Multiplayer VR Painting Application

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Introduction

> ***"Painting is the magical conjunction of space/no space; movement in stillness. A balanced experience of absorption and self-awareness" -Anonymous***

All you need to paint is a few tools, a little instruction, and a vision in your mind. Painting is the baseline of an explosion of feelings; images and colors that hide inside common perceptions like hope, desire, recovery. It is more of a sole contemplation medium. Sometimes it proves to be better therapy than medicine. It's so addictive that it can be passed on to others as well. A painting is a gift for everyone. A scan of destiny and it may serve as a therapy for the one that finds himself in this creative universe. Virtual reality (VR) is probably the most used oxymoron of this century, and it is only in recent days that people have started to realize the importance and power of this technology. Virtual reality is dreamlike. In fact, it is a dream but with the added fact that you are conscious about your presence in it. Some of us have our fondest early computing memories of playing and messing around with programs like Microsoft Paint. While virtual reality is conquering the world and affecting everyone's life in one way or another, we will be able to once again indulge in our fantasies and make some colorful memories. If you are someone with the slightest interest in painting as well as have friends who are painting freaks and if you want to paint with them, here is a multiplayer VR application that will take things to the next level. This application lets people paint in the virtual environment by adjusting the angle of the canvas and provide users with a blissful experience.

Project Description

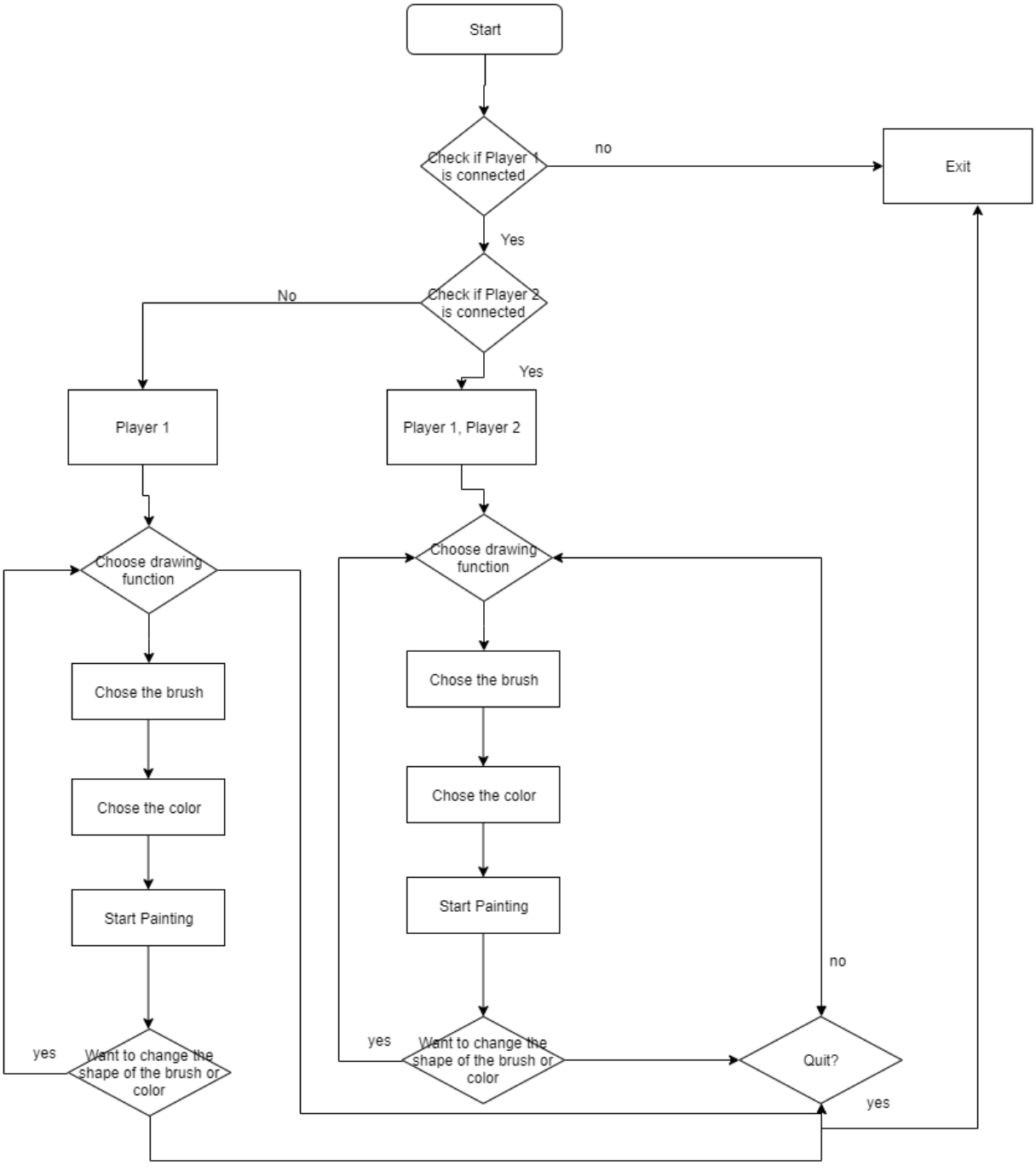
The aim of the project is to develop a multiplayer Virtual Reality Painting application where multiple players can draw and paint inside a 3D VR environment at the same time. The drawing can be considered as “tangible” entities in the VR world and the application allows multiple players to explore and enjoy it by using a VR headset and controller, instead of ancient tools (pencils and pens etc.) at the same time.

