

# HangoutVR (HoVR)

by

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## Abstract

Throughout the last several decades the way people communicate and connect with one another has radically evolved. Compared to the start of the millennia when communication technology was more text-based, today there are devices capable of full HD video calling. The past two years during the COVID-19 epidemic have only added to the need for continuing to advance communication technology. The time spent indoors, separated from friends and family, left many people feeling alone and lonely. If left untreated, pervasive loneliness can have long-term effects on an individual's physical and mental health (Mushtaq and Shah 2014). Video calling was a great avenue for staying connected, but it can ultimately end up feeling stale and not very engaging. The next communication platform will be more immersive, allowing one to interact with others in a shared virtual environment. The project, HangoutVR (HoVR), aims to make use of game and VR technology to provide individuals with a new way to connect with others by providing a shared environment where they can all interact and play together. As a multiplayer game, HangoutVR uses a client-server architecture. In this model, all players are connected to the internet and Steam. One player then hosts a lobby and acts as the server for all other joining players, or clients. Once players have joined a session, they are free to interact with others using the multitude of features offered in HoVR including things such as voice chat, text chat, object interaction, and more. over voice and text chat. The results provide a preliminary working prototype of HoVR. Future work will focus on creating a more customized player experience (ex. Avatar customization) and streamlining the experience in VR.

# Introduction

## Project Summary

HangoutVR (HoVR) is a multiplayer desktop game with virtual reality compatibility that provides players a private and immersive space to invite and connect with other players.

## Problem Statement

Throughout the last several decades the way people communicate and connect with one another has radically evolved. Towards the beginning of the millennia, AIM (AOL instant messenger) and mobile devices, such as the Nokia 5110/5190 and Motorola Razr, were used to send text messages to friends and family over distances. Today, there are desktops, laptops, and even mobile phones capable of Full HD video calling (Apple 2022). Long-distance communication has become much more visual in a short amount of time.

The past two years during the COVID-19 epidemic have only added to the need for continuing to advance communication technology. The time spent indoors, separated from friends and family, left many people feeling alone. Harvard University reported that 36% of Americans reported feeling “serious loneliness” in the wake of the pandemic in October 2020 (Weissbourd and Torres 2021, 4). Even more startling, 61% of young people aged 18-25 and 51% of mothers with young children reported miserable degrees of loneliness (Weissbourd and Torres 2021, 6-8). If left untreated, pervasive loneliness can have long-term effects on an individual's physical and mental health (Mushtaq and Shah 2014). It has been linked to heart disease and stroke as well as increased rates of depression, anxiety, substance abuse, domestic abuse, and suicide (Mushtaq and Shah 2014). While staying connected and socializing with others does not miraculously help cure loneliness or other health detriments associated with it, it

is a great help (Williams 2019). Many individuals had to rely on technology to stay connected with friends and family. Video calling was a great avenue for staying connected, but it can ultimately end up feeling stale and not very engaging. The next communication platform will be more immersive, allowing one to interact with others in a shared virtual environment.

## Solution

With the intention to connect individuals separated from friends and family in a more private and interactive way, HangoutVR (HoVR) was born. HoVR is an online virtual world platform that connects players to a shared virtual space where they may interact and chat with one another. With the inclusion of Steam connectivity, players are able to easily connect and invite friends to play. Players are also given the ability to join mini-games designed to entertain and promote socialization.

HoVR can be played in a first-person view on a desktop computer or in Virtual Reality using a VR headset. By placing individuals into a shared 3D environment they can navigate and interact with, VR gives people the feeling they are really in the same space with other people, a phenomenon defined as ‘presence’ (Slater 2009, 3351-52). Due to presence, individuals are more susceptible to behave and feel as they would in reality (Slater and Sanchez-Vives 2006). This distinguishes the benefits of virtual reality socialization from video calling where one can only see a person's face. According to techjury.com, 78% of Americans are familiar with VR technology as of 2021, and there are more than 171 million VR users worldwide. Especially with recent events, it has been difficult for people to connect and socialize with others. A widely available solution to this issue is gaming. Gaming can connect one with thousands of players every day. HoVR allows individuals to socialize, interact, and play with friends and other players in an immersive environment.

## Project Source

HangoutVR was brainstormed during a video call between Maggie Seibert and Cade Myers in the Spring of 2020. The initial concept was to make a virtual reality game, however, they soon realized VR, and gaming in general, can be utilized for more than entertainment. It can be used to bring people together into a community, form friendships, and provide an escape from difficult times in reality. The COVID-19 pandemic, which was especially rampant at the project's original ideation and continues to be an issue in Spring 2022, highlighted the need for this formation of community. With many countries having strict quarantine and lock-down rules, it has been extremely difficult to bond and connect with friends, family, and especially strangers. Gaming connects millions of people worldwide daily. The added immersion granted by interacting in a shared environment aids in strengthening and forming communities.

Once the initial project idea was conceived, Seibert posted a message about the initial project idea on the "Looking for Teams" channel in the Sr Design Project Management Microsoft team. Seibert and Myers knew they wanted to develop the project in Unreal 4 Game Engine. Therefore, they were looking for other students who had experience developing in Unreal Engine 4 and preferably had 3D modeling, environment design, and/or sound design skills. These skills were essential for team members as it can take a while for developers to become familiar with Unreal. Emily Bender and Chris Doan responded to Seibert's message after seeing it in the Microsoft teams channel. Once it was confirmed Bender and Doan had adequate experience to help realize the project, the team was officially formed.

## Discussion

### Project Objectives/Goals

With the project introduction complete, it is now time to discuss the project development in greater detail. Once the team had a better understanding of how to address the problem statement with their solution, they laid out the major features of HangoutVR. These features included:

- Successfully implement multiplayer capabilities so players can connect with others. This includes features such as:
  - Proximal voice chat
  - Text chat
  - Steam connectivity
- Create a fun and relaxing user experience
  - Simple and clean user interfaces
  - Relaxing sound design
  - Low poly art style
- Implement mini-games that promote socialization
  - Campfire mini-game

### Project Scope

With the project's major features defined, the team had to scope out the project. The team decided they would develop a functional multiplayer game that enables players to interact with each other by making use of the following features and functionality: the option to play on a desktop or in VR, voice and text chat to communicate with friends and other players, the ability

to interact with objects in the environment, mini-games to provide entertainment and further social engagement.

HoVR supports both desktop and virtual reality controls. Upon booting up the game, players are taken to the main menu where they can host or join a lobby. The main lobbies are stylized rooms that up to six players can connect to. Each lobby contains interactable objects and proximity-based voice and text chat so they can communicate with nearby players. The purpose of the lobbies is to provide a place for players to meet and interact without the added goals or rules of a mini-game. In each lobby, there are also panels players can interact with to learn about game mechanics and tips. The player who hosts a session becomes the Lobby Leader and has the ability to kick troublesome or toxic players from the session. The player can adjust audio and graphic settings to their preferences by utilizing the quick menu. The quick menu also allows players to change to VR controls and exit to the main menu if they wish to join a different lobby. The main screen of the quick menu allows a player to host a Campfire session. If they are the current Lobby Leader, all players will be booted from the session and taken to the main menu to join another lobby.

Campfire is a four-person game mode where a random topic is presented to the host of the campfire. Other players can join the campfire from the main menu and each player can take a turn to speak about that topic. This game mode provides more guided conversations for smaller groups than the Lobby game mode does.

Our project will scope this solution into the timeline by planning a base schedule for the first semester based on what is achievable.

