End of Term Report:

Creating an Immersive Exploratory Space for Chronic Pain Related Artwork

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A report describing the findings of research conducted
during the W24 semester for COMP400

COMP400: Project in Computer Science
McGill University
Montreal, Canada
April 12, 2024

1 Abstract

This paper presents the development of a Virtual Reality (VR) environment for chronic pain related art therapy. The goal of this project is to enhance accessibility to art therapy for individuals experiencing chronic pain. This paper presents an extensive review of traditional art therapy methods, insights into online versus in-person therapy, past research on cultural inclusion in art therapy, and the therapeutic potential of VR for pain management. The paper then presents the design and development of a VR art therapy environment.

The methodology involves a multi-stage design process, incorporating both paper and digital prototypes, followed by specifications of the development of a VR museum environment using Unity. Artificial Intelligence (AI) image generation techniques were utilized to populate the Virtual Museum with artworks generated based on prompts related to chronic pain experiences. Ethical considerations, including cultural inclusivity and accessibility, were integrated throughout the design process to ensure the platform's unbiased use, a crucial component to using the VR environment for future research.

The paper outlines potential applications, including enhanced accessibility to art therapy, therapeutic benefits of conducting art therapy in a VR environment, integration of the tool with existing medical practices, and its contribution to future research. Development limitations are discussed which include time constraints of the semester-long course, and limited existing research on chronic pain related artworks. Finally, the paper proposes future research directions, including a deeper exploration of VR-based art therapy's benefits and limitations compared to traditional methods.

Fundamentally, this paper contributes to the evolving discourse on VR applications in chronic pain management and art therapy, laying the groundwork for future research.

2 Introduction

The Canadian Art Therapy Association defines art therapy to be a process which "using imagery, colour and shape as part of [the] creative therapeutic process, thoughts and feelings can be expressed that would otherwise be difficult to articulate" (Canadian Art Therapy Association n.d.). Chronic pain is an illness which often causes social isolation in affected individuals (Hadi, McHugh, and Closs 2019). Individuals whom experience chronic pain have found great success in art therapy treatments with seen improvements in pain, mood, stress, and quality of life (Raudenská et al. 2023). Although art therapy has seen great results, the practice remains obscure, with limited art therapists available globally. Due to its relatively recent emergence as a new form of therapy, art therapy remains uncovered by most insurance plans. Due to the lack of art therapists and the uninsured nature of art therapy, treatment is limited by accessibility barriers on many fronts.

The greater scope of this project is to develop a VR environment within which individuals suffering from chronic pain can undergo art therapy treatments at no cost and create artworks that represent their current pain experience using AI image generation. The goal of this project specifically is to create a first iteration of a VR-based art therapy platform which can be used for future research.

There is currently a gap in research related to chronic pain and VR and therefore it

is unclear whether such a product would be a viable substitute for traditional art therapy methods. The development of a VR-based art therapy platform will allow researchers to conduct the necessary research to discover whether VR based art therapy is an effective alternative to traditional art therapy or not.

The scope of this project was to design and develop a VR art therapy environment which can be used in future research. Extensive work was put in to researching various design techniques throughout the semester, with a focus on usability. Two prototypes of the VR environment were created, one a paper prototype, and the other a digital 2D prototype. The digital 2D prototype was designed to allow for user testing to gain feedback on the design. However, no user-testing was done due to ethical constraints on the project. Once the designs were finalized, development of the VR environment began using the Unity game engine. A VR museum was developed, with chronic pain related artworks hanging on the walls. The artworks used were AI generated, with a focus on themes related to common forms of chronic pain. Time did not permit for the development of the complete VR environment, however examples of the method to develop several features was included in the Unity environment to aid future researchers. An example was provided on how to implement speech-to-text capabilities using the Unity game engine, this will be used in future iterations to gain input from the user on what they want to change about artworks. The use of speech as the main form of input to the software has the benefit of opening up this software to those with physical mobility limitations, an important hurdle to overcome for art therapy for use in chronic pain sufferers. Additionally, an example was provided on how to generate artworks using the Unity game engine. This example shows how to generate completely new paintings, as well as how to "in-paint" within an existing artwork.

Although time did not permit the development of the complete VR environment, the efforts from this paper provide foundational knowledge required to do so, as well as detailed instructions and base code which can be used by future researchers.

3 Literature Review

3.1 Traditional Art Therapy Methods

Throughout the 19th and 20th centuries, interest from academics in the art created by psychiatric patients grew enormously (Rubin 1999, p.51). Paul-Max Simon was the first to conduct a study and try to find trends in artworks created by patients in psychiatric wards in 1876 (MacGregor 1983). This was the first time art was used to understand the human experience with pain and suffering from a formal standpoint.

Margaret Naumberg is said to have pioneered art therapy practices in 1941 by conducting the first trials of using art with psychiatric clients and publishing her findings in a series of case studies (Rubin 1999, p.59).

