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Designing Interactive Space for the XR Boardgame

Yuseon Jeong, Daeun Kim, Hyokyung Jang, and Jeeheon Ryu

Chonnam National University, Gwangju, Republic of Korea
jeeheon@jnu.ac.kr

Abstract. This study proposes a design perspective for a user interface to create an interactive space for players in the XR environment. A board-game-based application was designed for Hololens2, which comprised of four areas in the interactive space: 1) die rolling, 2) playing board, 3) message board, and 4) task area. Each component supported the user's engagement and facilitated an interactive user experience in the XR environment. Since spatial perception is crucial for designing the XR environment, the four components were created like a cinematic design. The dice rolling feature allowed the user to take turns with the computer. The playing board provided a navigational map of tasks, and the board was a mixed object combining physical and digital objects. The user was able to place the virtual playing board on a physical table for an authentically immersed environment. The message board provided various information to the user, while the task area represented unique characteristics of XR. We discuss the crucial design features of the application.

Keywords: XR, User Interface, Hololens2.

1 Introduction

Extended reality (XR) has the potential to provide students with an enriched learning experience through the use of 3D graphics and immersive visuals [1]. XR expands the learning environment and opens up new ways of learning that were not previously possible, stimulating learners and enhancing their technical skills [2]. XR is a broad concept encompassing both augmented and virtual reality [3]. It can also refer to a collaborative environment using 3D holograms [4]. XR is a unique technology that projects suitable content layers for education texts and classes onto the user's surrounding environment, providing students with interactive and meaningful learning experiences [5].

When designing an XR experience, two primary considerations are the cinematic design, which allows for panoramic vision, and the placement of components. The panoramic vision in XR overcomes 2D screen limitations and enables the user to be positioned within a 3D environment with an expanded field of view that incorporates as much content as possible [6].

The efficient operation of an XR application is another critical factor to consider when employing components in an XR environment. The strategic placement of components can provide users with a controlled environment to gain experience and knowledge, potentially leading to improved performance in real-world applications [7]. This study focuses on the design and creation of a user interface focused on organizing an interactive space for players in an XR board game-based application.

2 Design of interactive space

2.1 Components

Overview of the design perspective for the user interface

The game-play process involves several steps. First, the learner rolls the die on the left side and moves the player the number of spaces indicated. Once on a block, the learner checks the information about United Kingdom's culture and interacts with the object on the right side of the board. If the learner lands on a transportation block, the learner either moves up on the rail or the road. However, if the learner lands on the dark clouds, they move down by riding the dark cloud. The learner competes with the PC character to be the first player to reach the last block. Whoever reaches the last block first wins the game. Once the player reaches the last block, the learning activity is finished, and the learner takes a quiz. Additionally, learners can check the ranking chart and discover any badges they have won during gameplay. This application consists of 17 interactive activities that enable learners to engage with cultural symbols and learn about British culture. When the learner lands on a block, an instructional pop-up appears that provides information about the object and instructions on how to interact with it. For example, learners lay on the colors of the U.K. flag when they learn about Union Jack as the national flag of the U.K. (Fig. 1.).

Description of the four design components

The user interface design consists of four components (Fig. 1.). First, the dice rolling area is located in the lower-left corner of the screen. When it is the user's turn, they press a button to roll a die, which outputs a random number between 1 and 6 and moves the user's character based on the number shown. When the user's turn is over, the virtual opponent's roll and movement are automated. During this time, a virtual hand object appears above the button when the opponent's dice are rolled to enhance telepresence.

Second, the playing board is a 6X6 area (36 spaces) that is located in the center of the screen. Each of the spaces has a picture on it, and when a character lands on a space, they can learn a cultural element related to the picture in that space. Third, there is a message board area on the panel provides instructions and learning content for the overall play. In particular, when a learner reaches a learning element section, the panel shows the cultural information and directs the learner on what to do in the task area. Finally, the task area related to the learning content is presented, which enables interaction with virtual objects, including hand interactions. The application includes 17 tasks that can be applied to this area.

Fig. 1. Design component of XR boardgame.

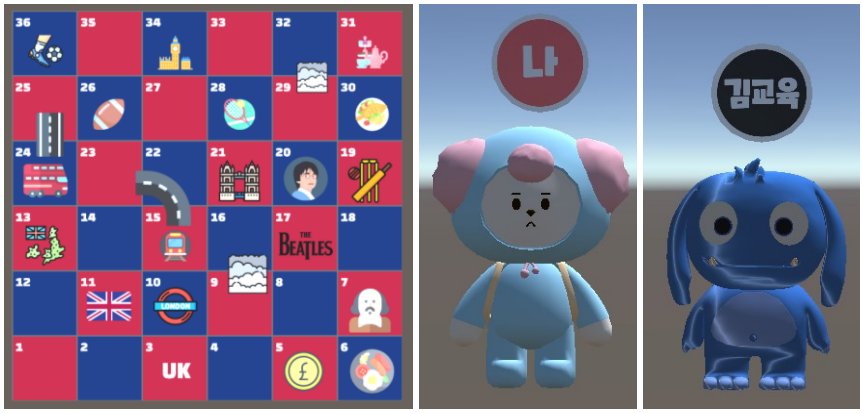

Fig. 2. Playing board (left), Player character (middle), Computer character (right).

