Dissertation Title:

Karl's sketchbook：

A puzzle narrative game with image recognition technology

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I.Abstract

This study describes the design process and ideas of Karl's Sketchbook, a puzzle narrative game developed based on Unity3D. It also evaluates and analyses the strategies of fragmented narrative and image recognition techniques applied to the game through user testing and user interviews, and explores their impact on the game, as well as the key factors in puzzle design that attract players, to provide valuable suggestions for the future development of the game as well as the puzzle narrative game.

II. Introduction

Developing from face-to-face oral narratives to more artistic novels, frescoes and music, from theatre to film and television, storytelling has undergone a constant evolution over time, encompassing a wide range of domains and taking on an ever richer appearance. From its inception, narratology, the study of the structure and function of narrative, has been conceived as a project that surpasses the boundaries of both disciplines and media(Ryan, 2004, pp.337–358). Nowadays, with the rise of video games, games have opened up new possibilities for storytelling as a new narrative tool, differentiating itself in some way from previous forms because it is more interactive. It is the goal of narrative games to cleverly incorporate game mechanics into their games to tell a compelling story and bring players a richer emotional experience. The author created a 3D puzzle narrative game, Karl's Sketchbook uses fragmented

narrative combined with image recognition technology to allow players to follow Karl's footsteps and explore the creation process and life experience of each piece of artwork. This paper explores three main research directions.

1. In games, the influence of fragmented narrative on the player's understanding of the story.
2. What difference image recognition technology can make to the experience of a puzzle game.
3. The key factors affecting puzzle design for player engagement.

Through a comprehensive analysis of the game development process and user test results, this paper attempts to reveal the application of fragmented narratives in games and to reveal the key factors in puzzle design that attract players. This study aims to provide valuable insights into the design of puzzle narrative games.

III. Related Work

Puzzle games have a richer form of narrative than other game genres, and as the centrepiece that drives the progression of a puzzle game, it is key to integrate it with the game mechanics. Player preferences can be associated with that different strategies for combining storytelling forms with gameplay, including linear, non-linear and emergent narrative structures(Lindley, 2005). What Remains of Edith Finch, developed by Giant Sparrow, It is a game with a

fragmented, non-linear narrative. The game is presented as an interconnected anthology, utilising unique mediums from varying perspectives, The story is told through a series of fragmented vignettes. This narrative is constructed in a patchwork fashion, assembling itself through a sequence of unearthed manuscripts, a characteristic element often found in Gothic fiction. Each manuscript triggers an interactive micronarrative that portrays the demise of members of the Finch family(Kirkland, 2020).

Puzzle games often centre on unique puzzle mechanics to design interesting puzzles, and these puzzles and mechanics are cleverly combined to bring rich emotional value to the player. Viewfinder, developed by Matt Stark, it transforms 2D photos into part of a 3D game scene through the in-game camera, a clever perspective-based puzzle mechanic. The journey through the Viewfinder occasionally resembles not just squinting through a camera lens, but rather, it feels like gazing into an exciting and ever-changing kaleidoscope of creative ideas(Ogilvie, 2023). Another puzzle game that relies on optical illusions, Moncage, also performed well. The developers of Moncage, Dong Zhou and Yijia Chen of New York University, found the presentation of optical illusions to be interesting, especially since it is a rare gameplay style in puzzle games. They realised that this type of gameplay was very appealing to players and decided to give it a try, Dong explains, adding that things that cannot be seen in real life are presented in the game by way of optical illusions. This type

of gameplay itself can stimulate players' visual senses to some extent and arouse their interest(Zhou, 2020).

Producer Tetsuya Mizuguchi attempts to bring VR technology into their puzzle game Humanity. Most VR(Virtual Reality) games are played in an immersive first-person perspective, and playing Humanity in VR in third-person initially made the team a little hesitant, says Tetsuya Mizuguchi, but after trying it out, everyone agreed that VR was a good idea(Welkin, 2023).

Video games may incorporate narrative and story components by blending diverse forms of interactivity, employing various strategies to fuse interaction seamlessly with non-interactive story and narrative elements (Lindley, 2005). Therefore, this project hopes to design a decrypted narrative game with a fragmented narrative, using image recognition technology combined with puzzle-solving gameplay. Let the player have a different plot experience in the process of solving puzzles.