There is a broad range of modern day art therapy practices, largely due to the wide variety of cases that are treated using art therapy, as well as varying personal preferences of art therapists. A popular form of art therapy is Mindfulness-Based Art Therapy (MBAT) which seeks to combine the therapeutic practises of both mindfulness, as well as art creation (Joshi et al. 2021). Another popular form of art therapy introduced in Hass-Cohen and

Clyde Findlay 2019 is the four-drawing protocol in which the art therapist asks the client to create 4 drawings with the following four prompts: (1) "Draw a picture of the problem", (2) "Draw yourself", (3) "Draw the internal and external resources that helped you with the problem", and (4) "Draw yourself, as you see yourself now". Hass-Cohen, Bokoch, et al. 2021 did further research on this theory, experimenting also with a 3-drawing protocol and discovered that "significant improvements were found in ratings of pain, depression, anxiety, relationship quality, and helplessness" for both the three and four drawing protocols.

3.2 Virtual Reality for Pain Management

In recent years, VR has been applied as a pain management tool amongst chronic pain users. McNeil 2023 defines an important term in the VR-Chronic-Pain space, the embodiment process, as "manipulating a person's perception of their body using VR to change their perceptions of pain". The embodiment process can leave users with lingering pain relief for several hours after use.

Koebner et al. 2019 conducted a study in which participants with chronic pain engaged in a 1 hour docent-led tour in a virtual museum. The results were a great success, with 57% of participants experiencing pain relief during the virtual tour with an average rate of pain relief of 47%. It was also noted that participants experienced a decrease in pain unpleasantness after the tour compared to before.

These results indicate that art therapy conducted in a VR environment has the potential to have even more benefits to chronic pain sufferers than traditional art therapy methods. This is due to the fact that pain relief is provided by the VR, in addition to all the benefits of traditional art therapy.

3.3 Online Versus In-Person Art Therapy

Rubin 1999 discussed the potential applications of computers to art therapy already in 1999. She explained that for chronic pain sufferers in which mobility is a limiting factor for accessing art therapy options, a computer makes it a much more accessible and viable pain management and expression option. In fact, in 2000 art therapists were already beginning to consider the idea of incorporating computers into their practice (Malchiodi 2000).

Clinical trials have shown that there is little difference in results when conducting art therapy online compared to in person. Hass-Cohen, Bokoch, et al. 2021 conducted a trial which isolated for discovering the difference in effects of online versus in person art therapy and found that "online [art therapy] was as effective as in person". This indicates that should all other factors remain constant, there will be no disadvantages to conducting art therapy in a VR environment.

3.4 Cultural Inclusion

Finally, an important topic to consider when discussing art therapy practises is cultural inclusion: addressing and supporting the needs of people from diverse cultures, and values their unique contribution. Betts 2013 discusses the importance of art therapy patients having sufficient inspiration and guidance which is culturally relevant to themselves to be able to

fully express themselves and gain all the benefits possible from art therapy. An example is provided in which two individuals, one South Korean and one Indian, are asked to draw a person picking an apple from an apple tree. There are similarities in the two drawings however there are also many differences, including but not limited to color choice, background imagery, and the look of the characters drawn. Considerations such as these are important to remember when designing art therapy tools so as not to have bias for or against various groups of people. The development of a virtual art therapy tool has the potential to be less biased than any traditional form of art therapy because it will be trained on a much greater base of knowledge than any one individual art therapist could ever study.

4 Methods

4.1 Design Process

Rubin 1999 postulated that above all, art therapy "needs to allow for personal expression and definition", and that "the materials used in art therapy tend to be simple and unstructured". It is for this reason, in addition to the fact that most individuals who experience chronic pain are elderly (Schopflocher, Taenzer, and Jovey 2011, p.445-450) and thus not technologically proficient, that my greatest priority in designing the VR space was usability.

There is debate amongst art therapists on how much freedom clients should have in terms of material. Some believe very few materials are sufficient whereas others believe clients should have every imaginable art tool at their disposal. However, the majority of art therapists are in between these two extremes (Rubin 1999).

With these pieces of information in mind, I began the design process by creating a first draft of a storyboard. In this design, the concept was to have the user be an art collector who travels to an art gallery to find a painting to "buy" which represents their current pain experience. In this design, the user would interact with another character in the environment who is the art gallery owner. They would be able to discuss artworks with the owner and give feedback to the owner regarding what they wanted to change about a specific painting. Then, three gallery employees would walk into the scene holding three AI-generated artworks based upon the user's feedback. The user would then be able to recursively give feedback to any newly generated painting. This design was deemed to have too much movement which would induce cyber-sickness in users so it was iterated upon.