Playing board and interactive events

The playing board (See Figure 2) is a vital component of this application for a user to play. It is 6x6 cells and has seventeen placeholders to provide interactive events to a user. We applied two characters to play the game. The middle of Figure 2 shows the user's character. When the user plays the game, he should move the user's character by his hand. However, the computer character (on the right of Figure 2) moves automatically. We designed the events to cover the socio-cultural features of England, from cultural icons to heritages and sports. Figure 3 shows the graphic objects that will appear in the task area in Figure 1 when a player character stops on a cell on the playing board. The number on each graphic represents the cell number of the playing board. The list of interactive events is on the right of Figure 3.

3. Country name
5. Currencies
6. Food (English Breakfast)
7. People (Shakespeare)
10. Capitals
11. Flag
13. Geographic map
17. People (Beatles)
19. Sports (Cricket)
20. People (J. K. Rowling)
21. Landmark (Tower Bridge)
26. Sports (Rugby)
28. Sports (Tennis)
30. Food (Fish and Chips)
31. Food (Afternoon Tea)
34. Landmarks (Big Ben)
36. Sports (Soccer)

Fig. 3. Graphic arts of interactive events and list of object names.

2.2 Development

Playing board and interactive events

This XR board game-based application was developed using several software and hardware components. The XR hardware chosen for this application was Microsoft HoloLens2, which allows effective learning through various interactions, such as moving, resizing, and rotating the virtual object using hands. In addition, Unity 3D game engine and Microsoft's Mixed Reality Toolkit (MRTK) were used to develop the XR application. For the implementation of the game mechanics, the scripts were developed in C# using Microsoft Visual Studio 2019.

Figure 4 is the playing mode in that we placed the cinematic scene space on a table. We identified that the matched position on a table gave a user to play a physical board game. At the beginning of the game, the characters

are near the die-rolling area. Once the game starts, the user moves the character by hand when he completes the interactive event. Figure 5 shows how a user can interact with the object. The user can pick and grab a 3D object in the task area. He can manipulate the object.

Playing board and interactive events

The developed application's primary functions are as follows: First, when it is the learner's turn, the learner rolls the die by pushing the blue button to produce a number is randomized through the system. Second, the learner competes with the virtual opponent during the game. After rolling the dice, the learner moves the player by grabbing the virtual object. On the other hand, the player of the virtual opponent is automatically moved without needing to operate something. Third, the instructional contents are developed around interactions with virtual objects, such as coloring, fitting the blocks, and manipulating (moving, rotating, and resizing). Fourth, the quiz is based on the content of the information in the game. Three quiz questions are randomly selected from the learning contents during the board game. Finally, the ranking is based on competition with the virtual opponent. The badges are provided based on the content to learn.

Fig. 4. Initial setting of the playing mode.

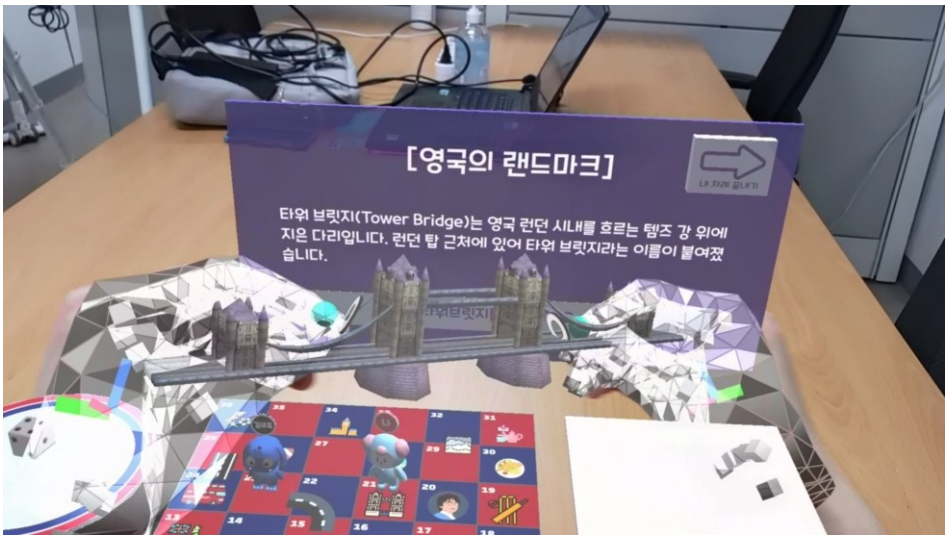

Fig. 5. Two hands interaction**.**

3 Discussion

This study explores the interface design of a board game-based application in an XR environment using Hololens2. The design emphasizes the placement and organization of components to enhance user participation and experience, while utilizing cinematic design to optimize panoramic vision in XR. The resulting user interface comprises four key areas that can be tailored to specific XR characteristics to improve user experience. Future research should include preliminary testing to confirm the effectiveness of the user interface.

Acknowledgements

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