

House of Echoes

An Immersive Social VR Experience

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1 Project Description

1.1 Project Goal

The objective of this project is to develop an immersive social VR space that allows users to customize their avatars collaboratively and interact with each other dynamically and engagingly through Ubiq.

1.2 Background and Motivation

In Virtual Reality (VR), the avatar is the extension of the user, hence it plays a vital role in the immersion of the experience. The avatar is the medium to navigate and interact with the virtual space, as well as a canvas for the user to present themselves in a social setting. Good avatar design and freedom can enhance user engagement and experience. Research [1] has shown that the embodiment of a virtual avatar can significantly affect how users perceive themselves and their virtual surroundings.

In social VR, avatars provide essential visual and behavioural cues for social presence. It creates the feeling of physically being in the same room with somebody. Additionally, the concept of “transformed social interaction”[2] suggests that modifications to avatars can impact social influence and interpersonal dynamics. For example, altering an avatar’s appearance can affect perceptions and interactions among users. This highlights the importance of thoughtful avatar design in social VR contexts. Social VR platforms like VRChat, Rec Room and Meta’s Horizon Worlds all offer a range of customizable avatars.

1.3 Key Features

This motivates the current project: a social VR platform that focuses on collaborative avatar design and interactions. We created House of Echoes with the following key features:

- Advanced Avatar Assets
- Real-time In-game Outfit Customization System
- Environment Triggered Avatar Transformation
- Avatar-Specific Triggered Interactions

2 Game Design Highlights

2.1 Overview

The users are invited to a house party shown in figure 1 that is slightly different from your usual house parties. During the gameplay, players can customize their avatars by visiting the fitting room. A special guest, "the Wizard," shown in figure 2(a) also placed several enchanted objects around the house. Interacting with the magical objects shown in figure 2(b) allow players to transform into the objects themselves. The game encourages interaction between players through both avatar customization and the transformation mechanics, making it a fun and engaging social VR experience.



(a) A Human Avatar



(b) An Enchanted Object Avatar (Guitar)

Figure 1: Avatars and objects in the environment



(a) The NPC wizard Providing Instructions



(b) Enchanted Objects (Highlighted in Blue)

Figure 2: NPC and Interactable Objects

2.2 Advanced Avatar Assets

For avatar customization, we utilized the 3D Characters Pro - Casual asset library [3], available on the Unity Asset Store. This is a significant advancement compared to the default ReadyPlayerMe-compatible avatars. We successfully integrated these high-quality assets into the Ubiq networking system, allowing all players to see and interact with each other's customized avatars. Furthermore, our team also designed the game environment[4], ensuring a unique and immersive setting tailored to our gameplay mechanics.

2.3 Real-time In-game Outfit Customization System

Our game features a real-time avatar customization system, allowing players to change their outfits dynamically without having to restart or reload. This is implemented through a fitting room shows

in figure 3, where players can see their avatars in the mirror and experiment with different outfit combinations. Since customization happens in real time, players can observe changes immediately and discuss their outfit choices with others via voice chat, enhancing the collaborative and social aspects of the experience.

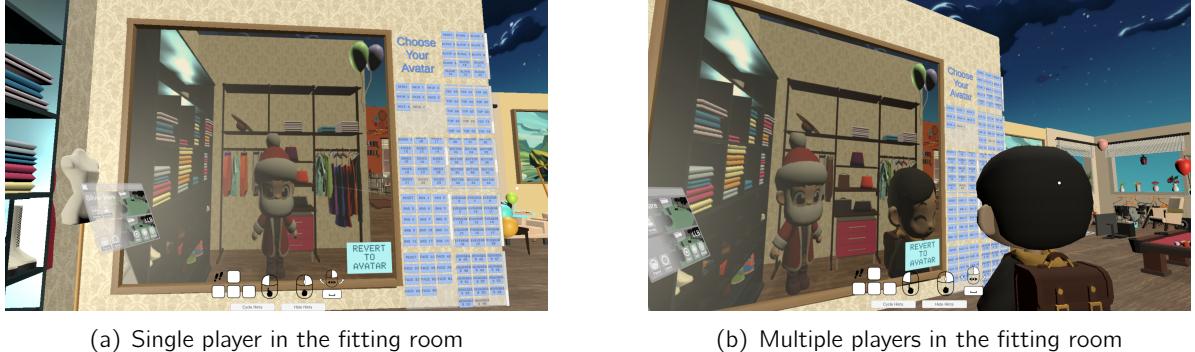


Figure 3: Players in the fitting room

2.4 Environment Triggered Avatar Transformation

One of the key features of the game is the ability for users to transform into enchanted objects found throughout the house. The wizard has placed special magical objects in the environment, and players can interact with these objects by grabbing them. Upon interaction, the player's avatar transforms into the corresponding object. This feature allows players to blend into the environment, creating amusing social interactions.