The next design iteration was a second storyboard which was accompanied by documentation on product overview, within which the overlying concept was a museum. This storyboard used a popular template for VR story-boarding introduced in McCurley 2023. This concept allowed for the elimination of moving game objects within the environment and therefore solving the problem of cyber-sickness. This prototype iterated on the previous to include more detailed specifications on how the user would interact with the art and placed an emphasis on the user creating a collection of their saved pieces.

Finally, this prototype was iterated upon by creating a digital 2D prototype using Figma, a collaborative interface design tool (Figma, Inc. 2024). This prototype built off the core ideas of the paper prototype, but showed more depth regarding the specifications of user's interacting with the art and giving feedback to generate more artworks. It also includes

greater detail in the scale of the VR environment and the layout of the VR environment's building. This prototype was built to conduct user-testing, with the artworks in the scenes interchangeable and easily replaceable by newly generated images. The goal of creating a testable design was to gain feedback from users on the user experience, design, and usability as early on in the development process as possible. Unfortunately, no user testing was conducted due to ethical constraints on the project. As such, once the digital prototype was complete, development began immediately.

4.2 Development Tools

Unity was used to develop the VR Environment, with the help of additional Unity and third party packages (Unity Technologies 2024b).

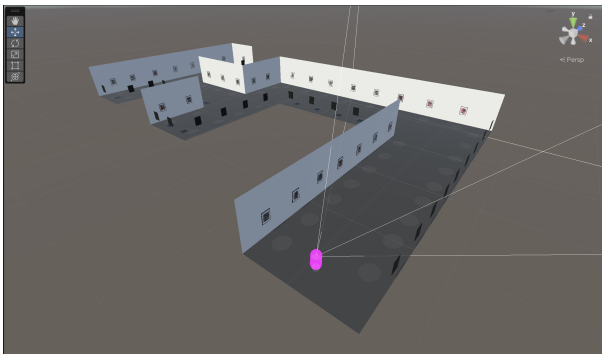

Figure 1: Aerial view of VR museum (screen capture of Unity Scene mode)

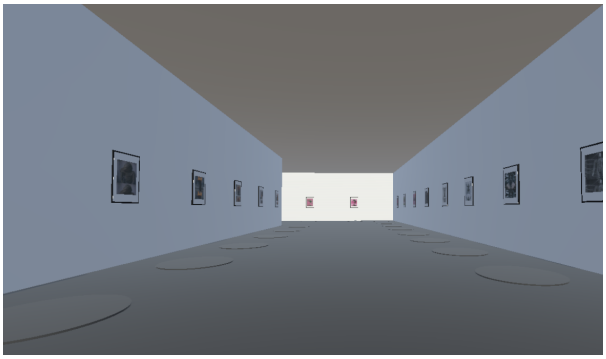

Figure 2: First person view of VR museum (screen capture of Unity Game mode)

ProBuilder, a popular Unity package developed by Unity, was used to create the structure of the buildings (Unity Technologies 2024a). It is a helpful package which reduces time spent constructing structures in Unity environments, allowing the developer to quickly get a baseline structure to begin developing the furnishings.

Next, the XR Interaction Toolkit package was used to add a first person VR game component to the environment (Unity Technologies 2024c). XR Interaction Toolkit provides four prefab components, `Input Action Manager`, `XR Interaction Manager`, `EventSystem`, and `XR Origin (XR RIG)`, that when combined under one empty game component create a first person VR controller. This controller can then be used to navigate around the scene by teleportation or gliding when the environment is being run on a VR headset. To aid with navigation, a prefab game component was created and named `HoverSpot`. This component provides users with visual indication of exact positions in the building where they can teleport to to stand directly in front of an artwork. This was motivated by the fact that it can be challenging in VR environments to use teleportation navigation to teleport to specific locations. Teleportation will be the main type of navigation to reduce VR cyber-sickness and optimize pain management possibilities. Since it is expected that many of the users will not be highly technologically proficient, the use of `HoverSpots` increases usability, reduces frustration in users, and facilitates a more relaxed experience overall.

Open-AI Unity is an unofficial (but highly popular) Unity package developed by Sercan Altundas that simplifies accessing the OpenAI API directly in the Unity Game engine (Altundas 2024). It was used to begin the development of speech-to-text and image generation capabilities within the VR environment. Speech-to-text was implemented using the `Whisper` sample which accesses OpenAI's Whisper automatic speech recognition (ASR) model. Image generation capabilities were implemented using OpenAI's `DallE` sample which accesses OpenAI's DALL·E 2 model which provides endpoints for in-painting and generation with input of image and prompt. Although neither of these two features were fully developed by the end of the term, a template on how to develop them in a VR space was exemplified for future projects.

4.3 Artwork Creation

The artwork which populates the museum was created using CanOfSoup, a free app which generates images based on a prompt provided by the user (*CanOfSoup* 2024). Three samples of images used in the baseline art collection can be seen in Figure 3, Figure 4, and Figure 5. Throughout the museum, many different genres of artworks can be found. Table 1 specifies the artwork genres, as well as sample prompts that were used to generate the artworks in the museum.