IV. Methodology

This study consists of two parts, the first part is about the game design of Karl's Sketchbook. The design ideas are presented in terms of narrative approach, image recognition technology and puzzle design. The second part is to use this game as the basis for two rounds of playtesting as well as user interviews to

evaluate my research objectives. The study invited ten testers to experience the game and participate in user interviews in two rounds of five testers each. The main purpose of the first round was to troubleshoot significant issues in the project that affected the complete operation, to inform iterative optimisation, and to help improve the accuracy of the second test data. The second round of testing uses a new version of the game after iteration and records the players' gameplay. User interviews were conducted with testers after both rounds of testing to evaluate Karl's sketchbook from the perspective of those who experienced it. The results from the ten testers are collated and some of the data is analysed quantitatively. This is used as a basis for exploring the impact of fragmented narratives on plot comprehension, the different experiences brought about by image recognition technology, and the key factors influencing the emotional value provided by puzzles.

V. Game Design

V.I Game Narrative

Fragmented narrative, as a unique storytelling method, integrates the game's backstory into all corners of the game world, and conveys the story information to the player through the words of NPC(Non-Player Character) encountered by the player, notes and items picked up in the game, and even the designed scene itself as the narrator. Compared to the traditional narrative approach, the integration of storytelling into the process of exploring the

world can give the player a sense of motivation and achievement, and the vague and white-space narrative also makes the players interested and enthusiastic in exploring and discussing the game's worldview. Karl's Sketchbook tells the story of Karl, a painter who grew up in a broken family and loves to draw. When he grows up, Karl leaves home and travels alone to sketch. Here he met the love of his life, Katherine, but fate played a trick on him and the two didn't get together. He falls back into the abyss, and destroys his own exhibition with his own hands. On his deathbed, he looks through his sketchbook and remembers the story of his life. The game does not tell the story directly, in its entirety, in a single way, but rather fragments it into different elements of the game. Using Karl's sketchbook as a starting point, branch out to tackle seven different puzzles with eight of Karl's drawings with notes to solve them. Each drawing, the notes, and the puzzles contain parts of fragmented story content or clues.

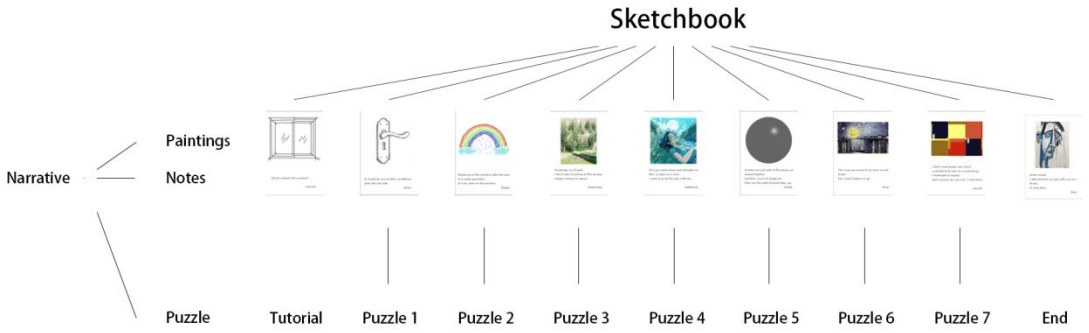

Figure 1: Narrative structure of Karl’s sketchbook

Paintings are a way of conveying the plot, and each of Karl's paintings is

influenced by the experiences of the period in which they were created, so the paintings are closely related to his story. If players divide Karl's works into childhood, youth and old age, they will find that the art styles of works from the same period are very similar, which also helps players to sort out the timeline. The notes are Karl's annotations for each piece of artwork and are the easiest way to convey the plot, as they are presented in text form. In fact, it also contains a large number of key clues for solving puzzles. The puzzles are the core gameplay of the game, and in addition to being a challenge for the player to face, they also play a narrative role. The plot of each puzzle is expressed in slightly different ways, some of which will be reflected in the layout of the scene for that puzzle, and others in the process of solving it.

