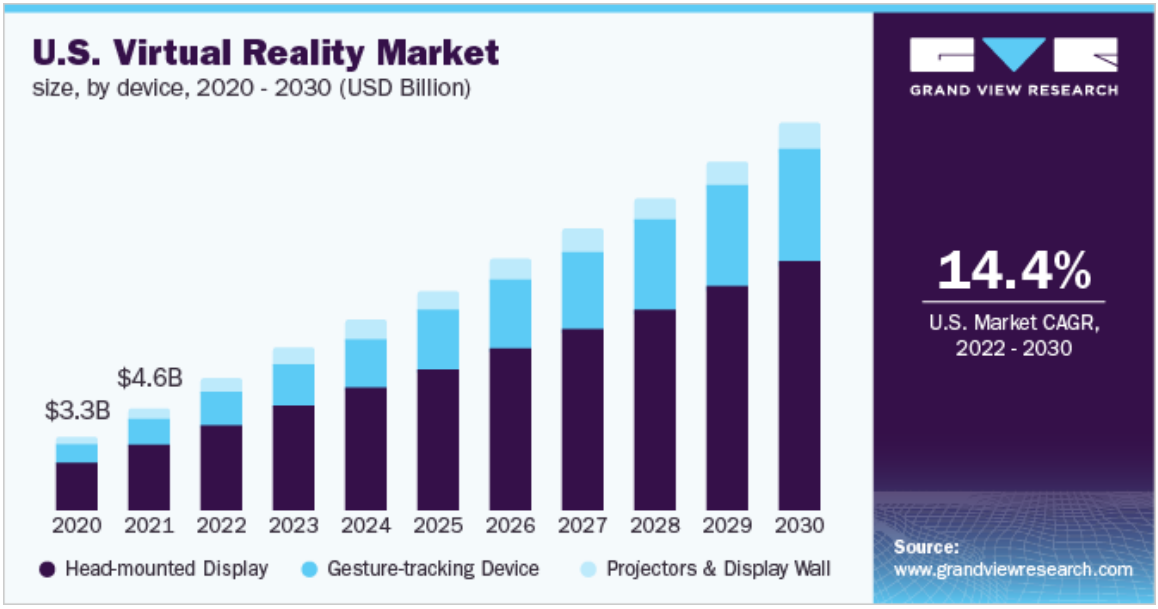


Figure 24 - Cash Flow Diagram for Expenses

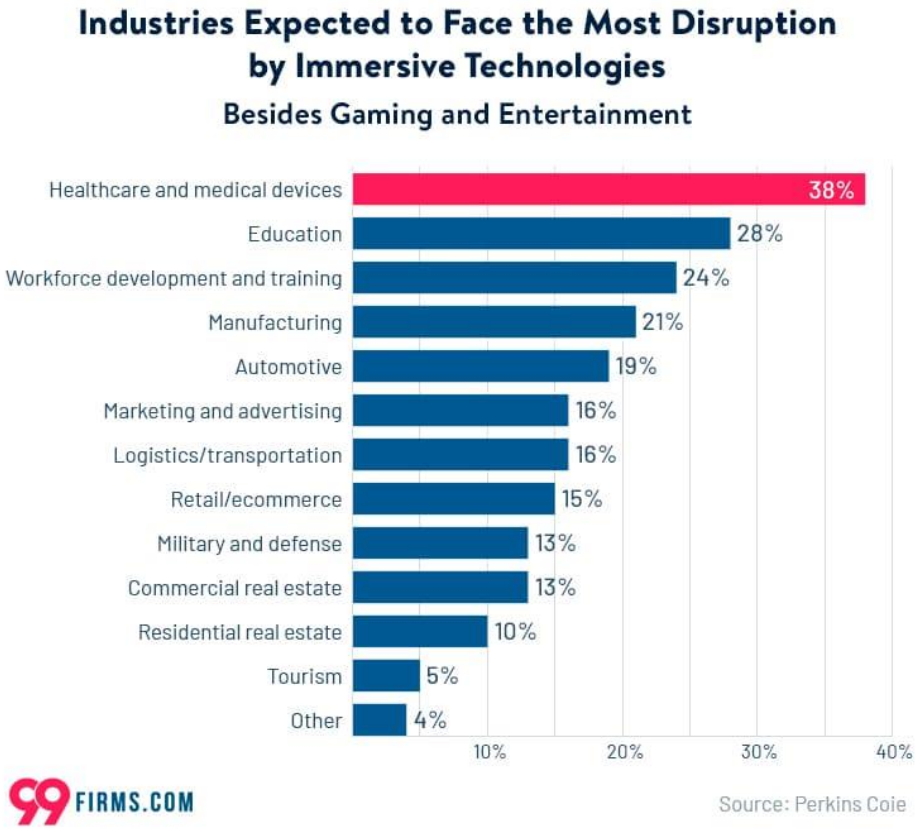
Market Research and Assumptions:

Conducting market research on the topic of VR simulation training and the cost associated with building such a business, we've come to discover the huge possibilities in the real-world market surrounding our business model idea. The VR industry has been experiencing immense growth in the last couple of years and is expected to reach a value of $120 billion (164.56 billion CAD) by 2026, with an annual growth rate of 40% according to one of the sources (Sheykin, 2023).