The application is developed keeping in mind people of any age who wish to explore, relax, express ideas, unleash their creativity with the help of three-dimensional brush strokes and at the same time enjoy the experience. Once a player enters the VR environment, the player finds himself inside a galaxy with stars all around providing the user a feeling of being present in space as well as a visual treat and a feeling of detachment from the real world. Once the user starts to paint, music starts to play in the background providing a soothing and eventful experience to the player. This application enables multiple players connected over the same network to paint together in the VR environment, making painting even more fun and interesting. Using this application all the players can contribute towards making a single painting or make their own individual paintings at the same time. All the players would be able to see each other’s paintings in the virtual world. All the players are provided with a range of 3D brushes to choose from while painting along with some animated brushes like fire, electricity etc. Using these brushes players can paint in various styles and explore different designs to express their creativity.

Equipment Required

- 2 – Oculus Rift (controllers, sensors and Head Mounted Display)
- Unity Game Engine
- Photon Cloud (by Exit Games)
- Oculus Unity Integration Software
- Steam VR Software
- 2 - High-end VR Ready Computer

Diagram of the VR Interface Functionality



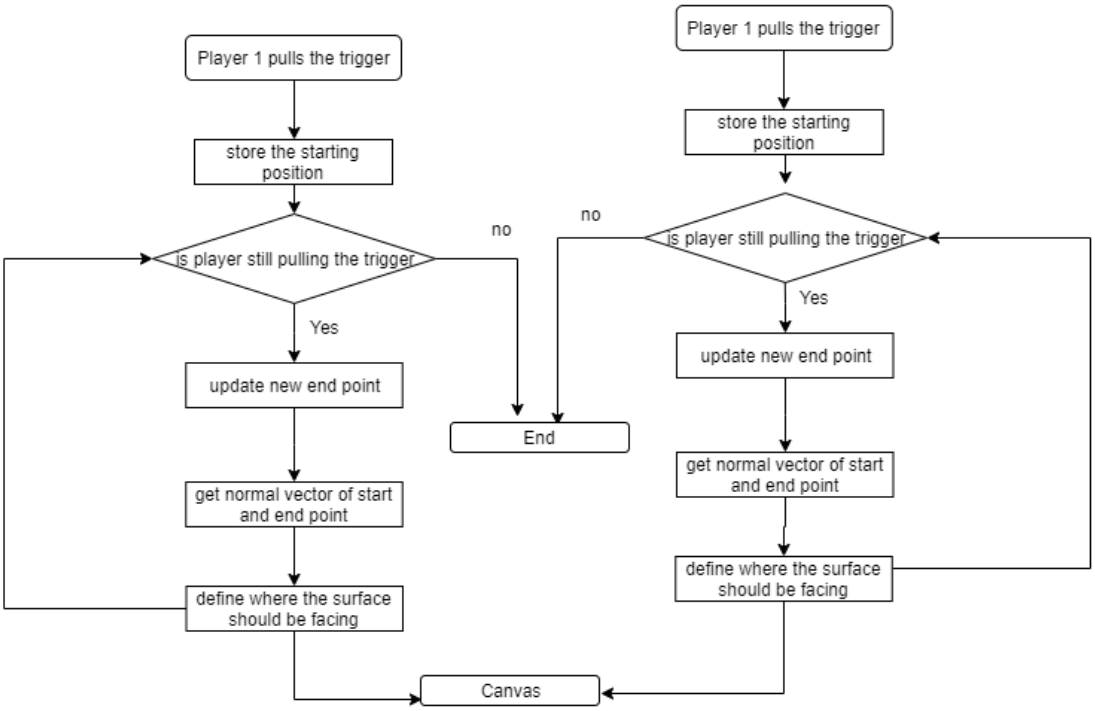
Implementation

Implementation of drawing tubes

To reduce the calculation time, a tube in our project is simulated by a regular hexagonal prism. Since regular hexagonal prisms have 6 surrounding surfaces, each surface can be defined in the same way as how we defined the surface in the previous section. The only thing we need to change is the rotation of each surface. We need to make sure that each surface is facing the center of the regular hexagonal prism.

Implementation of drawing surface