V.II Image Recognition Interactive

Karl's sketchbook uses the Vuforia Engine, which is essentially an augmented reality plugin for Unity, for image recognition. By uploading each page of the sketchbook to Vuforia's library, the camera makes a judgement when it detects the corresponding content. In addition, each piece of artwork is printed into a physical sketchbook, with each page intentionally out of order to symbolise the missing content of Karl's sketchbook and the forgotten memories of the main character, Karl. When the player places a drawing from the physical sketchbook in front of the camera, the image recognition technology renders this piece of artwork in the in-game sketchbook. The player can then use this piece of

artwork to interact with the puzzle, and if the piece of artwork is right, it triggers a subsequent storyline and passes the puzzle.

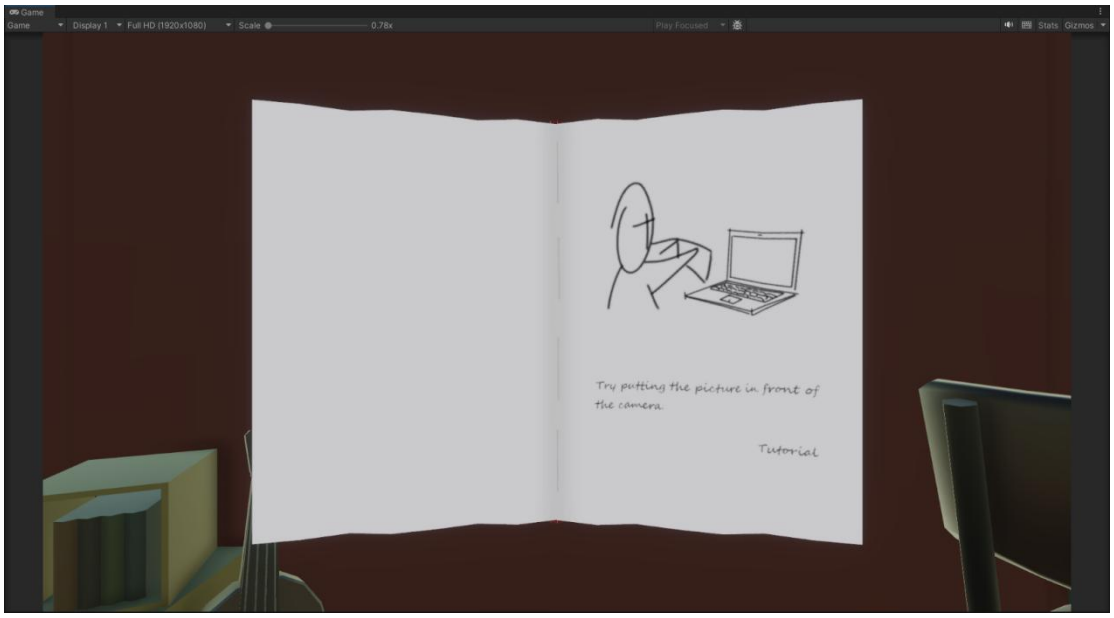

Figure 2: Image recognition method

Image identification is not just an innovative attempt at technology, it is inextricably linked to the fragmented narrative. As part of the gameplay, players need to search for clues in the printed pages of the physical sketchbook. This design enhances the realistic interaction of the game. In addition, it also greatly increases the player's understanding of the plot and leaves a lasting impression. It successfully avoids the problem of unclear understanding of the story background that the fragmented narrative structure may lead to. players can even sort by drawing style, sort by timeline, and place each page in the right order to sort out the logic.

V.III Puzzle design

Puzzle design is a key element that connects the plot narrative to the gameplay. The game's puzzles are intricately woven into the story. The clues to solving these puzzles are cleverly embedded in scenes, paintings and notes, with each subtle clue hinting at the solution. Players will need to explore and decipher Karl's paintings and select matching painting to interact with the puzzles to pass the puzzle. This process involves players not only appreciating the aesthetics of Karl's artwork, but also understanding it as an integral part of the puzzle, and appreciating the meaning behind each of Karl's works. The puzzles are designed with two basic principles in mind: Each puzzle and the drawings and notes used to solve them need to be interrelated and tightly centred around the plot, so that they can be used to piece together the story. The other principle is that using divergent thinking to create seemingly simple but surprisingly ingenious solutions, aiming to make the player feel surprisingly surprised when solving puzzles. With these two principles in mind, the puzzles are designed to provide players with interesting challenges, encouraging them to embrace divergent thinking and experience the excitement of unexpected puzzle solving, while understanding the story's plot in the process.