## Quick Project Timeline

Table 1. Brief Project Timeline

| Task # | Task Name                               | Duration                                            | Start Date | End Date   |
|--------|-----------------------------------------|-----------------------------------------------------|------------|------------|
| 1      | Project Creation and GitHub Setup       | 1 day                                               | 09/20/21   | 09/20/21   |
| 2      | Default Character Mesh, Animations      | 1 week                                              | 09/20/21   | 09/27/21   |
| 3      | Main menu, Host & Join Lobby System     | 2-3 weeks                                           | 09/27/21   | 10/15/21   |
| 4      | Art Assets                              | 4 weeks                                             | 09/27/21   | 10/31/21   |
| 5      | Proximity Voice Chat                    | 2 weeks                                             | 10/11/21   | 10/21/21   |
| 6      | Campfire mini game                      | Total 9 weeks spread out in 5 month period          | 11/04/21   | 03/06/2022 |
| 7      | Text Chat                               | 1 week                                              | 11/03/2021 | 11/17/2021 |
| 8      | UI interaction on desktop               | 3 weeks                                             | 10/31/2021 | 11/17/2021 |
| 9      | Environment Design                      | Total 5 weeks that was spread out in 5 month period | 11/09/21   | 03/03/2022 |
| 10     | Designing UI Art                        | Total 3 weeks that was spread out in 5 month period | 11/09/21   | 03/08/2022 |
| 11     | Creating UI in UE4                      | Total 8 weeks that was spread out in 5 month period | 11/09/21   | 03/08/2022 |
| 12     | Text Chat                               | 1 week                                              | 11/10/2021 | 11/17/2022 |
| 13     | Lobby Leader System                     | 1 week                                              | 01/22/2022 | 01/29/2022 |
| 14     | Steam Advanced Sessions for Multiplayer | 2 weeks                                             | 01/22/2022 | 02/06/2022 |
| 14     | IT Expo Abstract                        | 2 weeks                                             | 01/31/2022 | 02/13/2022 |
| 15     | VR Player controller                    | 3 weeks                                             | 02/20/2022 | 03/06/2022 |
| 16     | IT Expo Poster                          | 3 weeks                                             | 02/20/2022 | 03/13/2022 |
| 17     | Formal Testing                          | 2 weeks                                             | 03/06/2022 | 03/20/2022 |
| 18     | Sound Design                            | 2 months                                            | 01/22/2022 | 03/22/2022 |

|    |                                     |          |            |            |
|----|-------------------------------------|----------|------------|------------|
| 19 | Creating Presentations and Practice | 3 weeks  | 03/21/2022 | 04/12/2022 |
| 20 | Editing Final Paper                 | 2 months | 02/27/2022 | 04/27/2022 |

## Technologies Used

To build the solution, the team used a variety of technologies. The application was developed in Unreal Engine 4 (UE4). This game engine was chosen over other game engines as it makes multiplayer game development much simpler and everyone on the team is more experienced with Unreal Engine 4 than any other development engines. Audacity FP Studio was used to create audio assets, Figma was used to create the user interface art assets and some of the models and materials were created in Blender and Photoshop. Any models used in the project that were not created by the team are from Kenney Assets and are free for commercial use. Virtual Reality development was done using Oculus Rift S and Quest devices owned by the team.

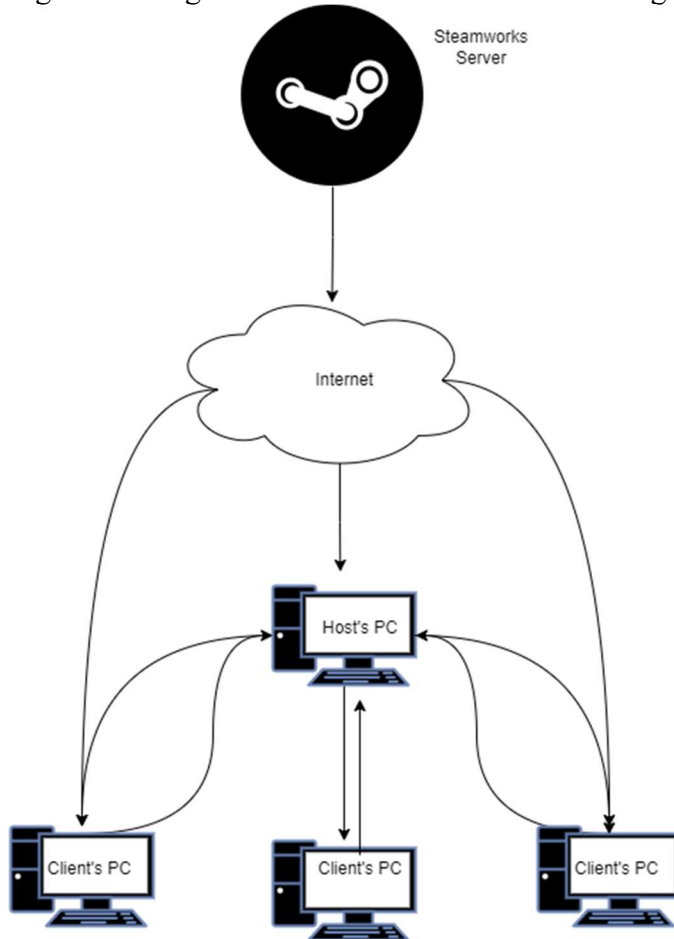
For team communication, the team used both Microsoft Teams and Discord. Microsoft Teams was mostly used to communicate with Professor Henderson, the project advisor. Discord was used as the main communication channel for the team members. Everything was discussed there from project ideas, progress updates, bugs and more. Online collaboration was possible using Google Docs and GitHub.

## Technical Architecture Diagram

Hangout VR uses a server-client model where HoVR is publicly available through Steam, one player hosts a game, then others join that session. The host then acts as the server and passes

information to joining players, or clients. When the host leaves their session, all players are removed from the session and the session is destroyed.

Figure 1. Hangout VR Technical Architecture Diagram



## User Personas

User personas are representative of the individuals who would play Hangout VR. The personas help to identify the needs of certain target audiences. For this reason, the team created the following user personas to get a better understanding of the issues the project needed to address.

Table 2. User Persona 1

| User Persona: 1                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                      |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  <p>Source: Man Free Icon. Flaticon. Freepik, n.d.<br/> <a href="https://www.flaticon.com/free-icon/man_4139981?term=male&amp;page=1&amp;position=12&amp;page=1&amp;position=12&amp;related_id=4139981&amp;origin=search#">https://www.flaticon.com/free-icon/man_4139981?term=male&amp;page=1&amp;position=12&amp;page=1&amp;position=12&amp;related_id=4139981&amp;origin=search#</a>.</p> | Title: Introverted Player                                                                                                                                            |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Name: John Smith                                                                                                                                                     |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Age: 22                                                                                                                                                              |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Gender: Male                                                                                                                                                         |
| Behavior                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | <ul style="list-style-type: none"> <li>● Introvert but enjoys hanging out with people he knows well</li> <li>● Funny, kind, and a little quiet</li> </ul>            |
| Pain                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | <ul style="list-style-type: none"> <li>● John feels lonely often.</li> <li>● Wishes he had more opportunities to make friends and talk with said friends.</li> </ul> |
| Needs & Goals                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | <ul style="list-style-type: none"> <li>● He wants to interact with friends online in an interactive and fun space.</li> </ul>                                        |

Table 3. User Persona 2

| User Persona: 2 |                      |
|-----------------|----------------------|
|                 | Title: Social Player |
|                 | Name: Jane Smith     |
|                 | Age: 30              |

|                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                   |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  <p><i>Source: Woman Free Icon. Flaticon. Freepik, n.d.<br/> <a href="https://www.flaticon.com/free-icon/woman_4139951">https://www.flaticon.com/free-icon/woman_4139951</a>.</i></p> | <p>Gender: Female</p>                                                                                                                                                                                                                             |
| <p>Behavior</p>                                                                                                                                                                                                                                                        | <ul style="list-style-type: none"> <li>• Is very sociable with friends and strangers alike</li> <li>• Compassionate, looks to try new things</li> </ul>                                                                                           |
| <p>Pain</p>                                                                                                                                                                                                                                                            | <ul style="list-style-type: none"> <li>• Wants more social opportunities but cannot find others to meet</li> <li>• Wants a space to hang out with current and new friends</li> </ul>                                                              |
| <p>Needs &amp; Goals</p>                                                                                                                                                                                                                                               | <ul style="list-style-type: none"> <li>• Needs to be able to interact with many people, but in smaller environments, so she can get to know people better.</li> <li>• The goal is to make new friends and enjoy time with current ones</li> </ul> |

## Use Cases

With the user personas defined, the team moved on to creating use cases. Use cases detail how users interact with the product and how the product reacts to user actions. These help to organize project ideas, gather requirements, and establish project scope.

Table 4. Use Cases

|                  |                                                                                                                                                                                                                          |
|------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Use Case ID      | 001                                                                                                                                                                                                                      |
| Use Case Name    | Host a Session                                                                                                                                                                                                           |
| End Objective    | Players can interact and play with others in the session they hosted.                                                                                                                                                    |
| User/Actor       | Player                                                                                                                                                                                                                   |
| Trigger          | The player selects to host a session.                                                                                                                                                                                    |
| Frequency of Use | Often                                                                                                                                                                                                                    |
| Preconditions    | Player is viewing the main menu and deciding whether to join or host a session.                                                                                                                                          |
| Basic Flow       | <ol style="list-style-type: none"> <li>1. Player launches game</li> <li>2. Player is brought to the Main Menu screen</li> <li>3. Player selects to host a session</li> <li>4. Player waits for others to join</li> </ol> |
| Alternate Flow   | N/A                                                                                                                                                                                                                      |
| Postconditions   | Other players can now see the player's session in the session list when deciding which session to join.                                                                                                                  |

|                  |                                                                                 |
|------------------|---------------------------------------------------------------------------------|
| Use Case ID      | 002                                                                             |
| Use Case Name    | Join a Session                                                                  |
| End Objective    | Player can interact and play with others in the session they joined.            |
| User/Actor       | Player                                                                          |
| Trigger          | The player selects to join a session.                                           |
| Frequency of Use | Often                                                                           |
| Preconditions    | Player is viewing the main menu and deciding whether to join or host a session. |

|                |                                                                                                                                                                                                                                                 |
|----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Basic Flow     | <ol style="list-style-type: none"> <li>1. Player launches game</li> <li>2. Player is brought to the Main Menu screen</li> <li>3. Player selects to join a session</li> <li>4. Player selects a session to join from the session list</li> </ol> |
| Alternate Flow | N/A                                                                                                                                                                                                                                             |
| Postconditions | The user is now in a session and can interact with other users.                                                                                                                                                                                 |

|                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Use Case ID      | 003                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Use Case Name    | Learn Game Controls                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| End Objective    | Player has a better understanding of game controls and how to navigate their environment.                                                                                                                                                                                                                                                                                                                                                                               |
| User/Actor       | Player                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Trigger          | The user wants to know how to control their player.                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Frequency of Use | Several times at most while player gets used to controls.                                                                                                                                                                                                                                                                                                                                                                                                               |
| Preconditions    | Player is in a game session.                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Basic Flow       | <ol style="list-style-type: none"> <li>1. Player spots panels nearby the spawn point that has the text “Welcome to HangoutVR!” at the top.</li> <li>2. The player approaches the panels and realizes the text explains some of the controls.</li> <li>3. The player interacts with the arrow button on each panel to view more information on the game controls.</li> <li>4. The player continues to read until they feel they understand the game controls.</li> </ol> |
| Alternate Flow   | <ol style="list-style-type: none"> <li>1. Player does not interact with the UI near the spawn point meant to teach the game controls.</li> </ol>                                                                                                                                                                                                                                                                                                                        |

|                |                                                                                                                                                                                                                                   |
|----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                | <p>2. The player learns the controls from trial and error or talking with other players.</p> <p><b>**Note:</b> The controls are designed to be initiative so players should not struggle with figuring them out on their own.</p> |
| Postconditions | The player better understands how to navigate the virtual environment and interact with others.                                                                                                                                   |

|                  |                                                                                                                                                                                                                                                                |
|------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Use Case ID      | 004                                                                                                                                                                                                                                                            |
| Use Case Name    | Voice Chat                                                                                                                                                                                                                                                     |
| End Objective    | Player can talk with other players in their game session using voice chat.                                                                                                                                                                                     |
| User/Actor       | Player                                                                                                                                                                                                                                                         |
| Trigger          | The player wants to talk with the other players nearby.                                                                                                                                                                                                        |
| Frequency of Use | Often                                                                                                                                                                                                                                                          |
| Preconditions    | Player is in a game session and understands the game controls.                                                                                                                                                                                                 |
| Basic Flow       | <p>5. The player sees they are currently muted as indicated by the mute icon on the HUD.</p> <p>6. Player presses and holds the T key to unmute themselves. The player can see they are unmuted when the muted icon on the HUD changes to an unmuted icon.</p> |
| Alternate Flow   | N/A                                                                                                                                                                                                                                                            |
| Postconditions   | The user understands how to mute and unmuted themselves to talk with other players.                                                                                                                                                                            |

|               |           |
|---------------|-----------|
| Use Case ID   | 005       |
| Use Case Name | Text Chat |

|                  |                                                                                                                                                                                                                                                                                                          |
|------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| End Objective    | Player can use text chat to talk with other players.                                                                                                                                                                                                                                                     |
| User/Actor       | Player                                                                                                                                                                                                                                                                                                   |
| Trigger          | The user wants to talk to other players but for some reason (such as a noisy environment or social anxiety) cannot use voice chat to do so.                                                                                                                                                              |
| Frequency of Use | Often                                                                                                                                                                                                                                                                                                    |
| Preconditions    | Player is in a game session and understands game controls.                                                                                                                                                                                                                                               |
| Basic Flow       | <ol style="list-style-type: none"> <li>7. The player opens text chat using the backslash key.</li> <li>8. Players talks with others in text chat by typing what they want to say and reading what others send.</li> <li>9. Player closes text chat when they no longer wish to use text chat.</li> </ol> |
| Alternate Flow   | N/A                                                                                                                                                                                                                                                                                                      |
| Postconditions   | The user is now in a session and can interact with other users.                                                                                                                                                                                                                                          |

|                  |                                                                                                          |
|------------------|----------------------------------------------------------------------------------------------------------|
| Use Case ID      | 006                                                                                                      |
| Use Case Name    | Interacting with Objects                                                                                 |
| End Objective    | Player can pick up, drop, and throw interactable objects.                                                |
| User/Actor       | Player                                                                                                   |
| Trigger          | The players wants to interact with objects around them for more fun with other players (ex. basketball). |
| Frequency of Use | Often                                                                                                    |
| Preconditions    | Player is in a game session and understands game controls.                                               |

|                |                                                                                                                                                                                                                                                                                  |
|----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Basic Flow     | <p>10. Interactable objects are outlined when the player is looking at them straight on.</p> <p>11. Player can grab or poke objects that are in their center of vision.</p> <p>12. If the player is currently grabbing an object, they can drop or throw the object in hand.</p> |
| Alternate Flow | N/A                                                                                                                                                                                                                                                                              |
| Postconditions | The user understands how to interact with objects.                                                                                                                                                                                                                               |

|                  |                                                                                                                                                                                                            |
|------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Use Case ID      | 007                                                                                                                                                                                                        |
| Use Case Name    | Lobby Leader System                                                                                                                                                                                        |
| End Objective    | Can access Lobby Leader System and remove players if needed.                                                                                                                                               |
| User/Actor       | Player                                                                                                                                                                                                     |
| Trigger          | A rude player in their lobby needs to be removed and the lobby leader is the only one who can do so.                                                                                                       |
| Frequency of Use | Often                                                                                                                                                                                                      |
| Preconditions    | Lobby leader is hosting a lobby with multiple people                                                                                                                                                       |
| Basic Flow       | <p>13. Lobby leader hosts a game.</p> <p>14. Other players join.</p> <p>15. Certain player(s) cause disruption</p> <p>16. Lobby leader accesses the leader system and selects the player to be removed</p> |
| Alternate Flow   | N/A                                                                                                                                                                                                        |
| Postconditions   | Players now know how to remove rude players from lobbies.                                                                                                                                                  |

|             |     |
|-------------|-----|
| Use Case ID | 008 |
|-------------|-----|

|                  |                                                                                                                                                                                                                                                                    |
|------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Use Case Name    | Using the Quick Menu                                                                                                                                                                                                                                               |
| End Objective    | Player can open, interact with and close the quick menu when they need.                                                                                                                                                                                            |
| User/Actor       | Player                                                                                                                                                                                                                                                             |
| Trigger          | The user wants to access something in the quick menu (i.e. moving to a mini-game, adjusting settings).                                                                                                                                                             |
| Frequency of Use | Often                                                                                                                                                                                                                                                              |
| Preconditions    | Player is in a game session and understands basic game controls.                                                                                                                                                                                                   |
| Basic Flow       | <p>17. Player opens game menu with the game control for the platform they are using.</p> <p>18. Player can navigate to different tabs of the quick menu to access what they need.</p> <p>19. Player closes the menu once they have completed what they needed.</p> |
| Alternate Flow   | N/A                                                                                                                                                                                                                                                                |
| Postconditions   | The user understands how to open, interact with and close the quick menu when they need.                                                                                                                                                                           |

|                  |                                                                  |
|------------------|------------------------------------------------------------------|
| Use Case ID      | 009                                                              |
| Use Case Name    | Hosting Campfire Mini-Game                                       |
| End Objective    | Player can host a Campfire Mini-Game session with other players. |
| User/Actor       | Player                                                           |
| Trigger          | Player wishes to host a Campfire game session.                   |
| Frequency of Use | Often                                                            |
| Preconditions    | Player has loaded into a lobby and can access the quick menu.    |

|                |                                                                                                                          |
|----------------|--------------------------------------------------------------------------------------------------------------------------|
| Basic Flow     | 20. Player boots up game<br>21. Player will join/host a lobby<br>22. Player accesses quick menu and selects, "Campfire." |
| Alternate Flow | N/A                                                                                                                      |
| Postconditions | Player now understands how to host a Campfire Mini-Game.                                                                 |

|                  |                                                                                                                                |
|------------------|--------------------------------------------------------------------------------------------------------------------------------|
| Use Case ID      | 010                                                                                                                            |
| Use Case Name    | Joining Campfire Mini-Game                                                                                                     |
| End Objective    | Player can join a Campfire Mini-Game session with other players.                                                               |
| User/Actor       | Player                                                                                                                         |
| Trigger          | Player wishes to join Campfire game                                                                                            |
| Frequency of Use | Often                                                                                                                          |
| Preconditions    | Player has launched the game successfully and clicks Join Lobby                                                                |
| Basic Flow       | 23. Player launches game<br>24. Player clicks Join Lobby<br>25. Player clicks on Session with Campfire listed as the game mode |
| Alternate Flow   | N/A                                                                                                                            |
| Postconditions   | Player can now join Campfire game sessions                                                                                     |

|               |                                             |
|---------------|---------------------------------------------|
| Use Case ID   | 011                                         |
| Use Case Name | Activating VR controls                      |
| End Objective | Player can play HoVR using their VR headset |

|                  |                                                                                                                              |
|------------------|------------------------------------------------------------------------------------------------------------------------------|
| User/Actor       | Player                                                                                                                       |
| Trigger          | Player wishes to play HoVR in VR                                                                                             |
| Frequency of Use | Once per game launch                                                                                                         |
| Preconditions    | Player launches the game and either joins or hosts a game session                                                            |
| Basic Flow       | 26. Player launches game<br>27. Player hosts or joins a lobby<br>28. Player uses the hotkey shortcut to activate VR, Shift V |
| Alternate Flow   | Player opens Quick Menu and navigates to the settings screen, then click the FPS/VR Switch Button                            |
| Postconditions   | Player can now play in VR for the remainder of their session                                                                 |

## Use Case Diagram

The following use case diagram depicts how players would interact with the HoVR application. The first player will need to host a session where other players can then join. Once players are in a game session, they can explore the space and interact using the features seen in the diagram below.

Figure 2. Use Case Diagram



## Testing Plan

HangOutVR will be tested every two weeks minimum by developers or play testers. This gives developers time to finish assigned development tasks and implement substantial features before testing is done. Here one can see the methods used to test as well as the scope of testing for the project. Each test will be documented in the table below and a brief testing review.

Should a suggestion for change arise in the testing period, the developers will meet and discuss

the change. If the change is approved by all members, it will be implemented. Necessary changes will be communicated with advisors.

## **Methodology**

All features of the project will be tested every two weeks minimum. Testing may be completed by all or some team members depending on their availability or by play testers. Play testers may include developers or friends of the developers. Testing is being approached this way to make sure everyone has time to commit a substantial amount of work to the project before it is tested. This ensures that all features will be tested before the final project is completed.

## **Scope**

Each feature in Hangout VR will be tested every two weeks to ensure that no system fails or becomes outdated. Features to be tested include: online multiplayer, voice chat, text chat, UI systems, Lobby Leader system, Campfire functionality and connectivity, VR functionality, and interacting with in-game objects like the tip screens and quick menu.

## **Objectives**

The team utilized two major testing strategies: testing within Unreal Engine 4's editor, and testing the game as a standalone application using two or more computers. Testing was done within UE4's editor to test the features that did not require a multiplayer or online connection. For example, when a player presses T to enable voice chat, there is a microphone icon that is crossed out when T is not pressed and held versus a regular microphone when it is. Unreal Engine allows testers to run the application as a standalone game outside of the engine, as it would be when published to a site like Steam. Epic Games provides a unique Steam ID that developers can use to test Steam multiplayer features in their game. The team utilized this tool to

test features like hosting and joining lobbies and retrieving Steam names. The end goal of testing was to ensure the final product was bug-free and an enjoyable experience for the player.

The following objectives were kept in mind while testing:

- a. All major features and use cases need to be accounted for
- b. All use cases must account for all the user roles
- c. All bugs need to be resolved before IT Expo or discussed in presentation
- d. All features will be tested as they are implemented or shortly after, then tested again later.
- e. All features will be completed to the best of the team's ability for maximum quality.

### **Test Logs and Procedures**

**Table 5.** *Test Logs and Procedures*

|                 |                                                                                                                                                                              |
|-----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Item #          | 004                                                                                                                                                                          |
| Test Case #     | 001                                                                                                                                                                          |
| User            | Maggie Seibert, Cade Myers                                                                                                                                                   |
| User Role       | Developers                                                                                                                                                                   |
| Expected Output | Voice chat activates when holding down the T key and deactivates when T is not held down, voice chat is proximity based, both players can hear others and be heard by others |
| Actual Output   | Voice chat activates when holding down the T key and deactivates when T is not held down, voice chat is                                                                      |

|                            |                                                                         |
|----------------------------|-------------------------------------------------------------------------|
|                            | proximity based, both players can hear others and be heard by others    |
| Pass/Fail                  | Pass                                                                    |
| Reason for Failure/Success | Voice Chat is programmed properly                                       |
| Date                       | 10/21/2021                                                              |
| Comments/Suggestions       | Add Mute/Unmute UI indicators so players know when voice chat is active |

|                            |                                                                                |
|----------------------------|--------------------------------------------------------------------------------|
| Item #                     | 001 and 002                                                                    |
| Test Case #                | 002                                                                            |
| User                       | Maggie Seibert, Chris Doan                                                     |
| User Role                  | Developers                                                                     |
| Expected Output            | One player is able to host a lobby, the other player is able to join the lobby |
| Actual Output              | Both players can host and join lobbies                                         |
| Pass/Fail                  | Pass                                                                           |
| Reason for Failure/Success | Programmed correctly                                                           |

|                      |                                  |
|----------------------|----------------------------------|
| Date                 | 11/1/21                          |
| Comments/Suggestions | Improve the UI for the main menu |

|                            |                                                      |
|----------------------------|------------------------------------------------------|
| Item #                     | 008                                                  |
| Test Case #                | 003                                                  |
| User                       | Emily Bender                                         |
| User Role                  | Developer                                            |
| Expected Output            | UI and fonts load correctly on Main Menu and in game |
| Actual Output              | UI and fonts load correctly on Main Menu and in game |
| Pass/Fail                  | Pass                                                 |
| Reason for Failure/Success | Programmed correctly                                 |
| Date                       | 11/14/21                                             |
| Comments/Suggestions       | Still designing and developing Quick Menu            |

|             |     |
|-------------|-----|
| Item #      | 005 |
| Test Case # | 004 |

|                            |                                                                                                                   |
|----------------------------|-------------------------------------------------------------------------------------------------------------------|
| User                       | Cade Myers, Maggie Seibert                                                                                        |
| User Role                  | Developers                                                                                                        |
| Expected Output            | Text Chat spawns and both players are able to send and read messages                                              |
| Actual Output              | Text Chat spawns on the main menu, which is too early in the game cycle. Text chat box does not close once opened |
| Pass/Fail                  | Fail                                                                                                              |
| Reason for Failure/Success | Buggy issues with spawning                                                                                        |
| Date                       | 11/26/2021                                                                                                        |
| Comments/Suggestions       | Need to add steam names to who sends what message                                                                 |

|                 |                                                                                                             |
|-----------------|-------------------------------------------------------------------------------------------------------------|
| Item #          | 005                                                                                                         |
| Test Case #     | 005                                                                                                         |
| User            | Maggie Seibert                                                                                              |
| User Role       | Developer                                                                                                   |
| Expected Output | Text Chatbox only can spawn once in a lobby, text chat box is shown when pressing backslash and hidden when |

|                            |                                                                                                                                                                                |
|----------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                            | backslash is pressed again. Players can read and send messages                                                                                                                 |
| Actual Output              | Text Chatbox only can spawn once in a lobby, text chat box is shown when pressing backslash and hidden when backslash is pressed again. Players can read and send messages     |
| Pass/Fail                  | Pass                                                                                                                                                                           |
| Reason for Failure/Success | Fixed issues in the player blueprint where there was no code to close the chatbox, changed the controller that was used in the main menu, and made the main menu UI input only |
| Date                       | 11/28/2021                                                                                                                                                                     |
| Comments/Suggestions       | Still need to add steam names                                                                                                                                                  |

|                 |                                                          |
|-----------------|----------------------------------------------------------|
| Item #          | 008                                                      |
| Test Case #     | 006                                                      |
| User            | Emily Bender                                             |
| User Role       | Developers, UI artist, and designer                      |
| Expected Output | Player can open and close the quick menu. The player can |

|                            |                                                                                                                                                                                                                                                 |
|----------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                            | move to different tabs on the quick menu. The audio menu allows users to change the volume on three separate categories of audio. The quit menu allows users to quit to the main menu.                                                          |
| Actual Output              | Player can open and close the quick menu. The player can move to different tabs on the quick menu. The audio menu allows users to change the volume on three separate categories of audio. The quit menu allows users to quit to the main menu. |
| Pass/Fail                  | Pass                                                                                                                                                                                                                                            |
| Reason for Failure/Success | Quick Menu's submenus work as expected.                                                                                                                                                                                                         |
| Date                       | 12/3/2021                                                                                                                                                                                                                                       |
| Comments/Suggestions       | Close the quick menu when the player moves away so it does not stay open. Finish the home and settings menu.                                                                                                                                    |

|             |                |
|-------------|----------------|
| Item #      | 011            |
| Test Case # | 007            |
| User        | Maggie Seibert |
| User Role   | Developer      |

|                            |                                                                     |
|----------------------------|---------------------------------------------------------------------|
| Expected Output            | Game launches in VR headset                                         |
| Actual Output              | Game did not launch in VR headset                                   |
| Pass/Fail                  | Fail                                                                |
| Reason for Failure/Success | Issues with how Seibert had Unreal Engine and Oculus Link installed |
| Date                       | 1/5/22                                                              |
| Comments/Suggestions       | n/a                                                                 |

|                            |                                                 |
|----------------------------|-------------------------------------------------|
| Item #                     | 011                                             |
| Test Case #                | 008                                             |
| User                       | Emily Bender                                    |
| User Role                  | Developer                                       |
| Expected Output            | Game Launches in VR headset                     |
| Actual Output              | Game Launches in VR Headset                     |
| Pass/Fail                  | Pass                                            |
| Reason for Failure/Success | Oculus App and Oculus Link was set up correctly |
| Date                       | 1/8/2022                                        |

|                      |                                                                        |
|----------------------|------------------------------------------------------------------------|
| Comments/Suggestions | Player cannot move, but code has not yet been implemented for this yet |
|----------------------|------------------------------------------------------------------------|

|                            |                                                                    |
|----------------------------|--------------------------------------------------------------------|
| Item #                     | 004                                                                |
| Test Case #                | 009                                                                |
| User                       | Cade Myers, Maggie Seibert                                         |
| User Role                  | Developers                                                         |
| Expected Output            | Newly Added PlayerHUD Mute/Unmute Icon works along with voice chat |
| Actual Output              | Mute button not showing up                                         |
| Pass/Fail                  | Fail                                                               |
| Reason for Failure/Success | Code had been accidentally overwritten in a github commit          |
| Date                       | 1/17/2022                                                          |
| Comments/Suggestions       | n/a                                                                |

|             |            |
|-------------|------------|
| Item #      | 001 or 002 |
| Test Case # | 010        |

|                            |                                                                                          |
|----------------------------|------------------------------------------------------------------------------------------|
| User                       | Emily Bender                                                                             |
| User Role                  | Developer                                                                                |
| Expected Output            | Testing new lobby map. Player Touches floor and room is scaled to fit the player         |
| Actual Output              | Room is scaled too big, character models float, and some objects have strange collisions |
| Pass/Fail                  | Fail                                                                                     |
| Reason for Failure/Success | Asset issues                                                                             |
| Date                       | 1/26/2022                                                                                |
| Comments/Suggestions       | May have to use different assets                                                         |

|                 |                                                                            |
|-----------------|----------------------------------------------------------------------------|
| Item #          | 001 or 002                                                                 |
| Test Case #     | 011                                                                        |
| User            | Chris Doan                                                                 |
| User Role       | Developers                                                                 |
| Expected Output | Testing the lobby map. Players able to walk around the room with no issues |

|                            |                                                                                                      |
|----------------------------|------------------------------------------------------------------------------------------------------|
| Actual Output              | The map scaling is off (bigger than character models) and there were collision issues within the map |
| Pass/Fail                  | Fail                                                                                                 |
| Reason for Failure/Success | There were collision issues within the map that made the players unable to walk around the map       |
| Date                       | 1/28/2022                                                                                            |
| Comments/Suggestions       | n/a                                                                                                  |

|                            |                                                                                  |
|----------------------------|----------------------------------------------------------------------------------|
| Item #                     | 001 and 002                                                                      |
| Test Case #                | 012                                                                              |
| User                       | Cade Myers, Maggie Seibert                                                       |
| User Role                  | Developers                                                                       |
| Expected Output            | Players are able to host and join lobbies                                        |
| Actual Output              | Join Lobby Screen is not populating results, randomly having issues with hosting |
| Pass/Fail                  | Fail                                                                             |
| Reason for Failure/Success | Multiple coding issues, missing code, missing info in the config files           |

|                      |                                                  |
|----------------------|--------------------------------------------------|
| Date                 | 1/30/22                                          |
| Comments/Suggestions | May need to rework the entire multiplayer system |

|                            |                                                                                                                                            |
|----------------------------|--------------------------------------------------------------------------------------------------------------------------------------------|
| Item #                     | 001 and 002                                                                                                                                |
| Test Case #                | 013                                                                                                                                        |
| User                       | Maggie Seibert                                                                                                                             |
| User Role                  | Developer                                                                                                                                  |
| Expected Output            | One player can host a lobby, another can view all available sessions based on the game's steam developer ID and click to join that session |
| Actual Output              | One player can host a lobby, another can view all available sessions based on the game's steam developer ID and click to join that session |
| Pass/Fail                  | Pass                                                                                                                                       |
| Reason for Failure/Success | Reworking the multiplayer code                                                                                                             |
| Date                       | 02/07/22                                                                                                                                   |
| Comments/Suggestions       | n/a                                                                                                                                        |

|                            |                                                                                                             |
|----------------------------|-------------------------------------------------------------------------------------------------------------|
| Item #                     | 011                                                                                                         |
| Test Case #                | 014                                                                                                         |
| User                       | Maggie Seibert                                                                                              |
| User Role                  | Developer                                                                                                   |
| Expected Output            | Player is able to switch from first person to VR headset by pressing shift V or using the quick menu button |
| Actual Output              | VR character model does not spawn                                                                           |
| Pass/Fail                  | Fail                                                                                                        |
| Reason for Failure/Success | Code was not correct in first person blueprint                                                              |
| Date                       | 2/26/22                                                                                                     |
| Comments/Suggestions       | n/a                                                                                                         |

|             |                |
|-------------|----------------|
| Item #      | 011            |
| Test Case # | 015            |
| User        | Maggie Seibert |
| User Role   | Developer      |

|                            |                                                                                        |
|----------------------------|----------------------------------------------------------------------------------------|
| Expected Output            | Player is able to interact with UI while playing in Virtual Reality                    |
| Actual Output              | Player is able to bring up quick menu and click on buttons using vr motion controllers |
| Pass/Fail                  | Pass                                                                                   |
| Reason for Failure/Success | Implemented Widget Interaction system in the motion controller blueprint               |
| Date                       | 2/28/22                                                                                |
| Comments/Suggestions       | n/a                                                                                    |

|                 |                                                                               |
|-----------------|-------------------------------------------------------------------------------|
| Item #          | 001 or 002                                                                    |
| Test Case #     | 016                                                                           |
| User            | Chris Doan                                                                    |
| User Role       | Developer                                                                     |
| Expected Output | Testing 2 new maps (campfire and park). Players should be able to walk around |
| Actual Output   | Players fell through the ground in a few spots on the maps                    |

|                            |                                                                                                                                                                       |
|----------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Pass/Fail                  | Fail.                                                                                                                                                                 |
| Reason for Failure/Success | Players weren't able to stand on the ground. Some of the assets used on the ground don't have collision (grass patch, grass ground, etc) so players can't stand on it |
| Date                       | 3/4/2022                                                                                                                                                              |
| Comments/Suggestions       | n/a                                                                                                                                                                   |

|                 |                                                                                             |
|-----------------|---------------------------------------------------------------------------------------------|
| Item #          | 001 or 002                                                                                  |
| Test Case #     | 017                                                                                         |
| User            | Chris Doan                                                                                  |
| User Role       | Developer                                                                                   |
| Expected Output | Testing 2 new maps (campfire and park). Players should be able to walk around               |
| Actual Output   | Added more assets to support the ground so players won't be able to fall through the ground |
| Pass/Fail       | Pass                                                                                        |

|                            |                                                                                                                                   |
|----------------------------|-----------------------------------------------------------------------------------------------------------------------------------|
| Reason for Failure/Success | Players can now walk around without falling through.<br><br>Added more assets to support the ground (ground path, dirt path, etc) |
| Date                       | 3/6/2022                                                                                                                          |
| Comments/Suggestions       | n/a                                                                                                                               |

|                            |                                                                                                                                                                            |
|----------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Item #                     | 001 and 002                                                                                                                                                                |
| Test Case #                | 018                                                                                                                                                                        |
| User                       | Maggie Seibert, Cade Myers                                                                                                                                                 |
| User Role                  | Developers                                                                                                                                                                 |
| Expected Output            | Main Menu music plays, all buttons work, one player can host a lobby, another can join, server name, game mode and number of players all populate on the join lobby screen |
| Actual Output              | Music plays, buttons work, server name, game mode, and max players do not show the correct information, players can host and join lobbies                                  |
| Pass/Fail                  | Fail                                                                                                                                                                       |
| Reason for Failure/Success | server name, game mode, and max players do not show the correct information, after the host leaves the game mode the                                                       |

|                      |                                                      |
|----------------------|------------------------------------------------------|
|                      | lobby needs to be removed from the join lobby screen |
| Date                 | 3/17/22                                              |
| Comments/Suggestions | n/a                                                  |

|                            |                                                                                                   |
|----------------------------|---------------------------------------------------------------------------------------------------|
| Item #                     | 007                                                                                               |
| Test Case #                | 019                                                                                               |
| User                       | Maggie Seibert, Cade Myers                                                                        |
| User Role                  | Developers                                                                                        |
| Expected Output            | Lobby leader system spawns for host and not client                                                |
| Actual Output              | Lobby leader system spawns for host and not client, but has the wrong steam names for the players |
| Pass/Fail                  | Fail                                                                                              |
| Reason for Failure/Success | Issues with replicating the steam name vs the instance of a steam name                            |
| Date                       | 3/17/22                                                                                           |
| Comments/Suggestions       | Still not solved                                                                                  |

|        |     |
|--------|-----|
| Item # | 005 |
|--------|-----|

|                            |                                                                                                    |
|----------------------------|----------------------------------------------------------------------------------------------------|
| Test Case #                | 003                                                                                                |
| User                       | Maggie Seibert, Cade Myers                                                                         |
| User Role                  | Developers                                                                                         |
| Expected Output            | Typing works, everything is logged and there is a functioning scroll bar for reading past messages |
| Actual Output              | No steam name next to the messages they send                                                       |
| Pass/Fail                  | Fail                                                                                               |
| Reason for Failure/Success | No steam name next to the messages they send                                                       |
| Date                       | 3/17/22                                                                                            |
| Comments/Suggestions       | n/a                                                                                                |

|                 |                                                                                                  |
|-----------------|--------------------------------------------------------------------------------------------------|
| Item #          | 004                                                                                              |
| Test Case #     | 020                                                                                              |
| User            | Maggie Seibert, Cade Myers                                                                       |
| User Role       | Developers                                                                                       |
| Expected Output | Players can use voice chat to communicate with others and the unmute/mute icon displays properly |

|                            |                                                          |
|----------------------------|----------------------------------------------------------|
| Actual Output              | Voice does not come through                              |
| Pass/Fail                  | Fail                                                     |
| Reason for Failure/Success | Voice Chat function not active in first person blueprint |
| Date                       | 3/17/22                                                  |
| Comments/Suggestions       | n/a                                                      |

|                            |                                                                                                |
|----------------------------|------------------------------------------------------------------------------------------------|
| Item #                     | 008                                                                                            |
| Test Case #                | 021                                                                                            |
| User                       | Maggie Seibert, Cade Myers                                                                     |
| User Role                  | Developers                                                                                     |
| Expected Output            | Quick Menu spawns when the players presses Q on the keyboard and all buttons function properly |
| Actual Output              | Quick Menu spawns when the player presses Q on the keyboard and all buttons function properly  |
| Pass/Fail                  | Pass                                                                                           |
| Reason for Failure/Success | n/a                                                                                            |
| Date                       | 3/17/22                                                                                        |

|                      |     |
|----------------------|-----|
| Comments/Suggestions | n/a |
|----------------------|-----|

|                            |                                                                    |
|----------------------------|--------------------------------------------------------------------|
| Item #                     | 003                                                                |
| Test Case #                | 022                                                                |
| User                       | Maggie Seibert, Cade Myers                                         |
| User Role                  | Developers                                                         |
| Expected Output            | All tips show up and the arrow buttons to switch between them work |
| Actual Output              | All tips show up and the arrow buttons to switch between them work |
| Pass/Fail                  | Pass                                                               |
| Reason for Failure/Success | All tips show up and the arrow buttons to switch between them work |
| Date                       | 3/17/22                                                            |
| Comments/Suggestions       | n/a                                                                |

|             |     |
|-------------|-----|
| Item #      | 011 |
| Test Case # | 023 |

|                            |                                                                                                                                                                                                                                       |
|----------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| User                       | Maggie Seibert, Cade Myers                                                                                                                                                                                                            |
| User Role                  | Developers                                                                                                                                                                                                                            |
| Expected Output            | Player can switch to VR controls using FPS/VR switch button or Shift V, a full character model is still visible for other players, motion controller hands still spawn along with widget interaction lines for the controlling player |
| Actual Output              | Lighting gets randomly dark when looking some ways, other hands see hands and not character model, quick menu is invisible, need to increase movement speed, controls guide doesn't spawn when vr model does                          |
| Pass/Fail                  | Fail                                                                                                                                                                                                                                  |
| Reason for Failure/Success | Lighting issues, replication issues                                                                                                                                                                                                   |
| Date                       | 3/17/22                                                                                                                                                                                                                               |
| Comments/Suggestions       | n/a                                                                                                                                                                                                                                   |

|             |                            |
|-------------|----------------------------|
| Item #      | 009 and 010                |
| Test Case # | 024                        |
| User        | Maggie Seibert, Cade Myers |
| User Role   | Developers                 |

|                            |                                                                                           |
|----------------------------|-------------------------------------------------------------------------------------------|
| Expected Output            | Players can host campfire game modes from the quick menu and join them from the main menu |
| Actual Output              | Players can host campfire game modes from the quick menu and join them from the main menu |
| Pass/Fail                  | Pass                                                                                      |
| Reason for Failure/Success | Players can host campfire game modes from the quick menu and join them from the main menu |
| Date                       | 3/17/22                                                                                   |
| Comments/Suggestions       | n/a                                                                                       |

|                 |                                                                                        |
|-----------------|----------------------------------------------------------------------------------------|
| Item #          | 006                                                                                    |
| Test Case #     | 025                                                                                    |
| User            | Maggie Seibert, Cade Myers                                                             |
| User Role       | Developers                                                                             |
| Expected Output | Both players can pick up the ball and throw it in the basketball hoop                  |
| Actual Output   | Host can pick up the ball but client cannot, collision issues with the basketball hoop |

|                            |                                      |
|----------------------------|--------------------------------------|
| Pass/Fail                  | Fail                                 |
| Reason for Failure/Success | Client cannot interact with the ball |
| Date                       | 3/17/22                              |
| Comments/Suggestions       | n/a                                  |

|                            |                                            |
|----------------------------|--------------------------------------------|
| Item #                     | 001                                        |
| Test Case #                | 026                                        |
| User                       | Maggie Seibert                             |
| User Role                  | Play tester                                |
| Expected Output            | Player can host lobby that others can join |
| Actual Output              | Player can host lobby that others can join |
| Pass/Fail                  | Pass                                       |
| Reason for Failure/Success | Player can host lobby that others can join |
| Date                       | 3/26/22                                    |
| Comments/Suggestions       | n/a                                        |

|        |     |
|--------|-----|
| Item # | 002 |
|--------|-----|

|                            |                                                                                                                                                         |
|----------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------|
| Test Case #                | 027                                                                                                                                                     |
| User                       | Maggie Seibert                                                                                                                                          |
| User Role                  | Play tester                                                                                                                                             |
| Expected Output            | Player can view the list of all available game sessions and click on one to join                                                                        |
| Actual Output              | Player can view the list of all available game sessions and click on one to join, Server name, player number, and game mode information all now show up |
| Pass/Fail                  | Pass                                                                                                                                                    |
| Reason for Failure/Success | Player can view the list of all available game sessions and click on one to join, Server name, player number, and game mode information all now show up |
| Date                       | 3/26/22                                                                                                                                                 |
| Comments/Suggestions       | n/a                                                                                                                                                     |

|             |                |
|-------------|----------------|
| Item #      | 004            |
| Test Case # | 028            |
| User        | Maggie Seibert |

|                            |                                                                           |
|----------------------------|---------------------------------------------------------------------------|
| User Role                  | Play tester                                                               |
| Expected Output            | Players can communicate with each other using voice chat                  |
| Actual Output              | Seibert's computer was lagging so the audio came through but it was laggy |
| Pass/Fail                  | Pass                                                                      |
| Reason for Failure/Success | Audio came through                                                        |
| Date                       | 3/26/22                                                                   |
| Comments/Suggestions       | n/a                                                                       |

|                 |                                                                                                |
|-----------------|------------------------------------------------------------------------------------------------|
| Item #          | 009                                                                                            |
| Test Case #     | 029                                                                                            |
| User            | Maggie Seibert                                                                                 |
| User Role       | Play tester                                                                                    |
| Expected Output | Player can open Quick Menu, click Host campfire and begin hosting a campfire game mode session |
| Actual Output   | Player can open Quick Menu, click Host campfire and begin hosting a campfire game mode session |

|                            |                                                                                                |
|----------------------------|------------------------------------------------------------------------------------------------|
| Pass/Fail                  | Pass                                                                                           |
| Reason for Failure/Success | Player can open Quick Menu, click Host campfire and begin hosting a campfire game mode session |
| Date                       | 3/26/22                                                                                        |
| Comments/Suggestions       | n/a                                                                                            |

|                            |                                                                                                  |
|----------------------------|--------------------------------------------------------------------------------------------------|
| Item #                     | 010                                                                                              |
| Test Case #                | 030                                                                                              |
| User                       | Maggie Seibert                                                                                   |
| User Role                  | Play tester                                                                                      |
| Expected Output            | Player can click join lobby on the main menu, see the sessions listed as campfires and join them |
| Actual Output              | Player can click join lobby on the main menu, see the sessions listed as campfires and join them |
| Pass/Fail                  | Pass                                                                                             |
| Reason for Failure/Success | Player can click join lobby on the main menu, see the sessions listed as campfires and join them |
| Date                       | 3/26/22                                                                                          |

|                      |     |
|----------------------|-----|
| Comments/Suggestions | n/a |
|----------------------|-----|

|                            |                                                                                                         |
|----------------------------|---------------------------------------------------------------------------------------------------------|
| Item #                     | 011                                                                                                     |
| Test Case #                | 031                                                                                                     |
| User                       | Maggie Seibert                                                                                          |
| User Role                  | Play tester                                                                                             |
| Expected Output            | Player can switch from first person view to VR                                                          |
| Actual Output              | Player can switch from first person view to VR, controls work, other players see the third person model |
| Pass/Fail                  | Pass                                                                                                    |
| Reason for Failure/Success | Player can switch from first person view to VR                                                          |
| Date                       | 3/26/22                                                                                                 |
| Comments/Suggestions       | n/a                                                                                                     |

|             |                |
|-------------|----------------|
| Item #      | 005            |
| Test Case # | 032            |
| User        | Maggie Seibert |

|                            |                                                                                                                      |
|----------------------------|----------------------------------------------------------------------------------------------------------------------|
| User Role                  | Play tester                                                                                                          |
| Expected Output            | Players can use text chat to communicate with each other                                                             |
| Actual Output              | Text chat work except it only knows the Host's name when they send a message, names not populating for other players |
| Pass/Fail                  | Pass                                                                                                                 |
| Reason for Failure/Success | Players can use text chat to communicate with each other                                                             |
| Date                       | 3/26/22                                                                                                              |
| Comments/Suggestions       | n/a                                                                                                                  |

|                 |                                                                                                                          |
|-----------------|--------------------------------------------------------------------------------------------------------------------------|
| Item #          | 007                                                                                                                      |
| Test Case #     | 033                                                                                                                      |
| User            | Maggie Seibert                                                                                                           |
| User Role       | Play tester                                                                                                              |
| Expected Output | Host can use lobby leader system to kick other players and not themselves                                                |
| Actual Output   | Host can use lobby leader system to kick other players and not themselves but the steam name is not populating correctly |
| Pass/Fail       | Pass                                                                                                                     |

|                            |                                                                                                  |
|----------------------------|--------------------------------------------------------------------------------------------------|
| Reason for Failure/Success | Despite the steam name not populating correctly, it still kicks the correct player from the game |
| Date                       | 3/26/22                                                                                          |
| Comments/Suggestions       | n/a                                                                                              |

### Testing Review

Several parts of the project were reworked, some several times. For example the online multiplayer system was finished in its entirety, then after a few months, stopped working. The team decided that it would be best to just completely rework and redo how the multiplayer connectivity was programmed. Many issues were a result of using Github and pushes overwriting other team members' work. This showed just how important it is to communicate during a project and for each member to know what each system in the game is supposed to do and how it functions at any given time.