It was clear the versatility of applications that can be achieved with this technology in different sectors, such as: Healthcare, Education, Automotive and manufacturing, TV and movie industry, Marketing and Advertising. According to Sumana Ganguly (2023), the VR App

representation in the Education and Healthcare Industry are both 41%, indicating that there is a huge need for such businesses in the real-world market. Additionally, industries are expected to be affected by Immersive Technologies by quite the margins (Perkins Coie).



NOTE: *Most of the following costs are based on research done in the US, therefore all the prices are in USD unless stated otherwise.*

Even with the VR industry being seen as a huge opportunity, it does require a big initial investment to start out. Our scouting for costs being associated with starting a VR Training Simulation business resulted in the following ranges for the various aspects:

- Cost of a VR Headset: $300 - $1,400

Some Companies offer business plans with headsets such as The Oculus for Business Solutions which costs $799/256 GB a year. This entails security, maintenance, and customer support. Additionally, there is the cost of the annual Oculus subscription of $180 after the first year of usage.

- Costs of Development Stations and Company Servers: $3,000 - $15,000

There exist a solution to the expense of the company servers' expense and that is by using Cloud – Based Storing Alternatives such as AWS or Azure. Then you'd only have to pay as you go

- Costs of Development of Software and Applications: $10,000 - $132,000

Of course, this is affected by a lot of factors which include the costs of maintenance and updates.

- Costs of hiring VR Developers and Programmers: $71,000 - $132,000

  This can is affected by the years of experience required, the needed technical expertise, and the complexity of the projects. Also, the number of people on the team affects these costs. Another viable option would be to outsource and/or freelance the projects, in which then the cost would vary a lot.

- Costs of creating immersive environments: $50,000 - $200,000

  These costs can vary depending on how one might approach the project. The costs of 3D models and assets which go into the environments could go anywhere from $20 to $500 per assets. One might also hire graphic designers and programmers to develop their own assets and models which are typically paid in the ranges of $200 to $300 an hour.

- Costs of Tools and software licensing options: $1,000 - $10,000

  As an example, the cost of a professional Unreal Engine 5 license is $200 per month. These costs would vary depending on the tools needed and also the complexity of the project.

- Costs of Research and Development: $50,000 - $150,000

  When dealing with very sensitive industries such as healthcare, one needs to do extensive research to make sure of the factuality of their product. This matters more in some industries than others.

- Marketing Campaigns: $1,000 - $10,000

  These could include social media campaigns, in person campaigns, paid advertising campaigns.

- Facility Costs:

  Utility cost of small office spaces: $200 - $500 per month, Maintenance: $1,000 - $2,000 per month, Furniture: $3,000 to $5,000, Specific Service: $500 - $2,000, Rent: $60,000 - $80,000 for 1,000 square foot in downtown San Francisco.

- Legal and Licensing Fees:

  These would include Business Structures, Local and State Licenses, Intellectual Property Protection, Legal Consultation, Insurance and vary from location to another, and with type and purpose to another.

It is important to remember that all those costs can and will vary depending on Location, Complexity, Supporting Platforms, Pricing Methods, and a lot of other factors.

Now to put definite intervals a startup working in the VR Simulation and Development sectors in the market would encounter, we found the various ranges:

- On Average a start-up costs are between $135,000 and $605,000 to launch a VR Training Simulation Development.
- Simple VR applications with a very short development time cost between $3,000 and $9,000.
- Complex apps, games, and eCommerce stores could cost anywhere from $10,000 to $85,000.
- The most complex applications that require the longest development times can cost anywhere from $90,000 to $150,000.
- The cost of Virtual Reality Training Development varies from $40,000 to $180,000 if we look at a solution of average quality and no specific needs.
- A full virtual reality training pilot program could cost between $40,000 and $60,000, and these ranges could go up to $150,000 if we are talking about a full training program design.

It has to be mentioned that the above-mentioned prices will be scaled reasonably to fit our limited business scope, since these prices are based on full, big scale business start ups.

Note: Sources and references mentioned at the end of the document.

7.2 Intellectual Property Report

Patents:

Educational Training Apparatus and Methods Using Virtual Reality:

https://patents.google.com/patent/KR101981701B1/en?

Virtual Reality Training and Evaluation System:

US20190392728A1 - Virtual reality training and evaluation system - Google Patents

Legal Constraints:

The legal constraints for our project are quite loose since there aren't very many similar projects that are patented. A lot of software is not patented, as it is covered by copyright law, it is mainly inventions and products that are patented. Since the actual software isn't patented and there aren't many products available now based on empathy of a group, or OCD specifically, legally, our product should be free to make our product. However below is a detailed breakdown of similar patents based on other virtual reality evaluation systems.