The combination of puzzles and plot can be found in each puzzle, which is briefly described here as an example in the first and fourth puzzles. In the first puzzle, observation of the environment and Karl's monologue reveals that the player is in Karl's childhood room. The locked door is a metaphor for the

protagonist's restricted childhood experiences, and the painting used to decrypt it, Doorknob, was created when Karl was a child longing for the world beyond the door. The door is opened by interacting the painting with the door. It also hints at the new life Karl has begun by freeing himself from his restricted past. In the fourth puzzle, the player is blocked by a red river, and next to the river is a palette containing red paint. It is easy to see that the puzzles in this puzzle are colour related, and the palette echoes Karl's identity as a painter, which is seen as the key to solving the puzzles. The painting used for solving the puzzle is called Katherine, the girl in the painting is beautiful, the whole painting is in blue colour, and "She's as clear as a river." implies that the painting has something to do with a river. Interacting with the palette, the paint in the palette turns blue, and the river turns clear blue. The whole process of solving the puzzle does not rely on any plot explanation, but it is easy for the player to find out that Karl has met a beautiful girl, Katherine, and the red colour of the river suggests the girl's future misfortunes. This puzzle design reinforces the connection between the gameplay mechanics and the fragmented narrative, emphasising the unlocking of Karl's memories.

Figure 3: The fourth puzzle in Karl's sketchbook

Designing puzzles using divergent thinking was actually a very difficult part of the development of Karl's Sketchbook, because as the game progressed, puzzle ideas needed to be more varied in order to avoid the boredom that comes with a single gameplay style, so that it could continue to surprise the player with new ideas. Good ideas sometimes come overnight, and it's hard to make progress in puzzle design without inspiration. So during the design process, the developer keeps going to experience different games and movie of puzzles to get inspiration.

Some of the puzzles in Karl's sketchbook are centred around optical tricks, such as optical illusions or optical overlaps. Of the seven puzzles in the game, the third is a typical example of a puzzle design that utilises optical illusions. The

third puzzle takes place in the location where Karl sketched during his youth, and the player is blocked by a collapsed stone door with a wooden easel standing next to it. By observing the environment of the scene, it is not difficult to find that the content of the Forest Trail painting is similar to the surrounding environment. After interacting with the easel, the painting appears on the easel, but the stone gate still blocks the way forward. According to the plot hints, the player needs to find the right angle so that the line of sight, the painting panel and the stone door are in a straight line. Through a clever optical illusion, the scenery of Forest Trail on the painting board obscures the collapsed part of the stone gate, and visually the scenery in the painting blends in with the jungle behind the stone gate, as if this stone gate has never collapsed. In this moment, all this becomes reality, the scenery in Forest Trail replaces the collapsed part of the gate, and the player can pass through it directly. optical illusions is a quirky design idea for a puzzle game, which can bring strong emotional impacts to the player at the moment of the illusion. It can be found in the design of both Viewfinder and Mencage. Propels the camera into a realm of optical illusions and reality-warping tools, playfully challenging your expectations of game aesthetics and behavior. It prods and pokes at your firmest gaming conventions(Valentine, 2023).