Figure 3: *CanOfSoup* generated image of glass in foot.

Figure 4: *CanOfSoup* generated image of limbs being pulled.

Figure 5: *CanOfSoup* generated image of body on fire.

These genres were created based on discussions during weekly lab meetings, as well as common examples of chronic pain provided by Dr. Yoram Shir, MD, Ex-Director of the Alan Edwards Pain Management Unit and practicing pain physician.

Genre	Sample Prompt
Wire	Body made of wire, chronically painful to move.
Wood	Stiff wooden body, cannot move.
Fire	Pain causing body to feel like it is on fire.
Green Goo	Goo covering body, so heavy on limbs.
Electricity	Electric shock going through body.
Slithering Snakes	Body made of snakes, slithering through body.
Pulling	Limbs being pulled by inanimate objects in all directions.
Falling	Body falling through air, cannot stop falling.
Nature	Large desert boulder crushing weight on shoulders.
Pins and Needles	Painful acupuncture all over body.
Restricted Movements	Body in twisted position, cannot move.
Feet	Shards of glass sticking into feet.

Table 1: Artwork Creation Genres and Sample Prompts

4.4 Ethical Considerations

In developing a VR art therapy platform which is meant to make art therapy more accessible, there are several ethical considerations to contemplate.

First, it is vital that the baseline artwork is inclusive to all. This can be done by sampling art therapy samples from patients with as highly variable nationalities, religions, sexes, genders, sexual orientations, and cultures as possible. This is an important step in the baseline artwork curation to ensure that there is adequate representation in the collection that each user feels comfortable and familiar with a roughly equal number of artworks.

Next, the image generation model must abide by the same inclusivity measures as mentioned above. This means that the image generation model must not be biased to produce art which relates more to one set of norms than another.

In keeping in mind these two ethical considerations, it will be possible to create a product which is inclusive to all. Ensuring that the product is inclusive to all is a vital step in making sure that any research conducted using this product will not produce biased or skewed results.

5 Applications

5.1 Enhanced Accessibility

Creating a VR environment which facilitates art therapy practices would greatly increase accessibility to art therapy. Although art therapy has helped countless individuals with pain management and understanding, it remains a somewhat novel practice. There are still very few art therapists globally compared to therapists who conduct more traditional forms of therapy. Due to the limited number of art therapists available globally, it can be difficult for chronic pain sufferers to find an art therapist in close proximity, and can be even more challenging for them to find an art therapist with whom they feel a sense of therapeutic alliance with, a construct vital to therapy. This geographical restriction which is currently

preventing patients from accessing art therapy would trivially be solved by a VR art therapy environment, which could be used from the comfort of patients' very own homes.

Another major hindrance to art therapy accessibility, specifically in chronic pain sufferers, is mobility limitations. Many individuals who experience chronic pain have significant mobility challenges which makes any forms of movement difficult. To some, traditional art therapy in a therapists office may seem to be more of a negative than a benefit since it would require them to travel to the therapist's office. A VR art therapy environment would greatly reduce this accessibility issue, with chronic pain sufferers being able to access art therapy at any time, from wherever they are, without adding the stress of having to move and risking increasing their pain experience.

A third factor which reduces art therapy accessibility is high costs and a lack of insurance coverage. Since art therapy is a rather new and not widely popular form of therapy, most insurance plans do not provide coverage for it. Thus, the full cost often falls on the patient. For many, this dissolves the viability of art therapy as a form of treatment due to the high costs of sessions. This project is being developed solely for research purposes and will therefore never be used to gain profit. This project will thus provide patients with access to art therapy for free or at as low a cost as possible to maintain services.

5.2 Therapeutic Potential

The exact therapeutic potential of a VR art therapy environment remains unclear due to the continuous development of the VR environment, as well as ethical constraints on this project. However, previous studies which examined the use of VR as a pain management tool for chronic pain sufferers found that time in a VR environment can provide pain relief, even after the patient exits the VR environment (McNeil 2023). Other previous studies investigated the difference in progress in art therapy patients who receive their therapy sessions online versus in person, and found that there was no difference between online and in person participants (Hass-Cohen, Bokoch, et al. 2021). With the knowledge provided from these two studies, it is logical to hypothesize that art therapy conducted in a VR environment could be extremely therapeutic, especially for chronic pain sufferers. VR art therapy has the potential to bring all the known benefits of traditional art therapy forms, with the added benefit of the embodiment process in using VR (McNeil 2023), long-lasting pain management from being in a VR environment.