Since Unity3D allows developers to define 3D mesh through scripting, we can create surfaces that are relative to the position of controller. In the 3D space, a line is best rendered as a very thin quad, because meshes are composed of surfaces rather than lines or points, whereas a quad is formed by 2 triangles that can be described with 4 vertices. For this application, we will only need the start and end points and a width. The start point is the position of the controller when the player pulls the trigger; The endpoints can be tracked by storing the position of the controller at each frame after the player pulled the trigger. Based on this information, we can compute a 3D surface in the following way:



Implementation of Brush Shaders

Since we want players to be creative and expressive while painting, we have created different brushes and attached them to the palette. These brushes consist of simple shaders as well as animations such as fire, comet, lightning etc. Once the player hovers over the brush, a collision detection mechanism is activated, and the material of the brush gets selected. Similarly, the player can select the color from the palette. Post selecting the type of the brush and the color, the player can pull the right trigger of the controller and start painting in the virtual environment.

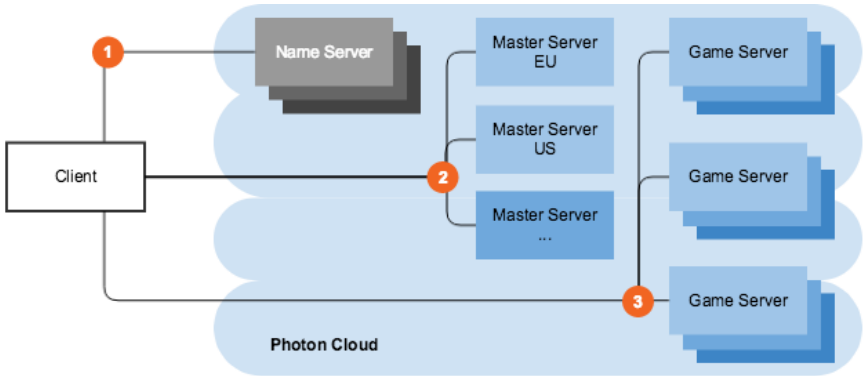
Implementation of Background music and Rotating Galaxy

To provide an interesting and soothing experience to the players, we have added different background music, that gets automatically played during the session of the players. We have also created a galaxy environment by adding the galaxy skybox such that it complements the background music and the user feels that he is present in space while painting as well as feels disconnected from the real world. Furthermore, the skybox is continuously being rotated along the y-axis to make the environment more realistic.

Implementation of Multiplayer

Painting has always been an interesting and a field which all of us explore either to relax or to pass some time. But assume that you and your friend can connect to one room and start painting together not being together. It would be so much fun. You guys can keep painting in space. For the same reason as playing sports with your friends. Video games by nature activates the reward centres of your brain. If you perform outrageous stunts in a game that is unique, you get extra points to do so. Gradually you build your skill level when you are playing a game. Consciously or subconsciously, your desire to do more makes your game look like a work of art.