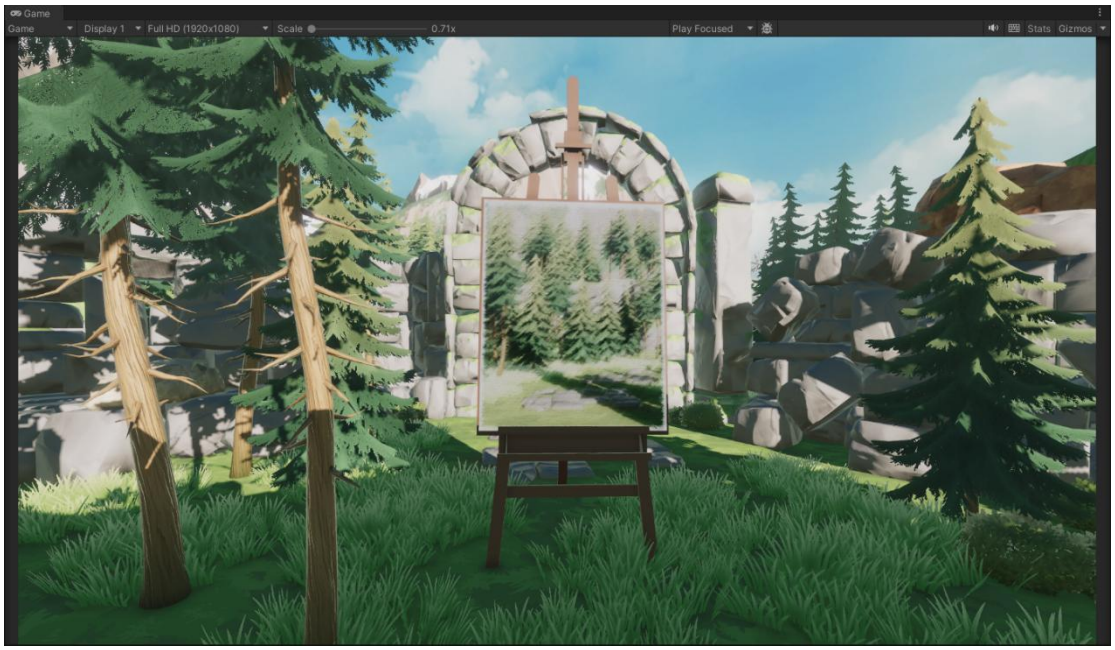

Figure 4: The third puzzle in Karl's sketchbook

VI. Evaluation

After the main design of the game was completed, this study invited five testers to start the first round of game testing to discover significant bugs in the game that affect the complete operation and provide a reference for iterative optimisation. The developer's prediction for experiencing the full flow of the game was 10 minutes, while the time taken by all five testers in the first round of testing was over 20 minutes. Considering the lack of guidance and the difficulty of the puzzles, the developers added a detailed tutorial in the early stages of the game, and some UI(user interface) hints to solve this problem. In addition, the image recognition sensitivity of the painting Rainbow is poor compared to other paintings because the Target rating of this painting in the Vuforia engine is very low, which may be related to the principle of

recognising the image in greyscale, and the developer tries to modify the grey scale of the colours to solve the problem.

In the second round of testing, players demonstrated a smoother gameplay experience than in the first round, with all five new testers experiencing the full game on their own without the assistance of the developers. The time spent by the testers was around 15 minutes, which is an improvement. During the game, all testers tried to find clues by looking at the contents of a physical sketchbook, observing drawings or reading notes, and then selecting drawings for image recognition. However, Rainbow was still more difficult to recognise compared to the other drawings and this issue was not addressed.

Ten testers were invited to conduct user interviews at the end of the playtest, asking them to tell the story of the plot as they understood it through the game. Comparing the content to the developer's plot outline, all testers understood the plot by more than 50%, with an average understanding of 60%, and one tester's understanding of the plot reached a high of 80%. When asked about what elements of the game tell you about the plot, figure 5 shows 80% of the testers thought that Karl's drawings, notes and puzzles tell us something about the plot. Some of the testers also thought that the main character's soliloquy and the scene design were also part of the plot.

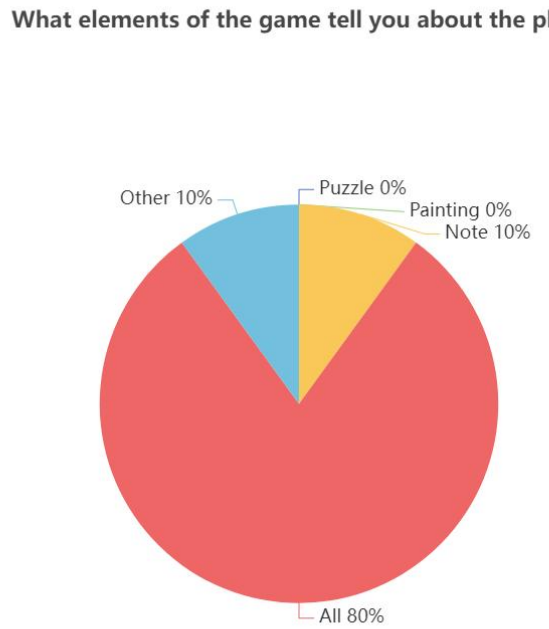

Figure 5: User research result of Karl's sketchbook (1)