5.3 Integration with Existing Practices

In conversations with Dr. Yoram Shir, MD, Ex-Director of the Alan Edwards Pain Management Unit and practicing pain physician, it was suggested that a virtual art therapy tool could be a useful tool for patients to express their current pain experience to their clinicians, to provide clinicians with additional insight into the patients pain experience. Dr. Shir encouraged the possibility of using such a tool in addition to the commonly used pain diagrams as a means to enhance the clinicians understanding of the patient. He shared that often times patients have difficulty when trying to explain their pain experience and that the pain diagram is helpful, but not all-encompassing. For this reason, he was optimistic about

the use of an artwork generation tool in addition to the pain diagram and confirmed that he himself would be eager to use a tool of these sorts with his patients.

Additionally, Dr. Shir suggested that such a tool could be useful in tracking patient progress over time. He suggested having patients generate one artwork which represents their current pain experience every month. This would provide clinicians with a clear visual representation of the progression over time of a patients view on their own pain. In future studies which seek to investigate the potential benefits of VR-based art therapy, we will likely pursue a repeated measures study design which factors in the considerations of Dr. Shir and other clinicians that we consult for this work.

5.4 Future Research

Research conducted throughout this term has developed a foundation of the viability of creating a VR art therapy environment, as well as a template to be built off of. Therefore, this paper should provide future researchers with the foundational information required to understand the purpose, benefits, and methodology on how to create such a product.

Once the product is completed, there are many exciting avenues of research which can be taken. It can be used to further research the embodiment process, the effects of pain management received from VR environments. It can also be used to research which types of artworks are most commonly used in art therapy by inspecting which artworks patients most often are drawn to. From this research, the VR environment could be improved upon to incorporate more baseline artwork which follows those discovered patterns. Additionally, the prompts users give the model to iterate on various artworks can be collected and studied to find patterns in prompts users give. Information such as this would be beneficial to art therapists who would gain greater insight into the average chronic pain sufferer. It would also be beneficial in finetuning an image generation model for the VR environment.

The greatest area of future research that can be done once the product is completed however is research on the viability of conducting art therapy in a VR headset itself. The difference in treatment between in person, virtual, and VR art therapy formats can be researched to discover which is the most beneficial, and which demographics prefer which platforms and why.

6 Analysis

It is important to note that no research with participants was done on this project due to ethical constraints, therefore there is no discussion of qualitative or quantitative data from test participants yet.

6.1 Limitations

The biggest limitation encountered during the semester was a lack of time in a one semester research course. Unfortunately, after extensive literature reviews and the creation of detailed designs there was not enough time left in the semester to fully develop the VR environment. Some changes which still need to be developed in the VR environment include connecting the

implemented speech-to-text models to user interactions with paintings, connecting the user's speech converted to text to the implemented image generation models, automatically saving the user's generated artworks to the personal gallery, and restricting the XR Interaction Setup to only allow for teleportation.

Additionally, there were issues in building the developed Unity environment to the Meta Quest 2 VR headset. There are three methods to build a Unity project to the headset: two options for development on a Windows PC and last for development on a Mac. First, I tried building the Unity environment to the headset directly from my Mac by connecting my Mac to the headset directly using a USB C to USB C cable. Unfortunately, even after testing many different configurations, the issue persisted that the Unity build would not recognize the headset as a build location. Next, the Air Link build method was attempted using a Windows computer in the lab however Air Link requires both the PC and the headset to be connected to the same WiFi network which was not possible to configure since the PC's internet is Ethernet based. Finally, the Meta Quest Link method was considered however shortly discarded due to a lack of access to the specific Link cable required. For future work, I would advise the lab to purchase the Link cable, or set up development on a Windows PC connected to WiFi.

Finally, due to a lack of information available regarding which are the best baseline artworks to include in the museum, random chronic pain related artworks were selected. In the future, it would be beneficial to more carefully select a baseline art collection based on previous research.

6.2 Future Directions

Rubin 1999 emphasizes the importance of an art therapist in being able to understand their client's creative process wholly and non intrusively, stating that "It is a major component of [art therapist] training because the more an art therapist can see, the more she can figure out, and the more effectively she can intervene to help" (Rubin 1999, p.72). A possible extension of this into the virtual world could be developing a machine learning model which observes how the user interacts with the system with a high degree of attention to be able to better suggest avenues of continuation in which the user is more likely to feel a high degree of self-expression and creativity. This connection of the software to the user's train of creative thought is an interesting problem which has potential to break down possible barriers in conducting art therapy virtually, without a trained professional art therapist guiding the client.

In future work, it will be important to research the major limitations of art therapy conducted in a VR setting compared to art therapy conducted in person. Those learnings could then be applied to bettering VR art therapy environments to achieve the end goal of creating a form of art therapy which increases accessibility to chronic pain sufferers, without lowering the quality of the benefits to the patient.

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Appendix

Cultural differences in artworks

The below artworks were presented in Betts 2013 to exemplify the idea that an individuals artwork is representative of their culture.