2.5 Avatar-Specific Triggered Interactions

When players transform into enchanted objects, other players can interact with transformed users, triggering unique sound effects based on the object they have become. For example:

- A player transformed into a guitar will emit guitar strumming sounds when another player interacts with them.
- A player transformed into a spray paint can will produce a shaking sound effect when clicked.
- A player turned into a cactus could trigger a humorous "ouch!" sound effect if another user interacts with them.

These avatar-specific triggered sound effects enhance the game's social experience by encouraging playful interactions and experimentation. It is also where the name "House of Echoes" comes from. Players are motivated to explore different transformations and discover how their presence in the environment can influence the behavior of others.

Overall, the combination of real-time customization, environment-driven transformations, and interactive object-based responses makes the game a uniquely engaging social VR experience.

3 Development Approach

3.1 VR Environment Setup

The VR environment was developed in Unity using the XR Toolkit for immersive, physics-based interactions. Ubiq was integrated to support multi-user networking, with real-time synchronization, shared object manipulation, and avatar presence across clients.

3.2 Outfit Customization System

The avatars are initialized with all the parts available in the prefab. By switching outfits the avatar changing panel, the script changes clothing part that is visible to the player and send it to the network in real time. This allows collaborative customization.

3.3 Player Interaction Mechanics

Interactive objects are visually distinguished using an outline effect, indicating that they can be grabbed or activated. Once transformed, the player's avatar is replaced with a themed prefab, and their scale and perspective are adjusted accordingly. When interacted with, these avatars emit corresponding audio cues. Each prefab is mapped to a specific sound for consistent feedback. An NPC wizard is present to guide players, providing narrative context and instructions for the transformation process.

4 Key Scripts Overview

4.1 SimpleAvatarCustomizer & AvatarCustomizationUI

The system preloads all part variants into the avatar under a hidden "Parts" structure. Only one variant per category is shown at runtime. `SimpleAvatarCustomizer` handles mesh switching and bone remapping to make only the chosen outfit is visible, while `AvatarCustomizationUI` generates buttons for each option. The code below is a simplified snippet that performs outfit switching:

```
smr[part].bones = bones.ToArray();
smr[part].materials = skm.materials;
smr[part].sharedMesh = skm.sharedMesh;
```

4.2 AvatarPartNetworkSync

This script synchronises avatar customisation across a networked multiplayer environment in Unity. It manages the selection and application of avatar parts (such as face and shoes) locally and shares these choices with other players via the network. Customisations are serialised into JSON format, stored within a shared room state, and reapplied whenever the avatar or room is updated, ensuring consistent appearance across sessions.

4.3 Avatar Animation

Avatar animations are controlled entirely through Unity's built-in Animator system without scripting. A float parameter `Speed` is used to drive transitions between animation states. When the character is stationary, the standing idle animation plays, and when the character moves, a walking animation is triggered.

4.4 AvatarSoundInteraction

Enables transformed avatars to play sound when interacted with by other players. It uses XR grab events and Ubiq for network synchronization. The following code plays the sound and sends a network message:

```
audioSource.PlayOneShot(interactionSound);  
context.SendJson(new InteractionMessage { interactorId = interactorId });
```

4.5 ObjectAvatarControl

Updates the position, rotation, and collider of object avatars based on the user's head and hands input. This ensures object avatars behave naturally in VR.

```
characterRoot.position = pose.value.position;  
characterRoot.rotation = pose.value.rotation;  
UpdateColliderPosition();
```

4.6 AvatarControlUbiq

Aligns humanoid avatars to user tracking data. The code below updates body position on the XZ plane and rotates head independently:

```
Vector3 newPos = pose.value.position;  
newPos.y = characterRoot.position.y;  
characterRoot.position = newPos;  
characterRoot.forward = Vector3.ProjectOnPlane(pose.value.forward, Vector3.up);
```

Conclusion

In this project, we successfully implemented a multi-user VR experience in Unity, with real-time avatar customization, transformation mechanics, and interactive feedback. Through collaborative effort, the end result is fun and engaging.

We hope you enjoy your time in the House of Echos!

Credits

Game Design:	Rachel, Jiale, Julian, Xiaojing
Avatar Features:	Julian, Jiale, Rachel
Environment & Assets:	Rachel, Xiaojing, Julian
Networking (Ubiq):	Jiale, Julian
UI & Interaction:	Julian, Jiale
Sound Effects:	Jiale, Rachel
Animation	Julian
Report Writing:	Xiaojing, Rachel
Special Thanks:	TA Team, Unity Asset Creators

References

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