Figure 6 below counts the puzzles that impressed the testers the most, and through quantitative analysis over 40% of the testers chose Puzzle 3. They think that optical illusions are like hallucinations, where everything happens so fast that the scene changes before you can react to what's happening. This kind of instant surprise is impressive. In addition, 30% of the testers chose Puzzle 6, and this group of players were quick to spot the two picture frames that could be rotated, but they said they didn't know what these mechanisms did. The realisation dawned on them when the two paintings were rotated to the correct angle and a new piece of artwork was put together. These testers thought they had never thought of what could happen before, and when it all

came together, the testers couldn't help but exclaim that they liked the design. However, most players took a long time on this puzzle and some didn't understand the puzzle idea.

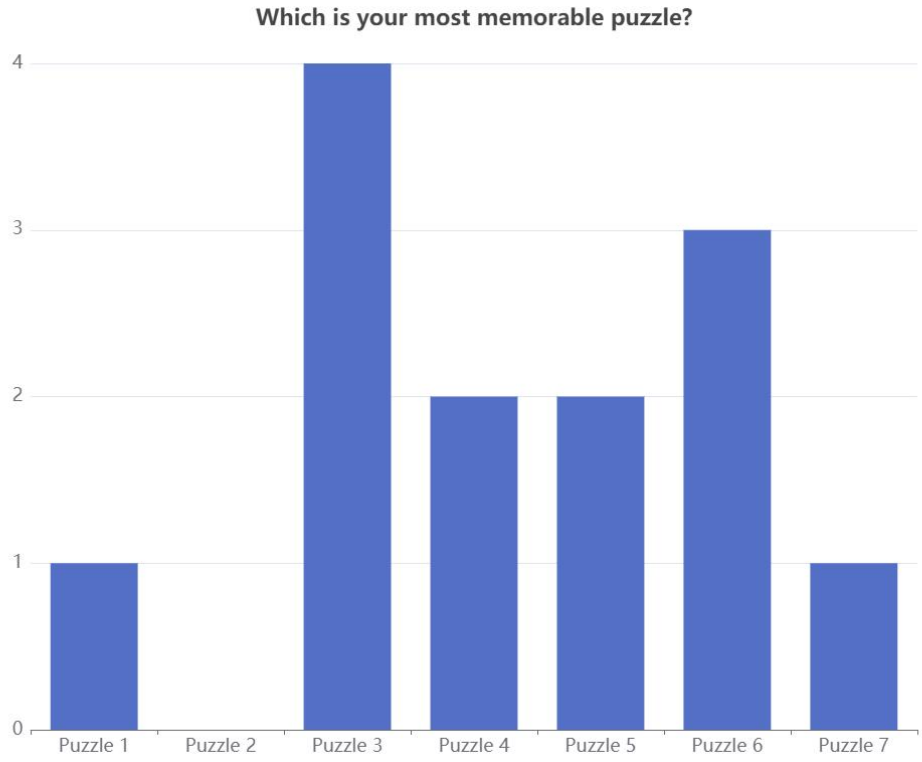

Figure 6: User research result of Karl's sketchbook (2)

