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# Game Design Document for prototype developed for the project Liberation of Mt.Ironhold

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## Game Overview

This game is based off the 'The Liberation of Mt. Ironhold' board game I worked on during my ECS7015 Fundamentals of Games Design module, link to the rules can be found here [https://docs.google.com/document/d/1e6YPZiU0Jv2eJT8hx\\_v0luhKwWFbFr2ZRL\\_MFV7Ftmg/edit?usp=sharing](https://docs.google.com/document/d/1e6YPZiU0Jv2eJT8hx_v0luhKwWFbFr2ZRL_MFV7Ftmg/edit?usp=sharing)

### Concept Statement

A grid-based Fantasy Exploration game which pits a dwarven warrior against The Dark Wizard, The Dark Wizard, as they try to take back control of the dungeon, The Great Mine, by reaching the Wizard's Keep, The Dwarves will be immersed in Virtual Environment having a full three dimensional view inside the dungeon, able to interact with their environment using their motion controllers, The Wizard will take the task of the overseer being able to manipulate the dungeon from above trying to thwart the Dwarves plans. Gaining the upper hand is not a simple task however, requiring the collection of treasure items to boost certain attributes for the player, whether that be within combat or of knowledge of the board, for a gruelling fight at the finish line, promoting exploration around the grid, a grid that is generated and manipulated in real time by the dungeon master, who has their own set of powers they may call upon to hinder the other players progress with their sole objective is to eliminate all the opposing players.

### Target Audience:

Ages 8+, requires 2-Players, Maximum 4-Players

### Player Experience Goals:

The Virtual Reality (VR) Players should also feel immersed in their environment, taking on this role of the warrior character trapped within a maze. However, I still want multiple choice elements for the other players, them also having to navigate different approaches to reaching the goal needing to prioritise different strategies, e.g. running straight for the exit or playing riskier and fighting larger enemies for higher rewards, there is also an element of resource management, items received from chests are limited and randomised, similarly different enemy types have unique attack patterns, forcing the player to be strategical with how they approach different encounters.

The Augmented Reality (AR) Players takes on a role similar to that of a dungeon master from D&D, they have a unique perspective of the board from the VR Players, having this top-down view of the dungeon's layout, they need to feel as though they are watching down over their domain, which leverages the AR format so well, allowing the player to transform their own real life environment into that of the Wizard's Keep. The need to strategically take control of the board, the use of cool downs for spells and enemy placement places heavy emphasis on smart and creative use of their turns, managing the players possible moves with the different abilities they have at their disposal at any one time.

## Sources of Inspiration



Captain Toad: Treasure Tracker (Wii U)

Inspiration Taken: Game uses two different playstyles, a tablet (Wii Gamepad) and display screen to maneuver character around the environment, the gamepad provides a way to stop enemies, reveal hidden paths etc. whilst the display provides a larger view for players to move



Stop Talking and Nobody Explodes (PC)

Inspiration Taken: An example of a co-operative game that implements two different systems of player interaction, one player plays in VR or on Desktop and has control of the bomb, the other player has this hidden from their view, instead having a set of instructions they must relay to the bomb diffuser, it is an interesting case unique player action sets. Also could be a good reference as for UI interaction for the object and the player whilst in VR.



Knightfall AR (Mobile)

Inspiration Taken: This game uses AR technology in order to place a small virtual world on a surface, specifically it is the use of the 360 view afforded by the platform that allows users to fire projectiles at enemies that roam around the small virtual space to provide engaging gameplay. This showing the possibilities that top-down perspective AR games have.



Blade and Sorcery (VR)

Inspiration Taken: Blade and Sorcery is a good example of VR Controls, the ability to use menus attached to the player and the different ways in which it is possible to interact with the environment in VR.

## **Mechanics**

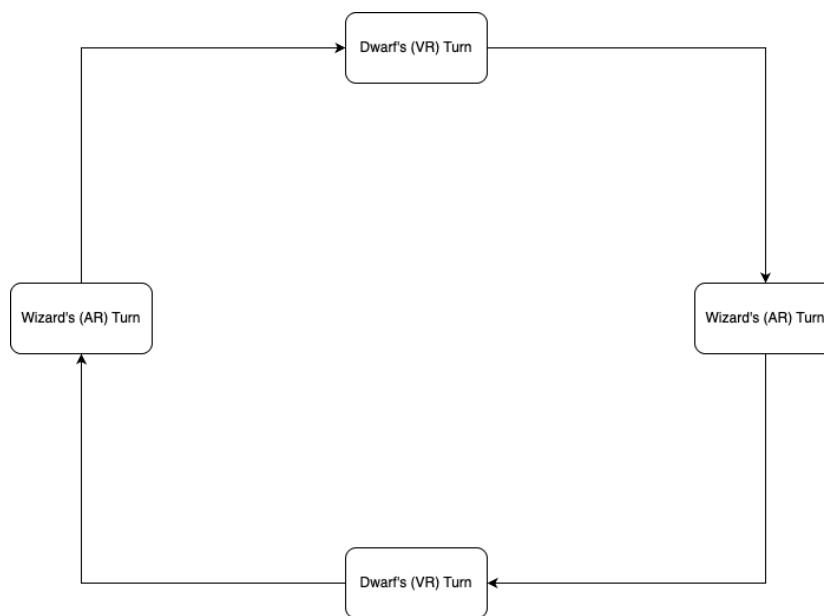
### Gameplay

Setup: At the start of the game the Dark Wizard will have an assortment of objects they can place on the map using the touchscreen, each area of the map is sectioned into a small room, these rooms will be highlighted when selected providing player feedback, when an object has been confirmed to be placed in a room a small representation will be shown on that room, allowing the player to keep track of objects placed around the map. This view of these objects will only be viewable however from the AR Players topdown perspective, the VR Player will operate within the dungeon themselves, a smaller representation of the Dwarf will be viewable to the AR Player from their perspective it will be fully synced up with their movements, unexplored rooms will be hidden from view using volumetric fog, only by passing through the rooms boundaries will this fog clear in order to see what is within.

### Main Gameplay Loop

The base game followed a turn-based format: Turn Order: Dwarf → Dark Wizard → Dwarf → Dark Wizard ... until the Dwarf reaches the Dark Wizard's Keep and defeats him in real-time combat. Turns progress for the AR Player by selecting the spell to use or creature to spawn, they are limited to one action per turn and some actions will incur a cool down once activated.

The VR Players turn on the other hand finishes when they have interacted with whatever object exists within the room, e.g. opening a chest, fighting an enemy etc. It should be noted that the Dwarves do have the ability to use their items at any point within either players turn, for example they may wish to use a Lantern to dissipate the fog from one of their tunnels in the interim between turns, however AR Players will be strictly limited to use of their spells and summons within their own turn.



To accommodate the turn based system whilst also providing free movement around the dungeon rooms when the Dwarf enters a new room, walls will be raised around the entrances to prevent further movement into multiple rooms per turn, they will only be lifted again once the AR Player's turn has finished, as mentioned before however they are free to use any items they wish during that interim.



*Example of fog blocking players view*

#### Dwarves (VR Player)

The Dwarf players will be able to interact with their environment within virtual reality, they will progress from room to room to complete their main goal of finding the Wizard's Keep, when entering each room they will presented with an obstacle placed by the Dark Wizard, they must resolve an interaction with that obstacle in order to progress. In order to help them in their journey they can obtain power-up items from chests, these will buff the player in different ways in order to make their experience easier and the Wizard's more challenging.

During each turn the Dwarf is required to move to a new room, where they will have to resolve an interaction with whatever obstacle they face, to progress to the next room.

They also have the opportunity to activate power ups that can be collected via chests around the map, by pressing X they can open up a powerup menu and use the motion controller left stick to select a power up to use, the uses of each power up will be noted below.

Movement: Motion Controller Right Stick (UP, DOWN, LEFT, RIGHT)

Rotation: Motion Controller Left Stick / VR Headset Gyroscopic Rotation

Interaction: Left and Right Motion Controller Triggers

Power Up Menu Control: X Button

### Wizards (AR Player)

The Wizards turn consists of selecting a specific object, to place, or spell, to cast, on their turn to hinder the players, the different options will be varied in effect.

Map Interactions: Touch Screen

Map Navigation: Gyroscopic Movement via the device's camera

Map Resizing: The buttons available on the bottom and side of the screen.

Touch Control based movement: When switching to first person mode for the final fight they can use the touch controls to move the character around.

Spells:

**Swap:** the Wizard has the ability to swap any two objects on the map, this can provide a huge strategic advantage for example if you know a Dwarf is heading towards a chest you can swap it with say a Goblin or Trap to flip the interaction in your favour. This will incur a 2 turn cooldown however.

**Block Tunnels:** Block Tunnels allow the Wizard to block the tunnels between two rooms, this will force the Dwarf to redirect possibly towards some trap the Wizard had planted in hindsight. This will incur a 2 turn cooldown however.

**Frenzy:** Frenzy can be applied to Goblins in order to double their size and increase their hit box making the possibility of hitting the Dwarf double, it also increases their health pool by 2 points, making them a tougher enemy to fight overall.

### Interaction Types

**Treasure:** Treasure objects are placed around the map by the Dark Wizard at the start of the game, they are interacted with by the Dwarf players and will provide a randomised item that will be added to their inventory, these items provide beneficial effects to the player and are a one time use only.

Health Potion: These provide a health boost restoring 2 HP to the player visually represented by a green flash and a change to the player health icons.

Attack Boost: These provide an attack boost to the player, doubling all damage they do to enemies, this can also be used to counteract the effect of an attack lower ailment they may be afflicted with from traps. This effect will wear off after interacting with the creature.

Speed Boost: The speed boost allows the Dwarf player to move two spaces rather than one on the turn it is activated, however they will not be able to interact with the object in the first room they move through, it will appear see through and have its behaviours turned off, the fog in the tunnel between rooms will still dissipate allowing the player to peer behind them, this can be useful if a chest is behind them for example, they can go back and pick up whatever item is in it, the effect wears off when they reach the second room, they will still have to deal with the encounter in that one.

**Lantern:** The Lantern Power up allows the Dwarf to dissipate the fog on one of the connecting tunnels between rooms, allowing them to see into that room, this effect will only apply to tunnels where fog is present, arrows will appear on the floor to show which tunnels are available to use the power up and will be selected using the right bumper.

**Traps:** Trap objects are the opposite to treasure objects, they are hidden from the Dwarf player when they first enter a room, however when they walk into the center of it, the trap will activate and apply a detrimental effect on the player, it should be noted that whilst these traps will be hidden from the Dwarf Player they will be marked on the AR Players map with a red cross.

**Health Reduce:** This will simply reduce the Dwarf player's health by 1.

**Attack Down:** This is the opposite of an Attack Boost, this will half the Dwarf players attack in their next encounter, as mentioned before this can be counteracted if the player uses an attack boost power up.

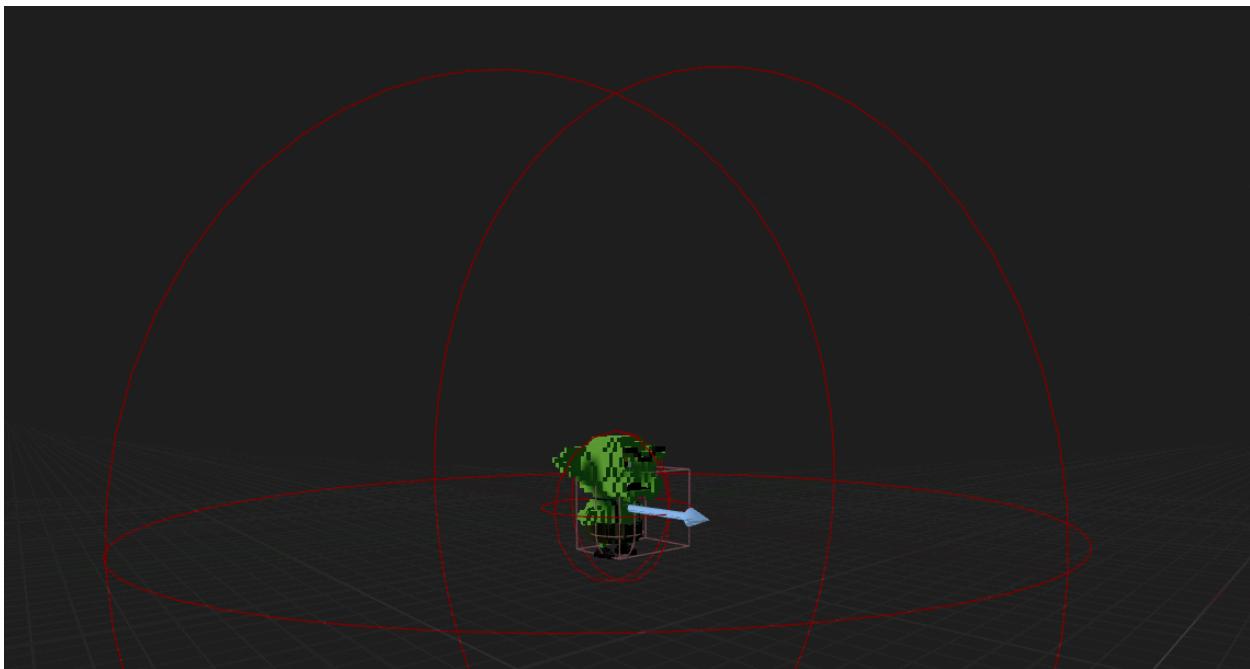
**Speed Down:** This similarly is the opposite to a Speed Boost power up, freezing the Dwarf stopping them from receiving any input from the player's controllers, keeping them stuck until 2 of the AR Players turns have progressed at which point they will be freed and allowed to resume their turn.

### Combat

Combat will be all real-time, The Dwarf will have access to a Hammer which they can wield by reaching their motion controller behind their back, the hammer will have a hitbox connected to its head, when this head interacts with a creature it will take damage from it's health pool until it runs out and is defeated, dropping a card that will help the player, same goes for the player, they too will have their own health bar, always viewable to the AR Player in their UI, the creatures will have animations and hit boxes that become harmful on certain frames.



## Goblin



As you can see from the screenshot the Goblins have 3 colliders, when the Dwarf players enter these colliders different effects will occur.

### Finite State Machine (FSM)

The Goblin enemies are managed by a finite state machine, this allows for the Goblin to keep an internal state and perform actions based on the state they are in:

#### Idle (Default)

The Goblin will play the idle animation and stand on the spot, this is their default state. When the Dwarf Player enters the outer collider the state will be changed to chasing.

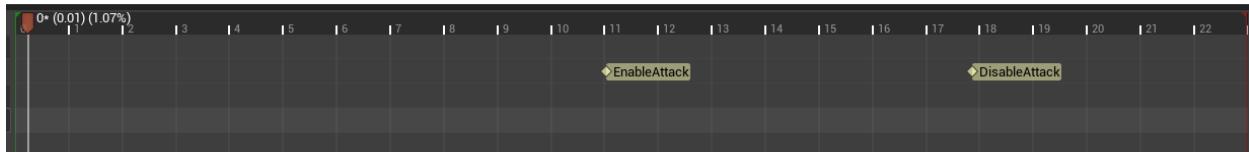
#### Chasing

When chasing this will activate the Goblin's AIController from the Unreal's AIController's Move to actor function that will move the object towards the player object's position, this will be visualised through the Goblin's running animation. They will perform this until the Dwarf enters their attacking collider that will once again change their state prompting a transition to the attacking state.

#### Attacking

This will play an attacking animation on the Goblin, within this animation it contains 2 notifies.

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These notifications will call functions in the entity's main class to turn on the collider on the hand allowing for the Dwarf character to take damage if the collider makes contact.

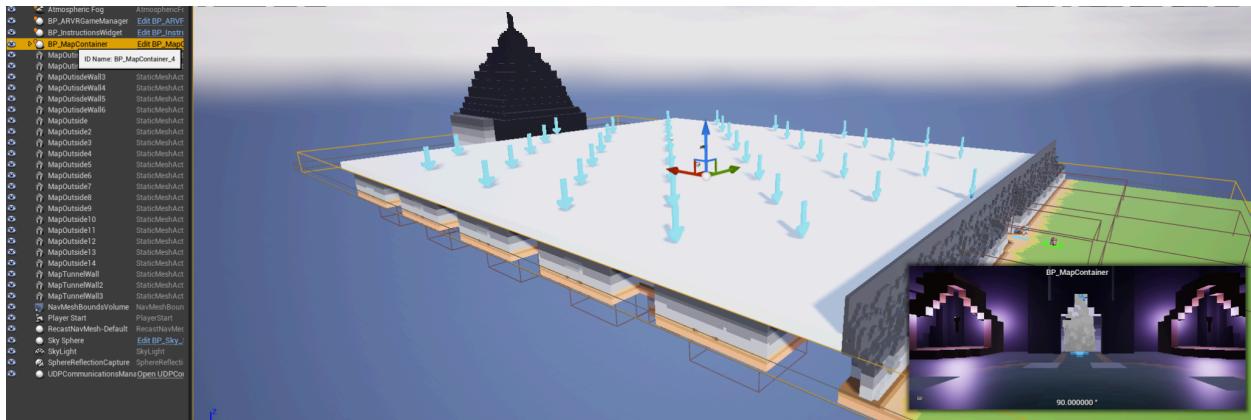
### Final Battle



The Final Battle at the end of the game will simulate the Dwarves bursting into the Dark Wizard's chambers, the Dark Wizard no longer looking down on the map but brought down to the same level as the Dwarves. This perspective change is made possible by the unique advantages of the AR format. The Wizard will control the game using the touch controls and will be able to shoot projectiles using the fire buttons. To counteract this the Dwarf will be able to block the spells with his hammer, leading to tense confrontation where neither side has a clear advantage.

### Map Setup

To synchronise map states, all positional and rotational changes needed to be exactly the same between both systems, the solution to this, to build a large box around the map, with all the map elements placed beneath it in the hierarchy.



This allowed for relative positions to be sent over the network rather than absolute world positions, allowing for the two systems to be perfectly in sync as they were essentially using exactly the same map.

### Map Sections

Each map section is able to hold one object within them, spawned by the Wizard Player, each of the exits to the other map sections are initially blocked off by fog, however when you move through them the fog disappears allowing you to see back through passageways you've already been through.

There is a piece of code that sorts all of the map sections by their position in world space, ordering them first by their y coordinate and then by their x, the first index in the array having the lowest x and y value and the last index having the highest y. This syncs up the two arrays between systems for easy reference of sections as the index values would be the same.

### Map Tunnels

Map Tunnels provide the connection between map sections; these are the game actors that contain the walls and particle effect fog. When the player enters a tunnel the wall behind them closes locking them into the direction closes and as they leave the tunnel and enter a map section proper the other wall is raised up on all the tunnels connected to the section, further trapping the VR Player into their decision.

### Network Implementation

To effectively connect the two different systems a multiplayer architecture was required, at first it seemed that Unreal's in-built multiplayer solution would suffice, however due to the unorthodox nature of the multiplayer system it became difficult to work with. The difficult decision was made move away from in multiplayer options provided by the engine and towards creating my an architecture specifically for the game, however there were a few considerations that needed to be taken i account before a decision:

- Real-time positional updates require low latency packet transmission and receipt.
- Ability to form a Peer-to-peer connection (P2P), allowing clients to exchange data with the need for an external server.
- Simplicity and Efficiency, when considering the contents of each packet.

Through research it was decided a local access network implementation (LAN) of the user datagram protocol (UDP) network would be the best fit for the needs of the system, due to its small packet size, fast transmission times and ability to continue even if some information is lost during transmission.

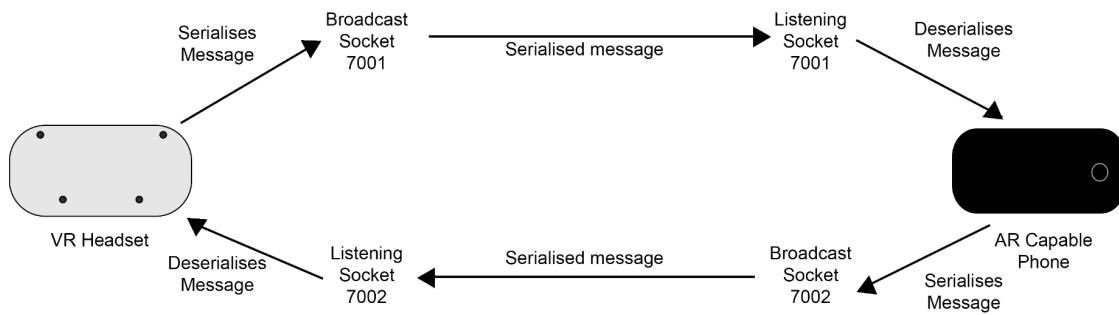
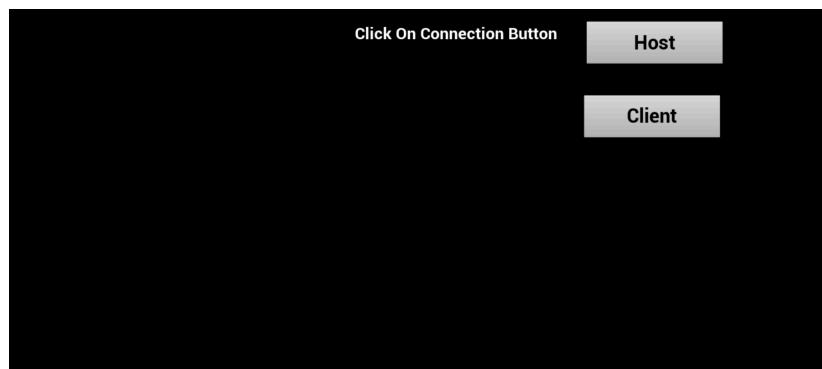


Diagram of UDP Network Setup

When the system starts the two users will be prompted to open a connection via a button on the screen, depending on their system different ports will be assigned to a broadcast and listening socket, these are set to two arbitrarily set numbers broadcast for the VR player will be 7001 and listening 7002, with that switched for the other player 7002, broadcast, and 7001, listening. The VR player will broadcast the message "searching", that has been serialised into a byte array by Unreal's FArchive library, to any ip address on the same network, with the ending port 7001. The AR player's device will be on the other end listening for any messages sent via that same port, once received it will store the IP Address and send out a "received" message directly via that newly obtained address with the port 7002 the same as the VR players listening socket, completing the handshake and establishing a peer-to-peer connection.



*The diagram shows connection buttons for each player type. The connection button for the AR player uses the touch screen while the VR Player uses simulated mouse controls to click the buttons.*

Once connection has been established it becomes trivial to send messages between the two systems all that is required is to format packets in a uniform manner to be understood and actions performed. Messages are structured as follows: Command Type, this will tell the system which type of message has been received and how to handle it, the sequence count, this is to keep count of the order in which messages have been sent, message content, the actual content of the message that will be interpreted by the command system, some messages contain a string of booleans its main values the purpose of which is to flag to the manager whether the following values exist within the packet, especially useful for values that have not changed between packets.

UDP however is not without its issues it is considered unreliable when compared to other architectures such as TCP, due to its lack of error checking and retransmission capabilities if a packet is missed, however to overcome these shortcomings, additional functionalities were implemented in order to solve these issues.

- **Sequencing:** UDP unlike TCP does not keep track of the order of what it sends instead opts to just send everything in its buffer, to combat this, within the packet as mentioned a sequence count is included in the packet as a way to ensure sequence dependant commands can reliably be performed in order, identifying any out of order or lost packets.
- **Retransmission:** If packets are missing, a retransmission method was added, some actions such as turn changes are important to the main flow of the game and if they are missed it could jeopardise the main game loop, depending on message type the system will wait an allotted amount of time, 1 second, to receive a "received" command back from the other peer, if they haven't received it the message will be sent again, continuing until there is confirmation of a state change, preventing any desync between peers. Message types such as positional updates are sent once per frame, with the system running ideally at 60 FPS, therefore if a packet is missed occasionally there is no need for retransmission.
- **Packet Combining:** The unreliability of packet transmission also created another opportunity for improvement, an increase in packet transmission rate inevitably leads to an increase in missed packets, so the decision was made to combine similar packets together, mainly with positional updates, the system will check if the character is within a section that includes a "living" entity and will include positional changes of that entity as well, cutting down possible packets per frame by half.

### Command Pattern

A primary part of the networking system is the distinction between messages types, this as previously mentioned is achieved in part by the command identifier attached to each packet. The Command Pattern was introduced as a way to "Encapsulate a request as an object, thereby letting you parameterize clients with queues, requests, and operations." [4] and is a common practice in the field of games development as a method of abstracting and isolating game logic from game actors. The commands are objects themselves containing all relevant variables and an execute function which links these abstracted values to the actual game logic, for example the update health command, there are various actions a player can perform in the game that would influence their own or another's health, say our character attacks an enemy, instead of directly addressing an enemy object, a command can be added to the queue and executed without the player object and enemy object having to interact keeping their logic completely separate and preventing any messy overlap logic.

A key advantage to this pattern in how it relates to this game is it makes sure actions are synchronised between both systems as the same command is created and executed by one player and executed by the other removing the worry of discrepancies. Additionally this proved very useful for my system, due to need for separate logic for similar entities between the two systems e.g. the VR Player character uses the motion controller joy sticks for movement, those changes in position and rotation are sent via a command to the AR Player which decodes the values and performs the commands execute function which updates a smaller representation of the VR Player within the map to this new position.

In order for messages to be sent and interpreted through the network a command system was implemented. To keep all the different objects within the system isolated from each other I created a manager class, this manager class would be employed as a middle man, allowing for full isolation of object types from each other, to prevent messy code.

### Entity Pools

To keep the system scalable Entity Pools seemed a good solution to solve the issue of the creation and deletion of a number of objects. When considering the limitation of mobile device hardware, of which the mobile device used for the AR system is and VR device is derived from, the cycle of instantiating and destroying objects can be taxing on performance. Entity pools manage the creation of all the objects at the beginning of the game, a pool for every object type, the amount of entities is directly influenced by the size of each pool, for our system a small number, 10, was chosen as this is a reasonable estimate for the amount of any one object type on the screen at one time.

## **Design**

### **Visual Style**

The visual style of the game is a fantasy style environment, theme appropriate character, enemy and item designs all rendered in a 3D voxel style, rather low fidelity, which was necessary to work within the specifications of the mobile player, as not to cause any unnecessary slowdown due to large graphical overhaul and instead focusing on smooth gameplay.

Dwarves



Goblin



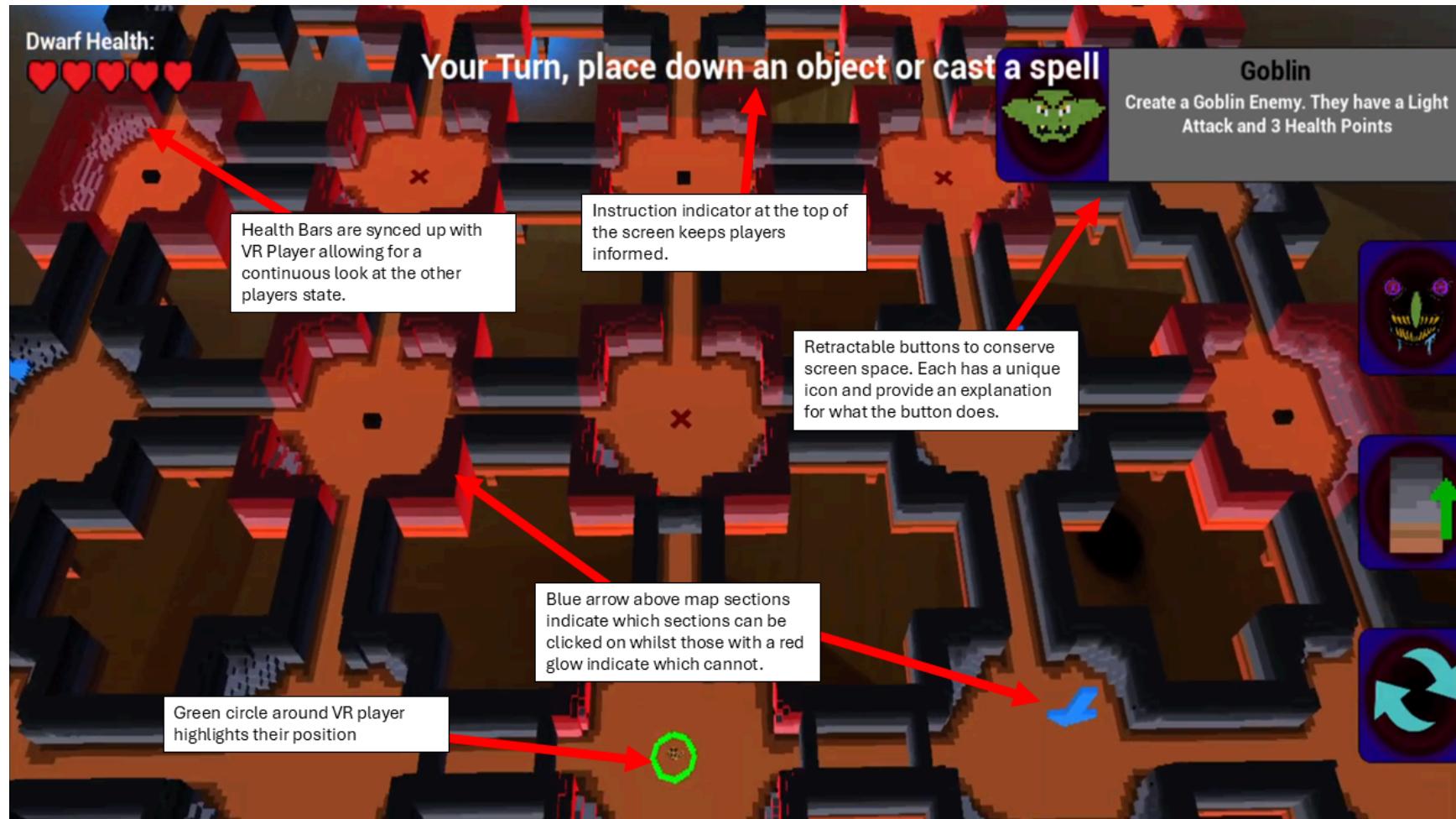
Wizard



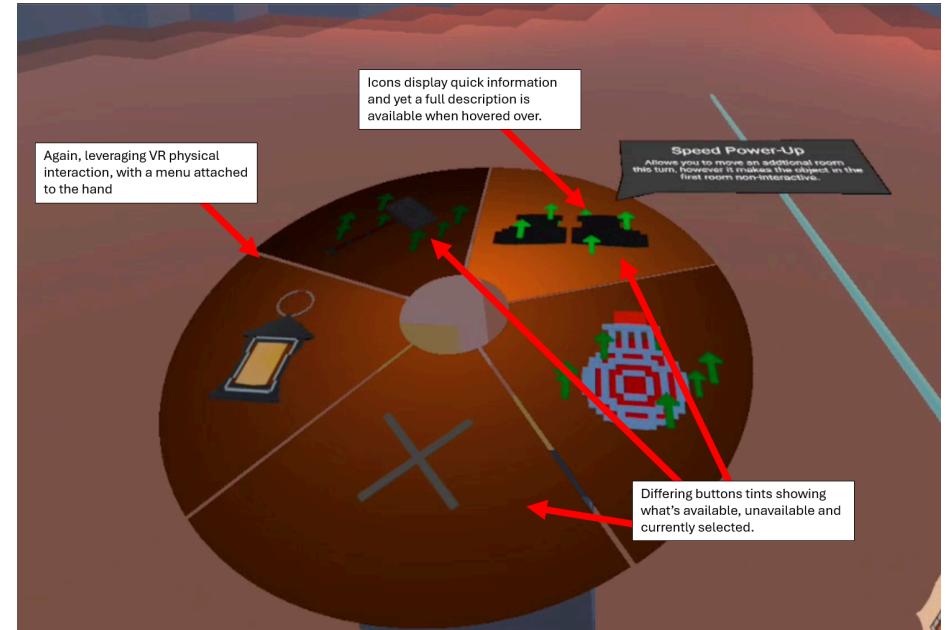
Treasure



## AR GUI



## VR GUI



## Playtesting Report

### Stage 1: Foundations

Date: 02/06/25

Playtest 1 :

Players: 1

No. of playthroughs: N/A

#### **Aim of playtest:**

To test the effectiveness of the initial prototype I had created and the connection between the two systems.

#### **Details of the playthrough:**

The playthrough was used to test the effectiveness of the first interaction of the networking system. I played as the VR Character, at this point in the systems lifecycle the model is simplified to just a capsule to represent the body and sphere to represent the hands, the spheres would move in unison with the motion controllers. The system included a small plane on which a cube object was placed in the middle of the map, when the cube object was touched by the player it would disappear, the aim of this playtest was to test the latency not only between the movement of the sphere and the direction and rotation movement of the player capsule, which could be adjusted via the left and right joystick but also the time it took for the cube to disappear. Initially whilst both playing as the VR Character and monitor the mobile AR screen I noticed there was significant input delay between the movements I was making with my hands and the VR representation of myself. I tried playing the game in a few other locations around my house, surmising that possibly due to the LAN connection between the two devices being close to the WiFi source would solve the issues, it did not.

#### **Feedback from playtesters:**

No formal feedback was given as I was performing the playtest by myself, however it was obvious from this test that something related to the networking was not working as intended, something was causing the issue and it was unrelated from networking, the networking not working correctly had led to an incomplete experience, however it did indeed test the aim of this playtest

#### **Major Changes made due to this playtesting:**

Extended research was done in what could have caused this latency issue, it was found to be due to the speed at which packets were being sent out, my system was sending out packets for positional updates at a rate of 200 fps, this was backing up the buffer with a lot of old packets leading to the experience feeling slow and sluggish to fix this I ramped this number down to 60 fps a commonly used benchmark for many commercial games, this proved a great success motion was much smoother allowing me to

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approve this concept as successful, due to this freeing up of the buffer it also meant the interaction between the player on the cube object were almost instantaneous.

Date: 18/07/25

## Playtest 2 :

Players: 2 (1 being myself)

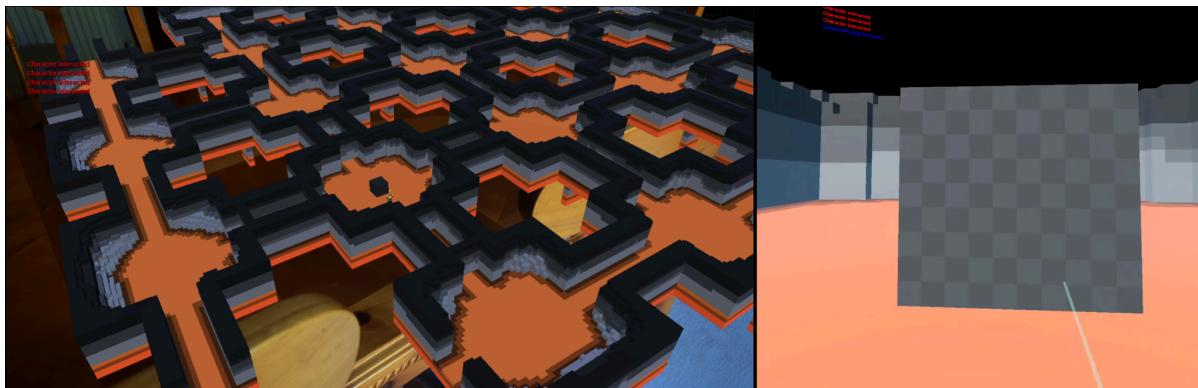
No. of playthroughs: 1

### Aim of playtest:

To test increased functionality of the game and evaluate the success of newly implemented features, specifically the spawning of objects on map sections and retest connectivity, more elements were added to the game.

### Details of the playthrough:

Although deviating from the development methodology it felt necessary to allow other players to playtests the game and gain opinions other than my own on how things were progressing, changes made from the initial playtest include: the addition on map sections and the ability to spawn in objects by tapping on the sections, increased mobility added to the vr representation of the player, adding an additional head object that would rotate with the players head and the ability to move from room to room with walls raising when you entered a new room and lowering once you touched the object in the middle and the ability to place down the map on a surface. I relayed the instruction of the game to the playtesters, to open up the application on the phone, select the plane that is shown and then tap the screen when the cube disappears as that would mean it was their turn. The playtest immediately showed some issues, the detection for the AR planes was not working incredibly well, the playtest was performed during daytime on a flat surface to avoid any issues with floating planes I had experienced, however the application needed to be restarted a couple of times in order for the application to pick up a suitable plane. When that worked however the playtest went smoothly for me, the VR player could successfully walk from room to room and tap the object with the representation of my hand and it would disappear and the participant would tap on new sections to map another box.

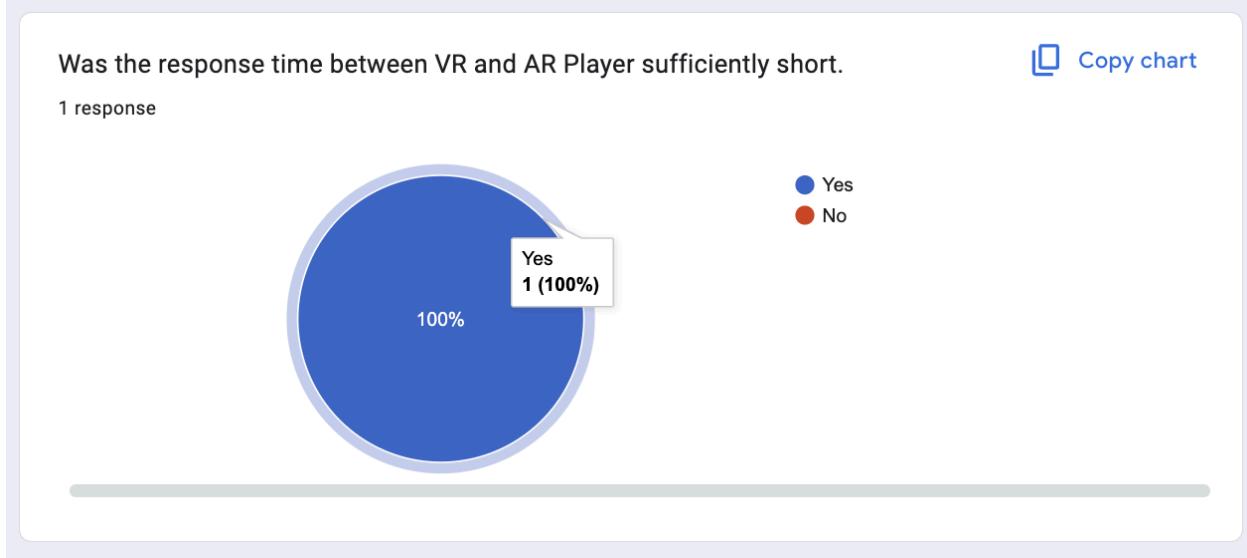


Screenshot from playtesting session.

### Feedback from playtesters:

I asked the playtester to perform a short Google Form, the questions geared towards the topics described in my aims, but most importantly to get a second opinion in regards to the success of the networking system and the synchronicity of the two systems.

Here are two answers of note that are worth talking about:



This was incredibly pleasing to see it proved that I was correct in my assumptions after changes were made during the last playtesting session, the decrease in packet transmission speed had made my networking system function to an acceptable degree and this effect didn't change despite the increase amount of objects onscreen in this playtests compared to the last.

What suggestions do you have regarding the project so far?

1 response

There needed to be more visuals to tell what I which map part I was actually choosing

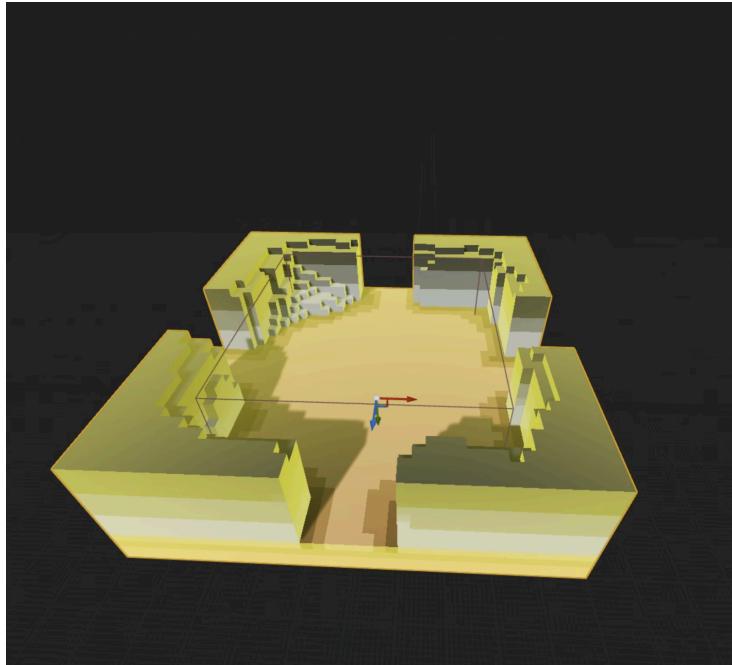
This was an answer I'd like to note as this was a part of the project I had yet to think about during my testing being so hands on during the development process, tapping on the screen to select the map sections has become second nature to me, it seems that in future iterations of the system I need to provide a big push into providing more key feedback to the player on what effect their actions are actually having.

### Major Changes made due to this playtesting:

With this feedback on the visuals in mind whilst working more on my system in order to prepare for stage 2 prototyping I took big strides in telegraphing players actions to them, I started by adding a second material to all the map sections that would highlight them yellow when selected, see the picture below,

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this allowed for a much easier selecting experience for the AR character as they were able to physically see which part of the map they had selected, however as the player would have to select the same map section twice in order to change the colour I think it would also be a good idea to include a confirmation button into the AR using UI when they are setting up the map, allowing to have a sense of confidence when they are making decisions and decrease the chance of accidental misclicks, overall improving their experience.



With the foundations established in the last two playtesting sessions the decision was made to move onto Stage 2 of the playtesting

## Stage 2: Structure

Date: 30/07/25

Playtest 3 :

Players: 2 (1 being myself)

No. of playthroughs: 2

**Aim of playtest:**

To gauge the success of implementation of the new features added and gain additional insight on steps I need to take to improve the experience outright.

**Additional features added since last playtest:**

In the transition between Stages I implemented combat mechanics for both Goblins and the Dwarf, being able to use the motion controller to swing a hammer to damage the enemy. Functionality for Traps was included; these would apply detrimental effects to the player when stepped on and Chests that allow powerups to be added to a players inventory, although functionality for these powerups wasn't implemented at this stage.

**Details of the playthrough:**

For this playtest the participant would be using the VR Headset and I would be using the AR Mobile device, after sufficient time in the experience we would both swap allowing the participant to experience both perspectives. I wanted to specifically focus on how the newly added features improved the gameplay experience and filled out the core gameplay loop, to do this I wanted to specifically make use of the new features, whilst playing with the AR perspective I tried to expose the player to as many combat scenarios and trap encounters as possible, and when we switched roles encourage them to try and build strategies based around the placement of their objects.

We each took turns playing, me sticking to my philosophy and trying to give the playtester as much experience as possible to evaluate the new mechanics, the combat seemed like it was engaging the other player audibly shouting at the goblins when hitting them with the hammer on occasions.

When it was time swap and I had to put the headset on however, despite my encouragement to explore strategic play, the experience, outside of the combat encounters seemed bland, and although I was within the headset it was clear this experience was less enjoyable for the participant.

**Feedback from playtesters:**

While no formal feedback was given I made notes from the verbal feedback after the playtesting session:

- The playtester ended up feeling lost whilst exploring the dungeon, although they occasionally found a tunnel with the fog cleared indicating they'd passed in that direction before it was hard to discern their location, mostly in part due to the similar geometry of each room.
- The AR player needed more to do, to be physically involved in the game, they're role of just placing down different objects, made the experience feel boring compared to wandering around the dungeon as a Dwarf
- The AR buttons weren't properly explained, even though the participant had prior to the game from playing the VR perspective before they still didn't quite understand what they all specifically did.

This was all valuable experience and made me realise that I may have been prioritising the VR experience and leverage its potential advantages with features like the real-time combat, that I had been neglecting the AR experience. In order to showcase both systems at their highest, therefore proving this project interaction concept fruitful, I would have to pay more attention to promoting the specific strengths of mobile AR in my gameplay.

**Major Changes made due to the playtesting:**

To address the issue of the participant feeling lost during gameplay, I decided to add a map to the VR Character, it could be activated with the A button on the right motion controller and it would appear in the players hand, like they were holding it themselves. The map has functionalities to tell the player the position they are in the game world and the current rotation they are in, due to each of the map sections being almost identical, displaying the players rotation can help to reorient the player.

As for the complaints regarding the AR experience, additional descriptions were added to each button as to ensure they didn't block up too much screen space; each button can expand to review text compress to hide it, this should provide the player with more information. This new information could be a way to allow the strategies with their placement of objects, fulfilling a key wish of mine I hope these new object types would encourage in these playtests.

Finally when addressing concerns about the AR playing needing to be more participatory within the game I intend to rectify this issue with the inclusion of spells within the next stage of development, this should allow more options for the AR Player. However it would also consider what unique options AR provides outside of just bringing the map into the real world and the touch controls to interact with it, maybe including some kind of motions specifically linked to the orientation of the phone could be an interesting idea to research.

## Stage 3: Formal Details

Date: 17/08/25

Playtest 4 :

Players: 3

No. of playthroughs: 3

**Aim of playtest:**

To gain evaluatory evidence on the system as a whole, to gauge my success in the project but also to identify any remaining bugs in the system.

**Additional features added since last playtest:**

The new features I added between playtesting sessions include the functionality of power ups, which had previously been placeholders, that can be used to benefit the VR Player in some capacity. Additional spells were also added into the AR Players arsenal, they could be used to manipulate the environment blocking off tunnels, applying frenzy to their goblins and the ability to swap objects on the map, these improvements being made in direct response to the feedback received last session about the lack of things to do for the AR Player. The most important feature added was the inclusion of a boss fight at the end of the game, this would change the perspective for the AR Player to a first person shooter role where they have to defeat the dwarf player using projectiles, able to move around the environment using the touch controls giving the AR player more interaction methods and playing on the strength of the systems ability to assume multiple perspectives.

**Details of the playthrough:**

Unfortunately due to the litany of bugs I was experiencing leading up to this next playtesting for the new features I had since added in, the playtesting for section 3 coincided with my final evaluatory playtesting sessions, while the aim of this playtest and the one after were to evaluate the system as a whole to use as evidence in my dissertation, I still included some questions that skewed towards feature development in order to perhaps add a little more polish to the game before the final set of playtesting.

So within this playtesting session 3 participants were chosen who had never played or interacted with the game before in any capacity, going into this completely blind, they would each play both of the different roles one time with the intention of using all the abilities provided to them in order to perform full runthroughs of the game. This did not go as intended, whilst testing the system myself I did not find any errors that would affect gameplay, the reason I believe it the right time for these final evaluatory playtest, this did not work out with other people's play styles. There were multiple instances during the playtest were the AR app would crash after certain actions were performed, this meant that playtests would have to be performed multiple times before completing a full run, however they did all eventually complete a full run all the way through for both player roles getting to playthrough the final boss battle, which considering was the latest addition to the game seemed to foster the most enjoyable competitive atmosphere, the playtesters audio laughing and experiencing mild frustration at each other whilst playing.

Whilst this is a positive it cannot be overlooked how much of a step back the AR Player had taken due to restrictions I had to artificially impose to keep the integrity of the system, them being unable to use several of the newly implemented spells that were paramount to my effort to improve their experience. However when I verbally confirmed with the players if they had experienced enough of the game to perform the survey they all responded with yes.

**Feedback from playtesters:**

Overall feedback was still positive despite the challenges in the session it seemed the concept of the novel interaction between these systems alone was enough to provide an enjoyable experience

**Overall Experience**

Please fill in the questions related to your overall experience with the game.

Overall, I found the game enjoyable? \*



The concept of combining VR and AR experiences into a shared gaming experience is compelling? \*



The game held my attention for the duration of the play session? \*



However as you can see the inconsistent gameplay experiences did cause participants to give lower scores in both enjoyability and ability to hold attention this same participant offering up this response

What was the least enjoyable part of the experience? \*

The game crashing. The boss stage felt very weak, moving and not being able to shoot while the opponent can as well as the spell shoots slow.

Citing that the boss stage felt very weak this could be in part due to the limitations imposed leaving the VR player with an easier experience allowing them to reach the boss room with a larger health pool than normal.

However this was not the only criticism of the system other responding:

What was the least enjoyable part of the experience? \*

Having to restart the games when it crashed. Having to zoom into the map to keep track of where the Dwarf was. Maybe make the character slightly bigger

This presented another key issue with the system, although I had implemented zooming as a way to be able to keep track of the players movement it seems when zoomed out they are still hard to perceive.

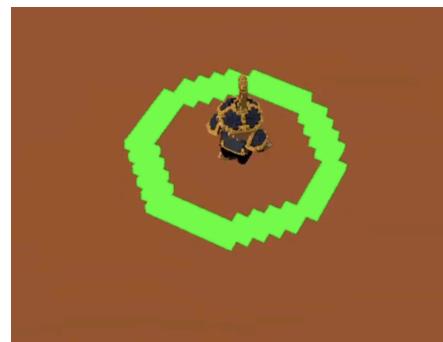
#### **Major Changes made due to this playtesting:**

From this playtest I discovered the crashing issues that had not been present during personal development, between that and the continued visibility issues of the AR perspectives, these were concerns I could not allow to continue into the next playtesting session.

Thankfully I was able to solve the crashing issue, the problem that caused it was to do with the way the two different systems handle memory management the Meta Quest 2 has a much larger storage pool than the Google Pixel 7 has to draw from that meant that as the application was playing if certain buttons weren't used or entities not interacted with their pointers would become null and when tried to access they would crash the game to fix this I had to declare all the instances of these pointers as UPROPERTY() as I am relatively new to Unreal I didn't know this would essentially mark these pointers as do not destroy without permission, this solving my issues.

Secondly I addressed some of the complaints about the Wizard, other playtesters described the experience as slow and clunky although fun overall. To combat this I increased the reload speed of the projectile fire and the speed of the wizard themselves this should help to provide a more enjoyable experience.

Finally to address the issue of character visibility I added a green ring around that player that makes them clearly visible from any angle when looking at the map from the AR Players perspective.



Date: 18/08/25

## Playtest 5 :

Players: 3

No. of playthroughs: 3

### Aim of playtest:

To gain evaluatory evidence on the system as a whole, to gauge my success in the project and to identify if bugs have been eliminated.

### Details of the playthrough:

With these bug fixes in place and the minor improvement to the AR Players visibility, I performed the playthrough in exactly the same way as before allowing all 3 participants to rotate between the 2 roles and filled out a copy of the survey after each playthrough.

I am glad to report that this playtesting session went off without any issues, both users were given their respective devices and were able to follow along with the game the whole way though without any input or interruptions needed, this was a very promising sight as both of the players were able to experience their roles without limitations.

### Feedback from playtesters:

Feedback from playtesters was overall far more positive than before; it would not be unreasonable to suggest that this is absolutely due to the ease of the session itself.

These are some responses from participants:

<p>My objectives were clear and easy to understand? *</p> <p>1      2      3      4      5</p> <p>Strongly Disagree      <input type="radio"/>      <input type="radio"/>      <input type="radio"/>      <input checked="" type="radio"/>      <input type="radio"/>      Strongly Agree</p>
<p>Did your actions have a meaningful impact on the games outcome? *</p> <p>1      2      3      4      5</p> <p>Strongly Disagree      <input type="radio"/>      <input type="radio"/>      <input type="radio"/>      <input checked="" type="radio"/>      <input type="radio"/>      Strongly Agree</p>
<p>The difference in information between me and the other player created engaging and tense gameplay? *</p> <p>1      2      3      4      5</p> <p>Strongly Disagree      <input type="radio"/>      <input type="radio"/>      <input type="radio"/>      <input type="radio"/>      <input checked="" type="radio"/>      Strongly Agree</p>
<p>Did you feel your role had a clear advantage of disadvantage over the other? Please explain why. *</p> <p>Placing my pieces on the board allowed me to stop or delay the Dwarfs course, so i could create disadvantages for my opponent</p>
<p>Which role did you play during the session? *</p> <p><input type="radio"/> VR Player (Dwarf) <input checked="" type="radio"/> AR Player (Wizard)</p>

I felt that my role was well-balanced against the other player's role? \*

1	2	3	4	5	
Not balanced at all	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/> Well balanced

My objectives were clear and easy to understand? \*

1	2	3	4	5	
Strongly Disagree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/> Strongly Agree

Did your actions have a meaningful impact on the game's outcome? \*

1	2	3	4	5	
Strongly Disagree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/> Strongly Agree

The difference in information between me and the other player created engaging and tense gameplay? \*

1	2	3	4	5	
Strongly Disagree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/> Strongly Agree

Did you feel your role had a clear advantage or disadvantage over the other? Please explain why. \*

Yeah having control over the wizard felt I had greater advantage over the dwarf as at some points it felt like he couldn't anything to stop me choices

Which role did you play during the session? \*

VR Player (Dwarf)  
 AR Player (Wizard)

As you can tell the AR Player experience has received far more positive reviews from participants now that the game is in functional working order.

The feedback from the Dwarfs from both playtesting sessions was already positive, with 83% responding yes when asked if they enjoyed the overall game specifically when playing that role.

This shows that the interaction between these two systems does not compromise any one experience, both feel whole in their own right, whilst still being able to come together to a seemingly well crafted multiplayer experience.

## Stage 4: Refinement

Due to the nature of the project behind this prototype section seemed unnecessary to pursue, game balancing the already existing game would have made for a better gaming experience, however I was mainly focused on how to expand the technical implementation in order to provide a system that would provide a unique interaction system between two systems, that utilised the advantages of the platform to provide an interesting gameplay experience. This interaction being the main focus not necessarily in the game itself.