Legal Constraints based on Educational Training Apparatus and Methods Using Virtual Reality:

The patent listed for educational training using virtual reality to train many people in a constrained environment. It is like ours, as it is training a user using a virtual reality system. A summary for the claims is as follows:

a) A trainee connects to a virtual reality device that supports a view, left and right hands to control the area and controls a virtual practice apprentice like that in real life. These virtual simulations are connected to a server that interacts with a practical training apparatus to simulate the real device training.
b) A second trainee can also do the same thing and simulate using the virtual tool and is connected via a server.
c) A display displays the data to users.
d) The training device can react to several users at once.
e) A physical electrical board directs where the practical training device is routed to.
f) The trainee is placed in an environment that feels like the real training environment to get results very close to using the practical device.
g) Sound is generated based on if you are connected to the training device.
h) The device will allow the user to select an exercise to select the difficulty, set the training tool based on the exercise, and then connect the practical training device.
i) After completing the simulation, a score is given to the trainee and the trainee can complete another exercise.

Legal Constraints based on Virtual Reality Training and Evaluation System:

The virtual reality training and evaluation system outlines a set of devices that instructs users to complete a task within a virtual environment. The user's performance of the listed tasks is monitored and compared to the defined evaluation criteria. A summary for the claims is as follows:

a) A virtual reality training and evaluation system, comprising of a visual display device, one or more user input devices, network communication device and computer-executable instructions executable by the computer processor.
b) Computer-executable instructions configured to cause computer processors to monitor the user interactions with the virtual environment.
c) Comparing the user interactions to the predefined efficiency criteria.

Based on the above claims there is some overlap between our system and the existing systems. We do use a virtual reality software that uses right and left hands to simulate a training event. However, our training event is entirely virtual and doesn't need to connect to a physical training device. That also means that for multiple users, there is no need for a server to connect them all to a physical training device, so no server is needed, the simulations can be done independently. The goal of both is to place a user in a situation as close to reality as possible to have them, experience

that exercise and apply it to reality in the future. If development was to continue our product, we may also have different exercises, as well as possible “difficulties” or just lengths the simulation lasts. However as stated before, the patent is mostly for the hardware needed to complete this, not the software. The patents also talk about transistors, servers, displayed, virtual reality devices that are all connected to simulate the training event, not how the training event will look, control, feel etc. Based on this, and the fact that we don’t cover all of the claims laid out by this patent, if we were to continue on this business path, we should be able to create our product without any legal repercussions based on the patents we looked through.

7.3 Project plan update

https://www.wrike.com/frontend/ganttchart/index.html?snapshotId=6TFtbl2x7Y0YOzz3i8Oy8QOzKE2P4CTu%7CIE2DSNZVHA2DELSTGIYA

8 Design Day Pitch and Final Prototype Evaluation

All Design Day materials have been submitted on Brightspace, including our Design Day Pitch, Back Board Picture, and any other miscellaneous documents that we will be using.

9 Conclusions

The OCD Immersive Experience was made based on the task of creating a VR experience that promotes empathy towards marginalized peoples. The creation process included many meetings with the client, idea development, research, storyboarding, and development of the actual VR experience. The project achieved success as it received numerous positive reviews. A key insight gained during the project was the significance of task delegation among team members to ensure smooth project operations. Breaking down the main project into smaller tasks, allowing each group member to complete them at their own pace, kept the project progressing and fostered collective accountability for the group's success. Additionally, the crucial importance of early involvement in the storyboard was recognized, acknowledging it as a pivotal aspect of the simulation. Initially contemplating audible character lines during the simulation, we ultimately scaled back this idea due to concerns about potential confusion for new VR users. Given a few additional months for project development, potential updates to the simulation were considered. This might have included a more detailed room layout for increased realism in a home environment, along with adjustments to certain textures.

References

Day, N. (2023, September 5). Cost Of Custom Virtual Reality Training: Full VR Price, Cost Factors, And Benefits [2022] - Roundtable Learning. *Roundtable Learning - The Future of Learning*. https://roundtablelearning.com/cost-custom-virtual-reality-training-full-vr-price-cost-factors-benefits-2022/

Ganguly, S. (2023, April 3). *Virtual Reality development cost*. https://www.designrush.com/agency/ar-vr/trends/virtual-reality-development-cost

Pavlov, D. (2023, October 13). *How Much Does it Cost to Create a VR Application?* SmartTek. https://smarttek.solutions/blog/how-much-does-vr-application-development-cost/

Program-Ace. (2022, July 1). *VR training cost: Factors affecting the development price | Program-Ace*. https://program-ace.com/blog/vr-training-cost/

Sheykin, H. (2023, November 10). *How much does VR training simulation development cost? Start now!* https://finmodelslab.com/blogs/startup-costs/vr-training-simulation-development-startup-costs