For achieving multiplayer, we have used Photon Engine which is open source free software which helps in creating multiplayer games. Photon Unity Networking (PUN) is a Unity package for multiplayer games. Flexible matchmaking gets your players into rooms where objects can be synced over the network. The diagram of how networking is achieved is shown below:



The player first hits the name server and gets connected to one of the master server regions in which the player joins any game server. The advantage of using Photon over UNet is that people can play it over the internet. So, there is no requirement to be over the same LAN. A player is first spawned to one location in our map and then receives the controllers which consists of paintbrush and palette using which the player can start painting. When other players join, they get multiple spawn positions allowing them to see each other in the virtual world. Once they are in the same room, anything that they paint is considered as a game object and it is transferred over the network using RPC calls. We are making RPC calls as we don't want to hamper the performance of the players. These RPC calls help us to give a real time transfer of the objects and make it visible to all the users on the server. Thus, all the players are able to see each other painting and can actually compete with each other or make a painting together.

Userability Study

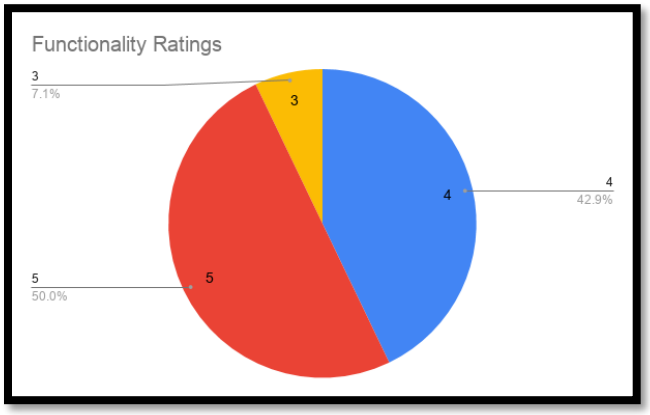
Survey Analysis

Lowest Rating: 1 & Highest Rating: 5

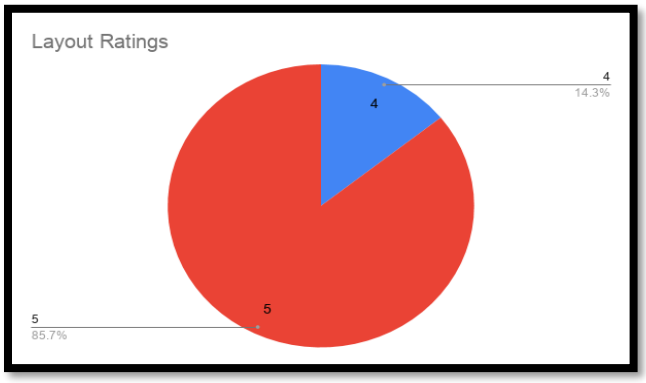
Evaluation Parameters	Average Rating	Description
Functionality	4.4	Describes the user friendliness of the application.
Layout/UI	4.8	Describes the look and feel of the application.
Painting Experience	4.7	Describes the overall experience of painting using the application.
Multiplayer Experience	4.1	Describes the experience multiple players had while painting together.
Variety of Paint Brushes	4.7	Describes the variety of brushes available enabling players to be creative.
Technical Errors	1.2	Describes the errors experienced while using the application.
Overall Experience	4.4	Describes the overall experience of the players.

Survey Results:

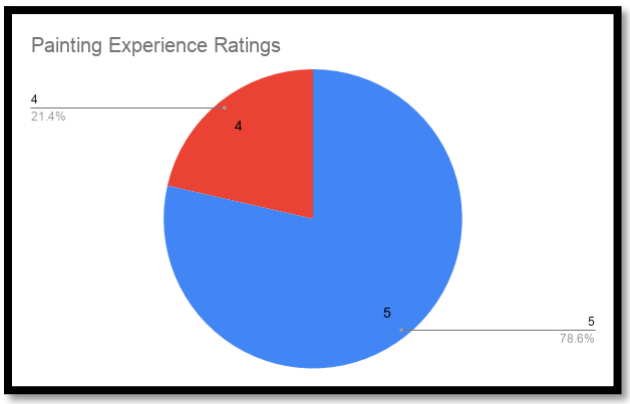
- Functionality



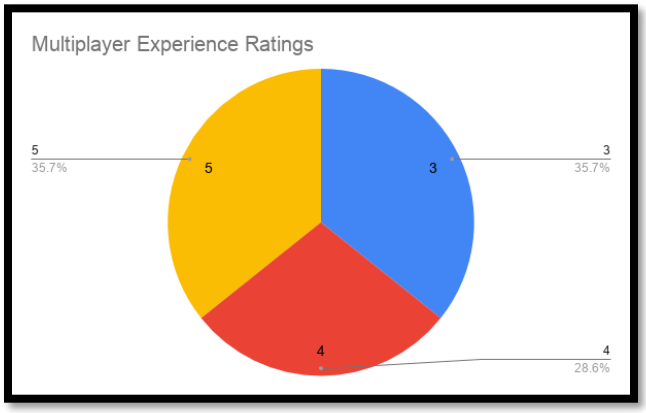
- Layout/UI



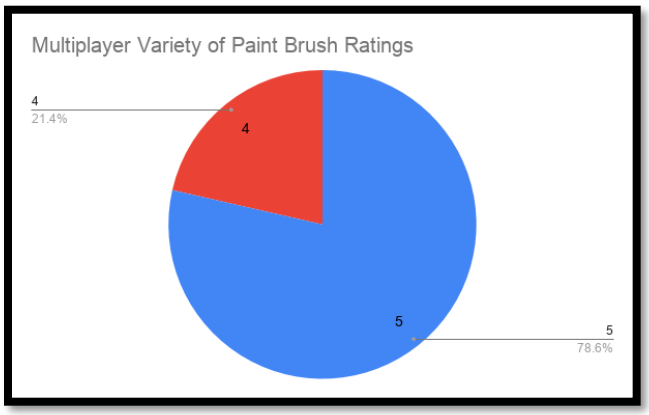
- Painting Experience



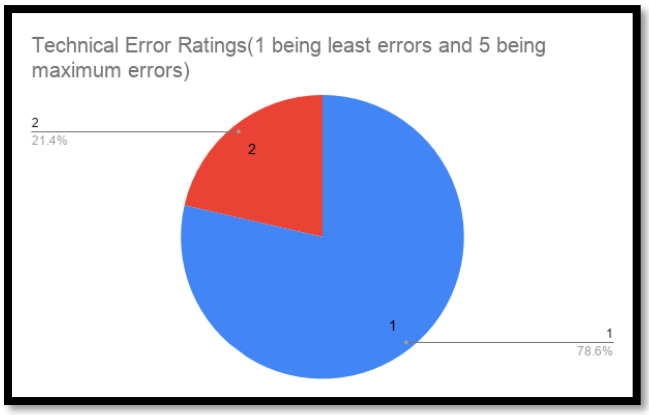
- Multiplayer Experience



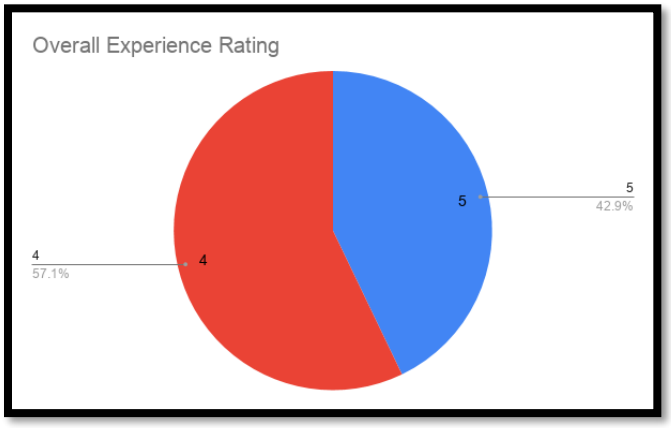
- Brush Variety



- Technical Errors



- Overall Experience



Conclusion

To conclude this project is a multiplayer VR Application. This application enables multiple players to paint at the same time in the galaxy using different types of brush shaders and colors. This application is developed for entertainment and relaxation of the players. While painting the players get to hear music as well which makes the experience more engaging and entertaining. Based on the analysis above, we can conclude that the application is user-friendly, and the players really enjoyed the painting experience. Players liked the multiplayer functionality as it made the application more interesting. The thorough exploration of all the brushes by the players show that our application successfully inspires their creativity and promotes the cultivation of artistic talents.

Future Work

- The application can be enhanced by adding an erase features where the players can erase the existing painting and paint again.
- The application can be enhanced by adding a Save feature where players can save their painting in their systems.
- Since this is a multiplayer game, chat feature can be added where the players in different places can chat among themselves making the application more interactive.

Moments captured during userability study: