**Virtual Reality Art Museum**

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*Dec. 2020*



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**Improving the usability of a Virtual Reality Art Museum for multiple virtual reality headsets using SteamVR2**

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*Submitted in partial fulfillment of the requirements for the degree of* ***Bachelor of Science***

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**Abstract**

Virtual reality is a new emerging technology that is only now beginning to branch out into the mainstream. This project hopes to bring the emerging technology of virtual reality and combine it with the traditional academic field. Creating such an experience requires the use of technology and history to create something brand new to peak the interests of future generations.

**Plagiarism Statement**

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**Acknowledgment**

I would like to extend my sincere thanks to all my family, and those who have helped me throughout my entire degree. I would also like to thank my supervisor Dr. Hubert Cecotti for all his support and guidance throughout the semester; the assistance he has provided has been invaluable to my learning experience at Fresno State.

# Introduction

## Aims and objectives

The main aim of this project is to bring fine art to the masses via virtual reality.

In order to achieve this aim, it is needed to create a virtual environment that can house paintings to show the user a life like version of these works of art. Included with each painting must be a questionnaire to find out each user’s understanding.

This project is important because virtual reality is growing in popularity and accessibility every day. This project can increase the amount of people that have access to fine art, without the need to travel great distances to witness these works of art.

The expected results of the projects are an immersive museum environment created in a virtual environment with life size paintings that can be examined from any angle the user feels necessary to appreciate the work of the artist.

## Outline

The remaining sections of this report are organized as follows: The state of the art technology related to virtual reality is described in Section [2.](#_bookmark3) The analysis of the project is detailed in Section [3.](#_bookmark5) The methods are given in Section [4](#_bookmark14) and the information related to their implementation is detailed in Section [5.](#_bookmark17) The results are presented in Section [6](#_bookmark18) and discussed in Section [7.](#_bookmark19) Finally, the main contributions and results of the project are summarized in Section [8.](#_bookmark22)

# Related works

This was my first virtual reality-based project. I have no previous knowledge of the IDE Unity, the language C# or any experience working with 3D modeling.

# Analysis

## Problem Statement

## What makes Virtual Reality Art more accessible to students, rather than a real-life physical museum?

## Proposed solution

## To create a virtual reality art museum, that will create the immersive experience of visiting a real-life museum. Traveling is not always possible, or available to everyone. In todays day and age, most people have access to a personal computer and most have one or more in their own home.

## Requirements

### Functional requirements

### A virtual environment to immerse the user.

### Paintings that would be found in museums at scale.

### Observable from all available angles.

### Accessible for all users.

### Paintings and questions must be editable by non-technical user.

### Program must run at a frame rate of 45+ frames per second to maintain quality of experience.

### Non-Functional requirements

### Virtual reality must maintain high visual quality throughout experience.

### Virtual reality must be consistent in textures, sounds, and quality throughout.

### Movements must be smooth and easy to use.

### Movements must not induce motion sickness or abrupt visual changes.

### Software requirements

### Steam VR

### Unity 2019.4.8f1

### Hardware requirements

### A Virtual Reality Headset

### A graphics card that supports VR.

### Nvidia GTX 960 4GB/ Radeon R9 290 or greater.

## Project management

The project has been organized following the timeline depicted in T[able.1.](#_bookmark4)

Table 1: Timeline for the CSci198 project.

|  |  |  |
| --- | --- | --- |
| **Week** | **Objective** | **Comments** |
| 0 | Familiarize with Project | Study Layout, learn Unity. |
| 1 | Project Doesn't Run, Start Rebuild | Project only runs in specific Unity version. Does not run on my PC. Rebuild entire project in current Unity. |
| 2 | Recreate Museum Room | Recreate the main Museum Room. |
| 3 | Recreate painting import and quizzes | Create the functions required to import JSON files and display information on screen |
| 4 | Troubleshooting | Paintings loading incorrectly and frame sizing/ textures are off. |
| 5 | Implement general controls | Implement movements and game controls in SteamVR which supports many different VR hardware devices. |
| 6 | Implement Teleporting | Implement teleporting to navigate environment |
| 7 | Troubleshooting | Fixing quiz moving with player, bugs with quiz going outside the room |
| 8 | Texture fine tuning | The textures for the room and painting frame need to be exchanged for better suited materials. |
| 9 | Fine tune quiz and lighting | Adjust quiz to encompass all texts, adjust lighting to equally light painting and rooms. |
| 10 | Adjust Room wall & floor textures | Room wall and floor textures were not scaling with room. |
| 11 | Change Teleporting implementation | Teleporting was previously to designated places in the room. Has been updated to anywhere in the room. |
| 12 | Troubleshooting | Adjusted JSON files, added dev modes, buttons updated to look better. |
| Spring Break | Code Refactor | Clean up unused items in code and in file structure. |
| 14 | Adjust painting frame and plaque | painting frame texture changed, adjusted scale for different size paintings. Added plaque to hold description. |
| 15 | Finalize Details | Finalize painting frames, painting size, bugs. |

# Methods

Detailed Description of the algorithms and methods...