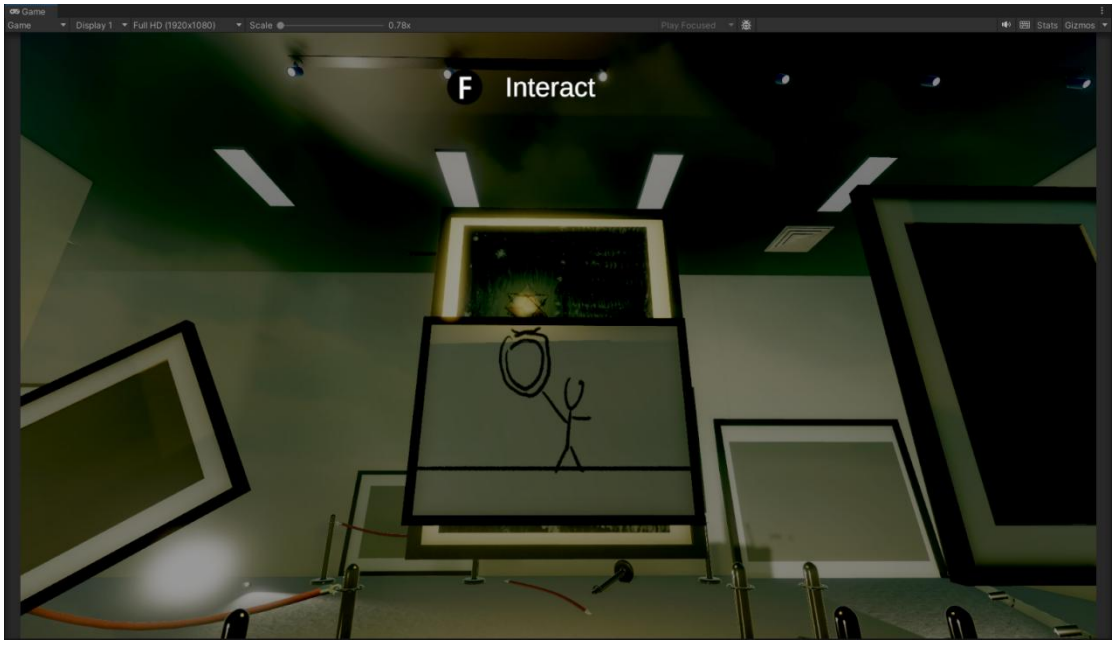

Figure 7: The sixth puzzle in Karl's sketchbook

VII. Discussion and future work

The development process and test results of this study provide some valuable information for other developers of puzzle narrative games, as well as more ideas for future iterations of Karl's sketchbook. By analysing the results of the tests and interviews, the fragmented narrative approach can convey the main plot content to the player, but it can also lead to some missing and ambiguous parts of the plot. The core of influencing the narrative outcome depends on the player's understanding of each narrative element differently, for example, some testers thought that the girl Katherine was just Karl's friend, while some testers associated her with the ring element thinking that they were lovers. However, such differences are not a bad thing in the game. The vague white space of parts of the plot will allow players to imagine what is happening, and each

player will have a story in mind that they think is plausible, this process can inspire players to discuss with each other and keep the game sticky. Therefore, the developers decided not to disclose the initial plot design, and the story in each player's mind is the plot that the game wants to convey.

In Karl's sketchbook, the image recognition technology enriches the form of the player's experience, and to some extent increases the player's understanding and impression of the plot. However, some testers pointed out that the image recognition technology and the physical sketchbook design are slightly redundant, if the physical sketchbook and image recognition technology are removed, allowing players to collect sketchbook pages in the game will make the game experience more holistic and logical. Based on this suggestion, the developers will consider adding a version without the image recognition mechanic in the future.

The players' focus on the game's puzzles differed from that of the developers, which was related to their respective ways of thinking. This leads to the possibility that some of the puzzle solving process may deviate from the original design intent. Players were pleasantly surprised by unexpected puzzle ideas, but it should not go beyond the players' thinking. The tester felt that some unexpected moments of solving puzzles would bring him surprises and a sense of achievement, and these emotions would make him rush to try the

next puzzle to validate himself. However, failing to find a solution for a long period may lead to irritation and boredom, thus weakening the motivation of the game. Therefore, in future puzzle game design, developers suggest avoiding the tendency to be overly subjective and overly complex to ensure that the player can understand and accept the designer's intention during the puzzle solving process. On this basis, try to design unexpected puzzles that can make players feel novel and surprise them in the moment of solving the puzzles, and this emotional value is a key factor influencing player engagement.

VIII. Conclusion

This study summarises the design process of the puzzle narrative game Karl's Sketchbook. It introduces the design idea from three aspects: fragmented narrative, image recognition technology and puzzle design, and focuses on the impact of these three aspects on the game. Combined with the results of user tests and user interviews, the report analyses and concludes that the fragmented narrative enables players to understand the main storyline, and even though it may lead to ambiguities and missing parts of the storyline, players will imagine the storyline subjectively and stimulate the discussion of the storyline. The physical sketchbook with image recognition technology enriches the interactive form of the game, and to a certain extent deepens the player's understanding and impression of the plot. In addition, the simple but

surprising puzzle design in a puzzle game is more likely to bring emotional value to the player at the moment of solving the puzzle, which is the key to ensuring player engagement. These conclusions will provide an important basis for the iterative update of the game in the future, and provide valuable suggestions for the design of mystery narrative games.

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