Figure 6: Person Picking an Apple From a Tree Drawing by a Woman in India (Depicting a Jackfruit Tree)

Figure 7: Person Picking an Apple From a Tree Drawing by a Woman in South Korea

First storyboard draft

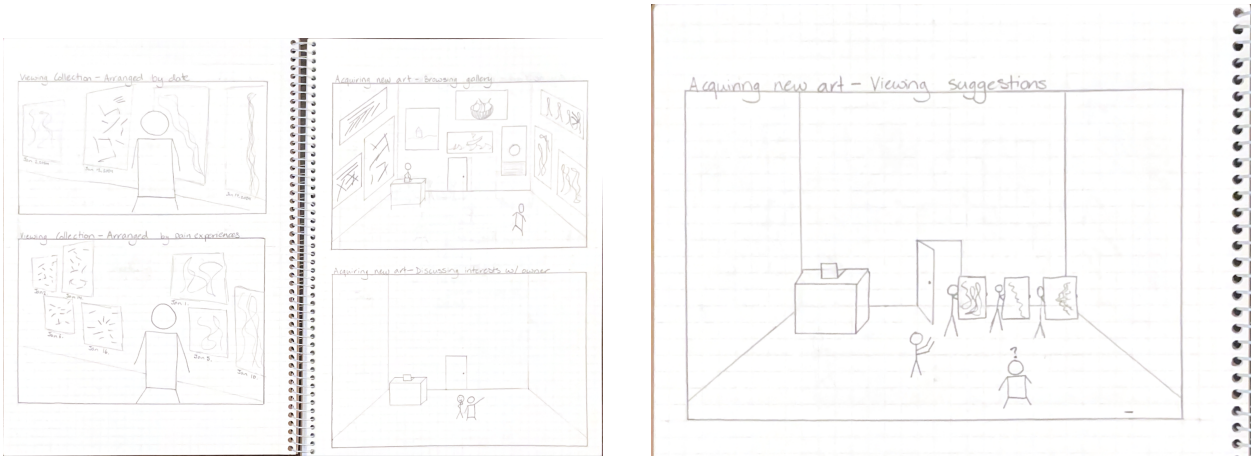

Figure 8: First design draft created in the form of a storyboard showing the user's progression throughout the VR space (designs made for an art gallery concept instead of museum design)

Second storyboard draft

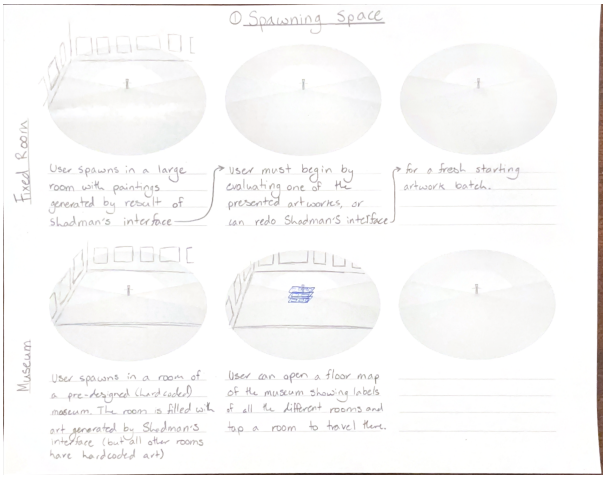

Figure 9: Storyboard prototype showing two possible design options of entry points for the user when the VR is initially entered

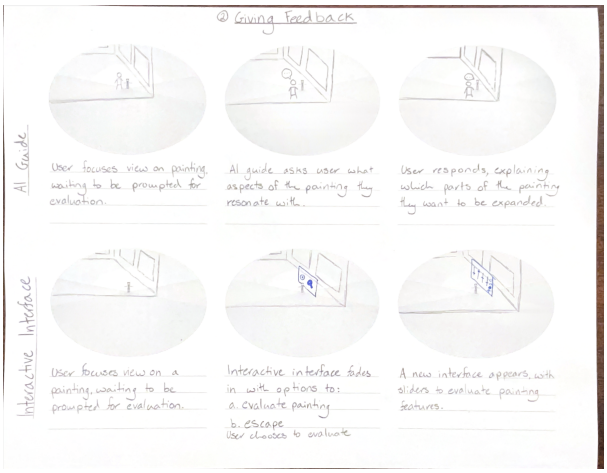

Figure 10: Storyboard prototype showing two possible design options for how the user gives feedback to generate more artworks

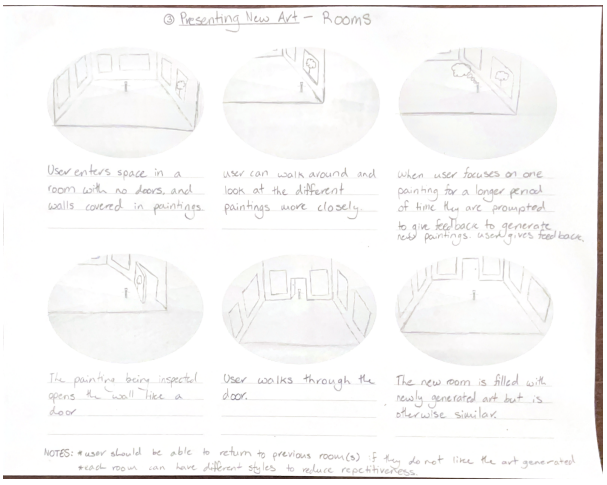

Figure 11: Storyboard prototype showing a design to present the newly generated artwork to the user using dynamically generated rooms

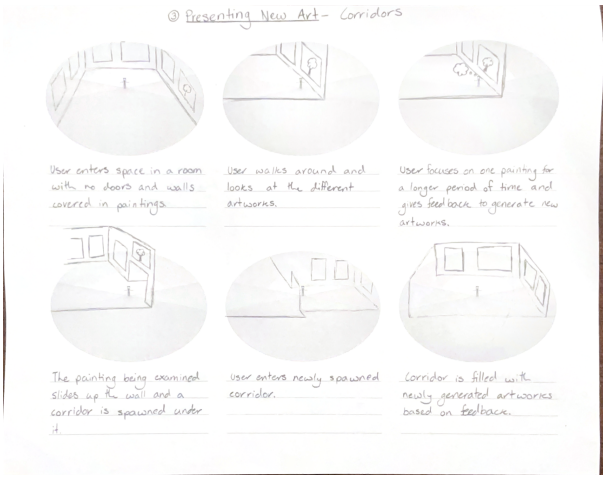

Figure 12: Storyboard prototype showing a design to present the newly generated artwork to the user using dynamically generated corridors

Product overview documentation

The following information was recorded as documentation which is aligned in the design process to the second storyboard.

Broad Product Idea

- build a museum with all different types of art (either generated from Shadman's interface or static images)
- user can traverse through museum and look at all art (either by walking or by teleportation by room)
- when user finds a painting they are inspired by, they can give feedback to the program to create more images similar to that one
- those new images are then faded in to be artificially hovering in the air in front of the painting
- the user can then give feedback on one of those three paintings or choose to retry the past generation if they did not like any of those provided
- if they give feedback on a generated painting, the previously generated paintings are discarded and the new paintings replace them
- the user can save any painting (AI generated or not) to their personal collection to reflect back on

Product Overview

Pre-Game Interface

Purpose: understand the user's general pain experience to generate collection of relevant images to them
Method:

- MVP $\rightarrow$ have the user complete the interface created by Shadman and connect this information to the VR program
- Goal $\rightarrow$ reproduce Shadman's interface in a VR setting to make it full integrated

Setting

A museum filled with hardcoded (not AI-generated) artworks. Has different rooms for organization of different types of paintings, but is all open concept and easy to travel through.
There is one room filled with the AI generated art from Shadman's interface.

User Starting Point

Location: entryway/lobby of the museum
Action: prompted to complete the "program tour" which walks the user through the different actions and commands they can perform in the program

- Map (button in bottom right corner) → when clicked, opens an interactive map
- Magnifying glass (button above map button) → when clicked, user can inspect/give feedback to program based on the artwork in their field of view

Completion Condition: If the user has completed the "program tour" this section is complete.

Exploring the Museum

Museum layout: Every room has several view points along the center of the room. In any viewpoint, the user can observe the art around them.
Travel:

- "Walking" → The user can move between viewpoints by clicking on another viewpoint to move there (as in google maps). This method of moving through the program is in place to reduce cyber-sickness in users.
- Teleportation → The user can click any room on the interactive map to teleport to that room. User is always teleported to the center viewpoint in that room.

In any view point, the user can rotate 360 degrees to view the full room around themselves.

Generating New Art

Purpose: The user may not find any art in the default images that they find reflects their current pain experience, the purpose of this museum is to allow the user to generate an artwork that they feel does.
How:

- When the user has an artwork in view and selects the magnifying glass, a VR interface is shown which assists the user in giving feedback on what aspects of the painting they feel resonates with their pain and which aspects do not.
- When the user is done conveying this information to the interface, three new paintings appear that are AI-generated based on the feedback received by the program. The user can select one of these three images and give feedback based on that artwork and continue the cycle recursively.
- At any point while in the feedback interface, the user can choose to save one of the generated artworks to their collection if they feel that it represents their current pain experience.
- Before the user exits the feedback interface, they are informed that if they choose to exit, all progress and generated artworks will be lost.