This Project required certain criteria to be met to ensure its success. The criteria was as follows, quality, realism, accessibility, usability. This project was previously implemented on an older version of Unity and with different visual stylings.

Definition of all the data structures that are created.

List of functions to manage the events

Class Diagram (relationship between classes)

Use cases

# Implementation

# 5.1 Quality

# Quality of the user experience was a focus from start to finish. The final product has been pieced together with high quality textures and materials that can be used consistently across a plethora of virtual reality headset. The program runs smoothly on minimal computer setups to ensure that regardless of hardware the user experience is consistently the highest quality available to them.

# 5.2 Realism

# Needed to include real paintings at scale. These paintings needed to be high quality and consistent across each painting. High quality textures were chosen, to help bring the immersive experience to life and bring the virtual environment closer to real life.

# 5.3 Accessibility

# The focus of this re-implementation of the project was to change the control scheme from the previous VRTK to SteamVR. The reason for this change being that VRTK only supported a couple of virtual reality headsets on the market. SteamVR has support for most headsets which greatly increases the accessibility of the program. The hardware in each headset on the market varies greatly. Some headsets contain sensors, headset, controllers, and treadmills while others may only include a headset and controllers. Each controller was designed differently, with different layouts and buttons. SteamVR works around this by creating a general layout and then assigning them to the controller that the user has chosen to enjoy the program with.

# 5.4 Usability

# The program needed to be simple and easy to use. The program needed to be easily understood by a non-technical person. Each set of paintings and questions have their own JSON files that can be edited as plain text by a standard user. This will allow users to expand upon what art pieces are included in the program after implementation.

# Results and evaluation

Due to the current circumstances regarding a worldwide pandemic, minimal testing has been performed on the current implementation of the project. There has been a small user group testing that was completed using close family. These tests consisted of people unfamiliar with VR and minimal experience with digital gaming. The results of small user group testing were consistent and positive. The experience is smooth, intuitive and visually appealing. Each user enjoyed the movement mechanisms that were implemented. They appreciated being able to teleport around the room whimsically to view the paintings from their desired point of views. The quiz questions were difficult for the user to answer correctly without previous knowledge of each painting.

Based on this feedback I believe it will be successful once fully implemented and made public. It would greatly increase the success rate to expand the single room to an entire navigational museum. If the user had more mobility, with a large environment to explore, I believe the user experience would be greatly increased to imitate the museum goers experience more closely without the fatigue of all the walking.

# Discussion

## Future developments

## The future of this project is only limited by imagination.

## Personal reflection

This project was a learning experience, with no prior knowledge of any of the tools required to implement this project I believe that I put my best foot forward and made sizable strides towards the goals of this project. This project was initially presented as a finished project, that required the user controls to be replaced with a newer more robust system. This requirement was met along with reimplementing much of the previous project. This was a great experience to work on a virtual reality project with a lot of frustrations and learning along the way. I had never worked with Unity, C#, or 3D designing. All these things were challenging and interesting to learn. I am grateful for the experience and pleased with the outcome of the work put in.

# Conclusion

# Virtual reality is quickly growing in popularity, technology, and accessibility. New use cases are being discovered daily; such uses include the medical field to train new surgeons. This project has attempted to seek out another use case for virtual reality to include it in academia and push it into the future. The VR Art Museum hoped to bring the experience of a museum to the user without them needing to travel for such an experience. The user would then be able to view and learn about historical art with minimal effort.

# While working on this project many iterations of textures, controls, and environment were experimented with to give the best user experience. Based on the minimal user group testing that was completed, alongside the testing from myself and the professor throughout working on this project. The public launch of this project will have a positive and successful response.

# During the implementation of this project, a lot was learned while working with Unity, C# and a 3D workspace. Unity is picky with which version a project was created, C# is not that bad, and I do not like 3D environments. Overall, the experience was positive, and I am pleasantly thankful for the opportunity to get to work on such a unique project with a very helpful professor.

# References

[1] YouTube.com