Develop Metaverse Experiences (3D escape room)

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***Abstract*—This project report details the development of a metaverse experience using the Unity engine, focusing on the implementation of a 3D escape game with a first-person perspective. The game was designed to provide users with an immersive experience that required them to solve puzzles and navigate through a virtual environment. The user interface was designed to utilize mouse and keyboard as input and object interaction in order to enhance the gaming experience.**

The report provides a detailed overview of the game's design and implementation, outlining the development of the game mechanics and environment. Overall, this project report aims to provide insight into the process of creating a metaverse experience using the Unity engine, specifically focusing on the implementation of a 3D escape game with a first-person perspective and mouse/keyboard input.

I. Introduction

The concept of the metaverse has been around for decades, and with the recent developments in virtual reality and online gaming, it is now closer than ever to becoming a reality. The metaverse can be thought of as a collective virtual shared space where users can interact with each other and engage in a variety of activities, including gaming, socializing, and commerce. The metaverse has the potential to revolutionize the way we live, work, and play by providing an immersive and connected online experience.

In this project, we aimed to develop an escape game with Unity Engine as a proof of concept for implementing a metaverse experience. Escape games are a popular genre of puzzle games where players are challenged to solve a series of puzzles to escape from a confined space. Our goal was to incorporate metaverse features into the game, such as an impersive game world and social interactions.

The project was motivated by the need to explore the feasibility of implementing metaverse features in an escape game and to evaluate the potential of this hybrid genre as a means of engaging users in a shared virtual space. By developing a proof of concept, we hoped to demonstrate the possibilities of a metaverse escape game and inspire further research and development in this field.

The report will detail the process of designing, implementing, and testing the escape game with metaverse features. We will also discuss the results of the project and provide a critical evaluation of the strengths and weaknesses of the implemented metaverse concept. Finally, we will suggest possible directions for future research and development in this exciting and rapidly evolving field.

II. Related work

A. 3D game design

Previous research has explored various techniques and tools used to create immersive 3D game experiences. Game engines, such as Unity, provide developers with a range of tools to create 3D environments, models, and animations. Effective 3D game design requires consideration of factors such as player engagement, game mechanics, and narrative design (Huizinga, 2019; Zimmerman, 2018).

B. Unity game engine

Unity is a popular game engine that offers many features to create immersive game environments, including scripting capabilities, physics engine, and a range of tools for asset creation. Unity provides a range of programming languages, including C# and UnityScript, which can be used to develop custom scripts to control game objects and interactions. However, developers often face challenges in creating efficient and optimized game assets and ensuring smooth gameplay experience (Davidson, 2019; Hartwell, 2017).

C. Interaction with objects

In a 3D escape game, interactive objects play a critical role in providing players with clues, items, and challenges. Researchers have explored various scripting languages and techniques to create interactive objects in Unity, such as using raycasting, colliders, and triggers (Klemmer et al., 2015). However, implementing effective object interactions in a 3D game can be challenging and requires careful consideration of factors such as object design, player feedback, and game mechanics (Golding, 2018).

D. Examples of similar games

There are many examples of 3D escape games developed using Unity, such as The Room, The Witness, and Myst. These games have been praised for their immersive environments, engaging puzzles, and rich storytelling. However, developers face challenges in creating unique gameplay mechanics and ensuring that the game provides a satisfying experience for players (Fröhlich et al., 2017).

III. Implementation

For our escape room we will use the first person core provided by unity. To make our Escape room interactive and to create a better experience for the player we decided on implementing a couple a features such us pick up and drop of

objects, Ability to open doors, drawers, kitchen cabinets and kitchen appliances.

A. Open and Close

For the implementation of the Ability to open and close we first needed to create an animation for all the object that will implement this functionality. We created a wait state which is the position that the object will have once the game start. Then we created the open and close state for which we used the transform functionality, for some object we use rotation and for others we change position. So when the player starts the game the state of the animation is in the Wait state and when user left clicks on the object that has an animation it will switch between open and close state. Also as seen in the figure 1 below we have created a Trigger which we have named Activate, which we will use in a script .

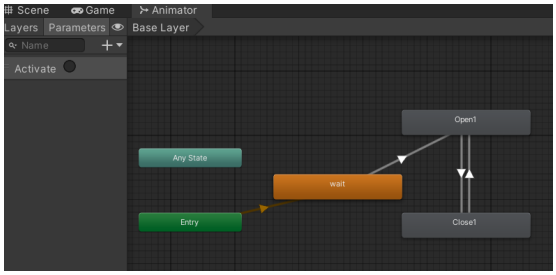

Fig. 1. Animation

We have created a script named PlayerActions which requires two parameters which we will need as parameters for or Raycast that will help us identify the objects in front of us. The first parameter is a Transform parameter which we need to grab the vector of the camera facing forward in the direction the user is watching and a parameter float which we will use to set the distance how far can the player reach to click or touch an object to interact . We use Input.GetMouseButtonDown(0) to set the left click as the command that user will use to interact with the object. We then use the Activate Trigger to change between states.

B. Pick up and Drop

To Implement pick Up and drop functionality we have created 2 scripts, PlayerPickUpDrop and ObjectGrabbable. We will Attach PlayerPickUpDrop to the PlayerCapsule and ObjectGrabbable to the object that we want to grab. For our PlayerPickUpDrop as seen in figure 2 we will need a Transform parameter which has the same function as in the PlayerActions script and another transform parameter named objectGrabPointTransform which we will use to define the place were we want the grabbed object to be placed on the screen.

For this we create a empty object as the child of the First Person Camera and placed it in front of the camera. We use the LayerMask parameter so we don't have to add the layer for each object that we want to grab so we select everything except for the player. We define E character as the input key

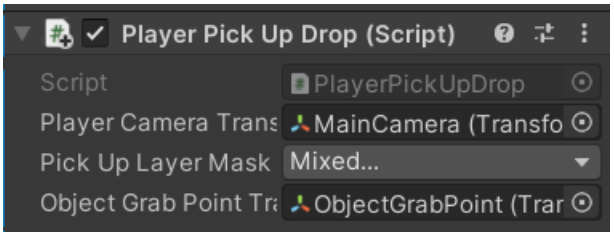

Fig. 2. Player Pick up Drop

to grab the object using Input.GetKeyDown(KeyCode.E) and we set the distance for how far we want the user to reach to grab an object using "float pickUpDistance = 2f;". We use Rigidbody to add physics to the object that we want to pick up and we use the ObjectGrabbable to define the grab and drop methods were we define the position of the object that we grab or drop and we remove gravity when we grab and add it when we drop. The FixedUpdate method it is used moves the object smoothly.

C. Keypad

Another key feature for our Escape room will be the ability to open a door after putting the correct password in the keypad. For this we have implemented 4 scripts. DoorController which opens and closes the door and it is attached to the door which will be opened by the keypad. PlayerAim which is attached to the PlayerCapsule and gets the position of the Camera and uses Raycast to identify the object in front of the player, in this case we look for the door and keypad numbers. KeypadKey gets the password user puts in the keypad. KeypadController is attached to the Keypad and it's the most important script. As it shows in figure 3 we attach to it the Door which contains the DoorContoller script, we set what should the correct password be and how long should it be. And Password Text displays the password that we put in the keypad. We also add an Audio Source and the sounds when the correct or wrong password is entered.

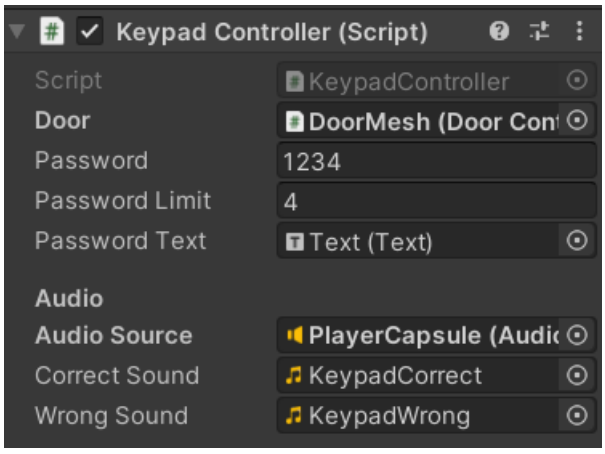

Fig. 3. keypad Controller

D. Scene and maps

The basic scenario of the game is open source assets found online.

Fig. 4. rooms

Fig. 5. rooms

Fig. 6. rooms

Fig. 7. rooms

We designed the route according to the room structure and the characteristics of the escape room. Then transform the scene into seven rooms according to the route and map. Here is the map.

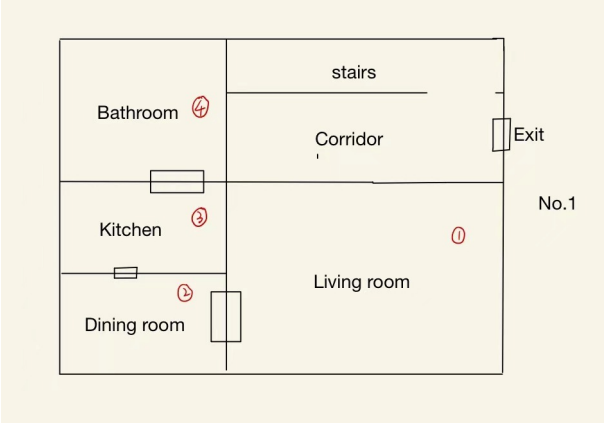

Fig. 8. map1

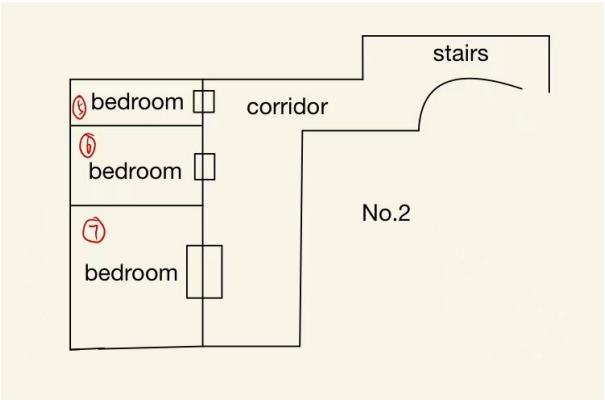

Fig. 9. map2

E. Puzzles Setting

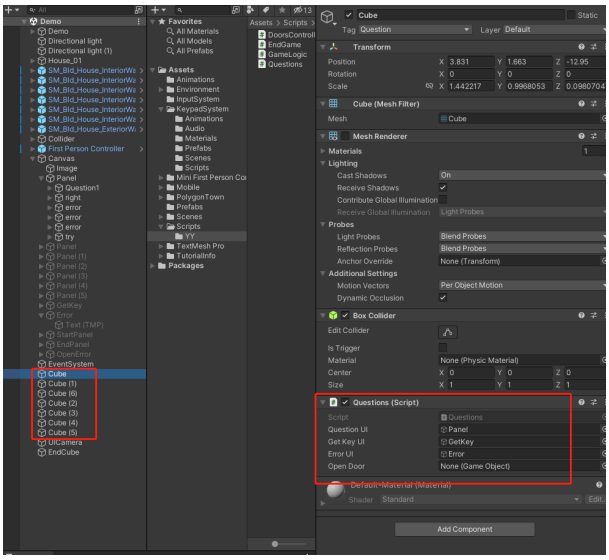

Fig. 10. puzzles setting

As shown in the figure, each cube corresponds to a prop to open the puzzle.

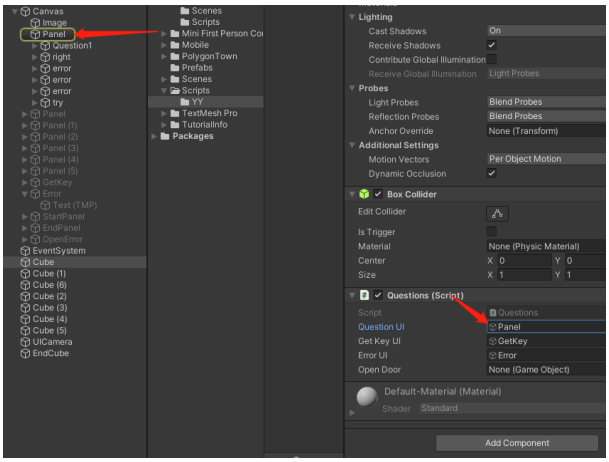

Fig. 11. Panel

In the code Questions attached on the right side of the cube, click the parameter of the parameter QuestionUI to lock the corresponding UI panel.

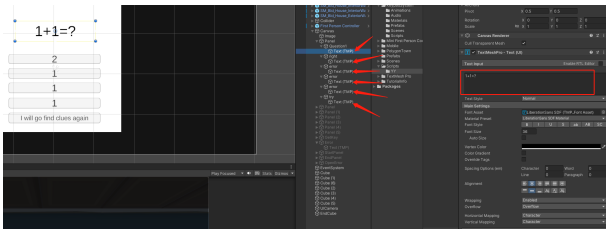

Fig. 12. question UI

In the UI panel of each question, you can see the question, right, error, try and other objects. There is a sub-object Text under each object. Click the Text object to fill in the corresponding text in the Inspector panel. Right is the correct option, error is the wrong option, and try is to close the answer UI.

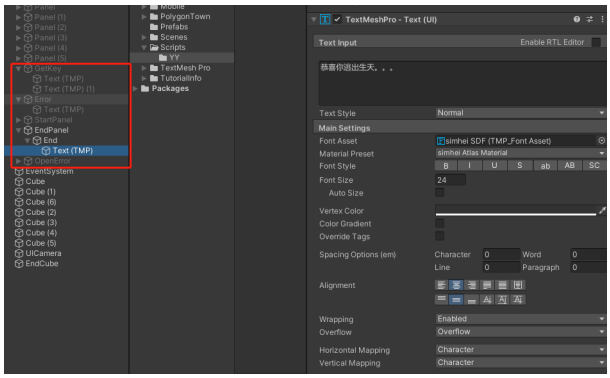

Fig. 13. other UI

In the same way, the text of the prompt page such as getting the key, answering the wrong question, opening the wrong door, and ending the game is also in the text object under the corresponding UI.

Fig. 14. object

After the above settings are completed, we will run the project. When you click the corresponding object, you will see the question.

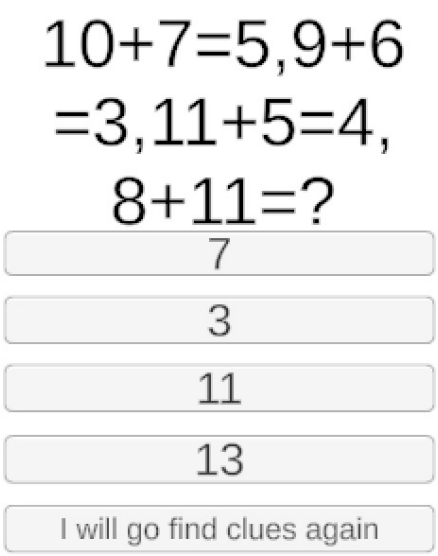

Fig. 15. question

When you answer the question correctly, you will be prompted to get the key, and then click the corresponding door to open it.

Fig. 16. right answer

When we go directly to open the door without a key, there will be a prompt that we need to find the key.

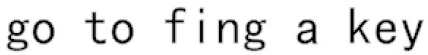

Fig. 17. no key

The following table lists the target objects in each room

TABLE I
TARGET OBJECTS

Living room	TV
Dining room	picture
Kitchen	Cabinet hanging on the wall
Bathroom	clothes
bedroom1	pillow
bedroom2	Drawer of TV cabinet
bedroom3	book

IV. Evaluation

The implementation of the 3D escape game using Unity and scripts to interact with objects successfully created an immersive and engaging player experience. The integration of keyboard/mouse input and first person perspective allowed for intuitive player control and increased immersion. The object interaction system allowed for the manipulation and interaction with objects, which was crucial to the gameplay and contributed to the player's sense of autonomy in the game world.

The game was structured around two challenging puzzles that required critical thinking and problem-solving skills. The puzzles were well-designed and integrated seamlessly into the game's environment. The implementation of these puzzles was effective in creating a sense of achievement when players solved them, which was important for maintaining player engagement.

From a technical perspective, the implementation was well-executed. The use of scripts to handle object interaction was efficient and easy to modify.

Looking to the future, there are several areas for potential improvement. For example, the addition of more puzzles and diverse environments could create a more engaging and challenging player experience. Additionally, the implementation of audio and visual effects could increase player immersion and add an extra layer of polish to the game.

V. Conclusion

the implementation of the 3D escape game was a valuable learning experience, providing insights into game design, programming, and project management. The implementation process required close collaboration and communication among team members, and the final product reflects the team's dedication and hard work. This project has provided a foundation for future game development projects, and the skills learned throughout the process can be applied to future projects in the field.

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