Collecting Artworks

What: Any artwork can be saved to the user's personal collection. The purpose of this is to create a collection of art pieces (with time and date stamps) which represent a history of the user's pain experience visualized through art.
Why: This collection can be useful to the user, to reflect on their past pain experiences and view their progress since beginning to use this program. It can also be useful to share the images within the collection with loved ones and medical professionals.
How: When the user is in this room, a third button will appear above the interactive map and the magnifying glass which is a "share" button which, when clicked, allows the user to export all the images (together with their time and date stamps of when they were collected) to an external outlet (default maybe to be to send a zip file by email).

Digital prototype

The following two figures are screenshots from the digital prototype created using Figma during the design process. This prototype is interactive and can be used for user testing by moving images around in the scenes to mock the generation of new artworks.

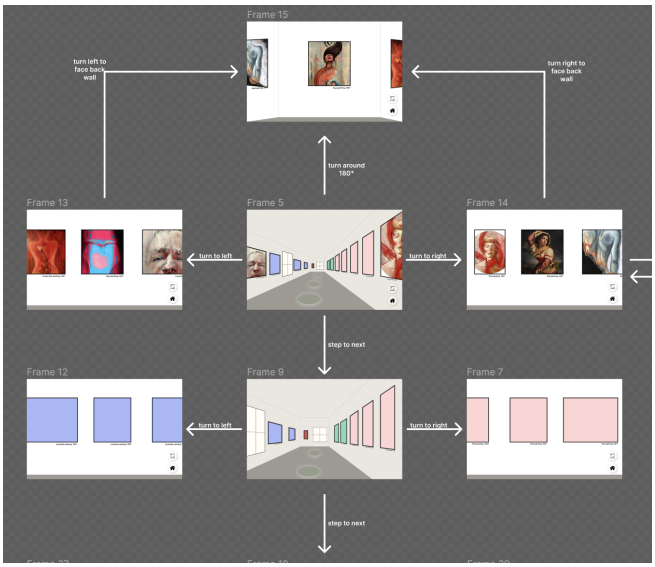

Figure 13: Sample navigation section of digital prototype which shows how users can turn their heads and move throughout the VR space, as well as the design of the artworks

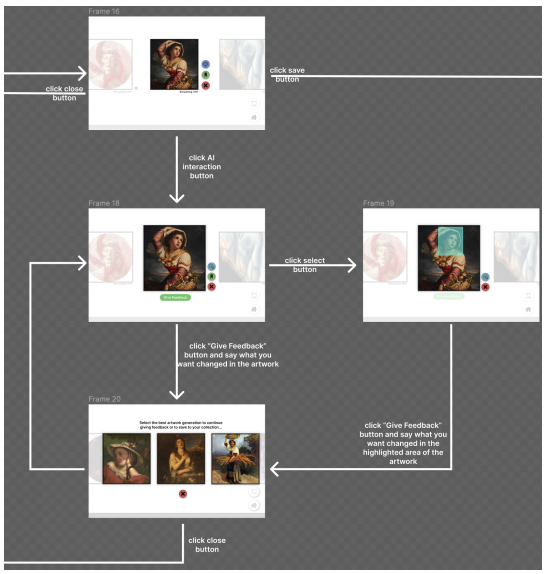

Figure 14: Section of digital prototype defining the user's interaction with the artworks, how they give feedback, and how new images are generated

Pain diagram

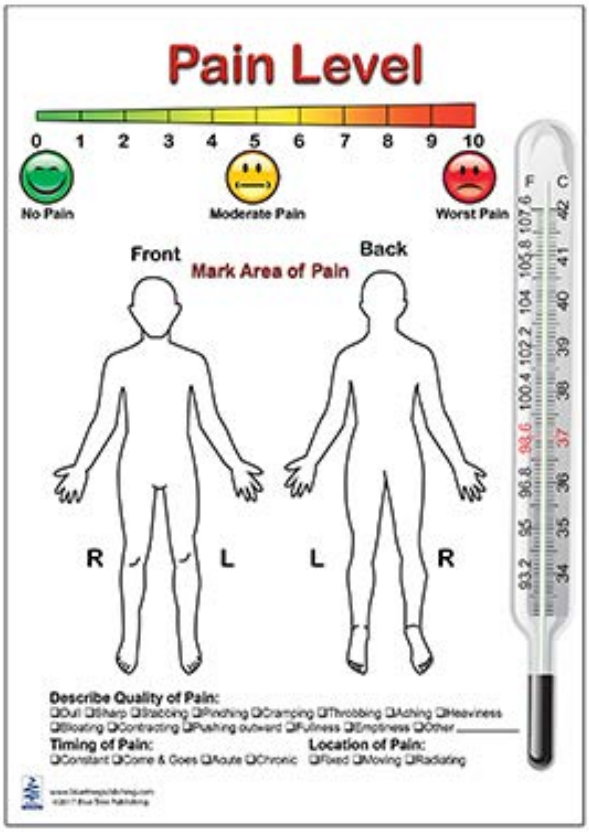

Figure 15: Example of pain diagram used by clinicians to assess a patients pain during an appointment