The development of Hangout VR was very educational. Several members went from never having done features like multiplayer or VR to having a greater understanding. One feature that would be redone or done differently in the future is switching between first person and virtual reality controls. Three separate player blueprints were used and the switch between them involved destroying character models and caused several bugs. In the future this would all be done in one player blueprint to make the transition from first person to VR less buggy.

### Change Management Plan

All team members can request a change, play testers may make suggestions in the circumstance that they believe a certain game mechanic, idea, or logic does not make sense or

they believe there is a more efficient way to solve an issue. The team will meet to discuss the change and if everyone agrees then the change will be made. All changes will be treated as important, if not critical so that all team members are on the same page. Necessary changes will be communicated with the advisors via email or Teams chat.

## Budget

The budget table below shows the cost to develop the project plus the cost to host and maintain the game annually. For the rate of labor, the team estimated what it would cost to develop the game and the team used the estimated average rate for entry-level game developers to calculate the ongoing annual cost to keep the game afloat (ZipRecruiter 2022). The team will not need any external labor but that might be subject to change in the future. In terms of software, the team mostly utilizes free applications for development, with one exception being Adobe Photoshop. Unreal Engine is free to use but there is a 5% royalty fee if the project generates \$1 million. There is a \$100 fee to publish the game on Steam and 30% of the game revenue goes to Steam after publication. AWS GameLift Services' c.4 large server costs \$0.14736/hour or \$53.79 per month (Amazon 2022). These are all estimated costs and are subject to change.

Table 6. Budget Estimates

|  | Rate<br>Per/Hr | Work<br>Effort<br>(Hours) | 1 X Costs | Ongoing Annual |                        |                        |
|--|----------------|---------------------------|-----------|----------------|------------------------|------------------------|
|  |                |                           |           | Rate<br>Per/Hr | Work Effort<br>(Hours) | 1 X<br>Support<br>Cost |
|  |                |                           |           |                |                        |                        |

|                     |       |               |                                                                                              |       |                    |                               |
|---------------------|-------|---------------|----------------------------------------------------------------------------------------------|-------|--------------------|-------------------------------|
| Labor - IT          | \$25+ | 40 hours/week | \$1000+/week                                                                                 | \$25+ | 1500+ hours        | ~ 53,000+/year                |
| Labor - External    | 0     | 0             | 0                                                                                            | 0     | 0                  | 0                             |
| Software - External |       |               | \$100 - to publish on Steam <sup>1</sup>                                                     |       |                    | 30% of revenue                |
| Hardware - External |       |               | - \$2000/pc (4 people)<br>- \$0.14736/hour or \$53.79 per Month for AWS servers <sup>2</sup> |       |                    | ~ \$650/year <sup>2</sup>     |
| Misc.               |       |               | \$50-150: art assets                                                                         |       |                    |                               |
| <b>TOTAL</b>        | \$25  | 40hrs/week    | \$9200+                                                                                      |       | 1500+ hours/yearly | ~ \$53,650+/year <sup>2</sup> |

<sup>1</sup>: Steam charges a fee of \$100 for each game one submits on Steam Direct. Although nonrefundable, this fee can be recouped once the product has generated at least \$1,000 adjusted gross revenue from the Steam Store and in-app purchases.

<sup>2</sup>: Assuming the team will be using AWS GameLift c.4 large servers (Amazon GameLift, 2022).

## Problems Encountered and Analysis of Problems Solved

List each problem you experienced and discuss how it was or was not solved in this section.

### 1. Merging branches

Most weeks team members were working on individual tasks. As such, each team member worked on their own branch where their changes were kept. When it came time to merge the team's branches to master, the team did not want to override anyone's changes as they would have had to do their work over again. The team overcame this issue by waiting to merge

to master until everyone could meet to do it together. With everyone present, it is easier to double-check which changes to keep.

## 2. Camera clipping head of player

When the camera was made the first person on the default third person character Blueprint, the team encountered issues with the camera clipping the head of the character mesh. Cade spent several hours trying to fix the issue and eventually solved the issue by moving the camera forward slightly.

## 3. Replication Issues

One of the most important aspects of any multiplayer game is replication. Some of the player's actions are replicated to all clients, however, some still are not. The team did not have time to make sure everything was replicated correctly when implementing features. The team needs to take time to make sure all actions that need to be replicated are replicated.

## 4. UI spacing and layout issues

Team member Emily struggled with creating UI widgets at first because she was not very familiar with them. After watching tutorials, reading documentation, and working with the UI widgets in Unreal, she was able to create the UI as she intended it to look and behave.

## 5. Animation and alternate skeletons

With multiple animation packs being pulled into the project, each used a different skeleton and therefore was not compatible with each other at first. This was solved by creating a humanoid rig to which animation would latch to instead, so when applied to the model used in-game, the animations would respond accordingly.

## 6. Networking issues

Issues due to the overriding of other's code in Github commits cause the multiplayer connectivity to fail. This resulted in Seibert having to redo the entire multiplayer system. Several features were impacted by this, as they could not be developed properly without proper Steam connectivity. Examples of this include text chat and the lobby leader system. These issues were not fully solved due to time constraints. The lobby leader system functions correctly but does not display the correct steam name for each player. Similarly, only the Host's name appears next to the messages they send in text chat. Client's names do not appear next to the messages they send.

## 7. Campfire

Campfire had issues with replicating the same prompt across all players. This issue was resolved by only displaying the prompt to the host player but also displaying instructions to all players that told them the host gets the prompt and has to tell them what it is.

## 8. Virtual Reality

Virtual Reality had an assortment of issues in the beginning such as the player not being able to move, not being able to interact with objects, not spawning the motion controller hands, and not being able to switch back to first-person view. All features now work in virtual reality aside from text chat and the ability to switch back to first person. It was decided to leave the switching mechanic as is for the sake of time and developing other parts of the game as most players who would want to play in VR would likely not need to switch back anyways.

## 9. Map Design

The hardest challenge that I went through when designing all the levels were collision issues. Some assets that I used created collision issues where you can't walk over a certain thing or there was an invisible object blocking the way or players will fall through the ground in certain places. I fixed those issues by going into the asset editor and edit the mesh and collision

settings, for the falling through the map issue I had to put additional assets to support the floor/map.

## Conclusion

What abilities/skills did you develop or enhance while you completed this project?

### Lessons Learned

- a. The team should have completed more research on the workload of developing a multiplayer social game for desktop and virtual reality platforms. It is a rather extensive and difficult task, as such, many of the original features had to be sacrificed to focus on getting core mechanics working.
- b. It is better to overestimate the time needed to accomplish a task. This gives the developer more leeway and does not leave them feeling discouraged when things do not work.
- c. Good communication is needed for a well-functioning team. All team members were good about responding on Discord and attending meetings. Merging changes to master went smoothly when team members communicated what changes needed to be kept.
- d. The core mechanics of HangoutVR should have been implemented and tested extensively before moving on to implementing minigames. The minigames add more fun to the game, however, the main mechanics of joining or hosting a session, voice chat, text chat, and interacting with the environment need to be refined before the team moves on.

### What abilities/skills did you develop or enhance while you completed this project?

- Working in a team environment
  - Managing progress
  - Scheduling meetings
  - Working with git control and GitHub
- Emily and Maggie developed their 3D modeling skills by working in Blender.
- All team members improved their scripting skills by implementing features using Unreal Blueprints.
- All team members have a better understanding of networking a game through LAN.
- All team members have a better understanding of multiplayer development.
- Emily improved her graphic design skills by creating assets in Figma for the game user interfaces and designing the IT Expo Poster and PowerPoint presentations.
- All team members improved their professional writing skills by working on the project report collaboratively.
- All team members improved their professional presentation skills by participating in in-class presentations and the IT Expo.
- Seibert greatly improved her understanding of multiplayer connections, virtual reality development, and Unreal Engine and coding overall

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