

**Literature Review: Video Game Design in Puzzle Games -
Unknot**

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Contents

1. Introduction -----	3
1.1 Background-----	3
1.2 Motivation -----	3
2. Existing Puzzle Games -----	4
2.1 Braid: 2D fantasy Adventure-----	4
2.2 Inside: Fascinating World View -----	5
2.3 Monument Valley: Innovative Labyrinth -----	6
3. Areas Worth Improving -----	7
3.1 Braid: Most Players Today Prefer 3D to 2D-----	7
3.2 Inside: Add More Exploration Elements -----	8
3.3 Monument Valley: Nowadays, Labyrinth is Somewhat Uninspired -----	8
4. Project Design Outline: Unknot -----	8
4.1 Overall Statement-----	8
4.2 World View Design: Near-Future Post-Apocalyptic Themes-----	9
4.3 Narrative Design -----	10
4.3.1 Story telling design: Tree Narrative Mode-----	10
4.3.2 Level design: Lighthouse Attraction Point -----	11
4.4 Puzzle Design: Knot Puzzle-----	11
4.5 Interactive Flow Chart: -----	12
5. Reference -----	13

1. Introduction

1.1 Background

The origins of puzzle games can be traced back thousands of years, when people already created several interesting and challenging puzzles such as Tangrams, Klotski and Lupin Locks. Nowadays, with the advent of new digital media such as video games, puzzle games started to come into their own, and became one of the mainstream game categories on the market.

Take single-player computer games as an example, puzzle game or puzzle element appears in several games genres. In action games, the player often has to figure out the boss opponent's weakness; adventure games are full of puzzles, frequently about obtaining inaccessible objects or getting information from other people; and even first- person shooters offer the occasional puzzle, figuring out how to get past locked doors and other obstacles[1]. And in order to explore the playability and enjoyment that puzzles can create, in addition to increasing the difficulty of the puzzles themselves, designers will also create new puzzles or innovate on the basis of the original puzzles, such as adding interactive elements, and excellent art style, etc.

1.2 Motivation

Over the past 30 years, game design has become a discipline with a systematic theory and methodology. By developing game prototypes, game designers test and evaluate to come up with interesting game design solutions, including but not limited to level design, system design, world view design, etc.

As one of the mainstream game genres today, puzzle games have a high degree of fun and playability while also easily be integrated into other game categories. This means that there is great scope for further research into puzzle game design in terms of gameplay, art and commerce. In the future, I look forward to innovating more in the puzzle game category, including but not limited to adding new gameplay and developing more puzzles that can be ported to computer games.

2. Existing Puzzle Games

2.1 Braid: 2D fantasy Adventure

Braid is a standard 2D puzzle-platform indie game developed by Number None. The player controls Tim, who is a little guy in a business suit, to travel through 6 worlds and try to save the princess from monsters.



Figure 1 Visual reference of Braid

The basic gameplay of Braid is classic. Arrow keys make your character Tim move left, right, up and down, and the space key makes your character jump. Players control Tim as he runs, jumps and crawls through the game's various levels. Tim defeats enemies by stomping on them and is able to collect items like



Figure 2 The shadow performs the actions that player rewind

keys to open doors or pull levers to activate some platforms. Player must collect the pieces contain in each level, to unlock the last level and create the jigsaw puzzles that tell Braid's main story.

The most special, interesting and attractive part of Braid is its "rewind" gameplay. Tim travels to six unique worlds and each world has its own time mechanics. Players can use these time-based game mechanics to reverse time and rewind the action to solve the level's puzzles, and the entire game process is driven by such a game mechanic. Such imaginative and flexible mechanic makes the whole game playful and philosophical and creates thoughtfulness and harmony between its various aspects, which is the factor to make Braid a really interesting project[2].

What really makes Braid a magnificent art is the way to connect all the different elements together. The story feeds into game mechanics that change your perception of time, and this new perception affects your reading of the story. The story ideas also act as a metaphor for the overall structure of the game, which in turn fills in the ending. Braid is like a giant jigsaw puzzle made up of some of the most interesting and innovative gameplay in stages. All of this is packed into a very compact and elegant package, an ideal format[3].



Figure 3 Tim, the main character design of Braid

2.2 Inside: Fascinating World View

Inside is a standard 2.5D puzzle-platformer adventure game developed by Playdead. Its control mode is quite similar to Braid, arrow keys make your character move left, right, up and down, and the space key makes your character jump. There is no main objective for the player in this game. All the player needs to do is to keep moving, avoiding death and gradually uncovering the hidden truths of the world as he goes along.

The most intriguing aspect of Inside is its anti-utopian worldview setting based on puzzle solving and the environment created to reinforce it. The whole story begins with a scenario in which a boy slides down a rocky incline, as the player controls the boy's actions to advance the game, the player will encounter a great variety of level elements, such as

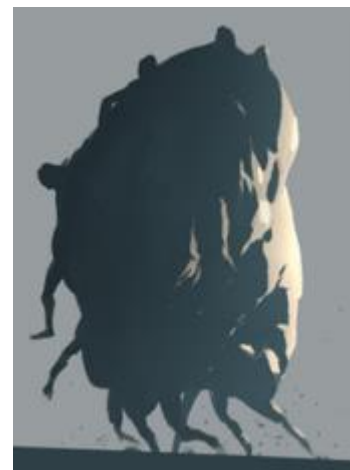


Figure 4 Huddle, the amalgam of body parts that the player controls at the end of the game

masked guards, fierce guard dogs, parasitic worms cause pigs to run rampant, lines of zombie-like people, a large factory of flooded rooms, a laboratory environment where scientists perform underwater experiments on bodies, and Huddle[4].

In Inside, the player needs to interact with these elements to find out the way to move on as they progress through the levels, and gradually uncover the secrets hidden deep within the world. To reinforce this world view narrative, the game has also gone to great lengths to create the environment. The game is dark, with color used sparingly to highlight both the player and certain parts of the environment, also the light is used very cleverly, and there are even several puzzles involving shadows. The game is also mostly silent, with the exception of occasional musical cues, the boy's vocals, dog's bark, equipment and sound effects, so that the oppressive and tense atmosphere of the game is well represented [5].



Figure 5 Visual reference of Inside

2.3 Monument Valley: Innovative Labyrinth

Monument Valley is an indie 2.5D labyrinth puzzle game based on architecture, geometry and illusions developed and published by Ustwo Games. In this game, the labyrinth is composed of optical illusions and impossible objects, which are referred to as "sacred geometry" in-game[6]. Players need to interact with the environment by creating bridges, rotating or moving platforms and pillars etc. to find hidden exit routes from the map for the main character, Ida. The game's colors and other design elements will provide indirect hints to the player's puzzle solving process, while the crows blocking Ida's path will also provide direct hints to the player to prevent the frequent occurrence of stuck levels.



Figure 6 Visual reference of Monument Valley

The most attractive part of Monument Valley is the clever integration of visual deception and spiritual aesthetics into the design of the labyrinth.

“People have an innate sense of geometry, patterns and space,” says Wong, the lead game designer of Ustwo Games. “We find cubic forms and staircases and interlocking tiles beautiful. There's also something satisfying and even a bit mystical about shapes lining up perfectly.[7]” Therefore, we can find many geometries and graphics based on different colors of patchwork in the labyrinth design within the game.

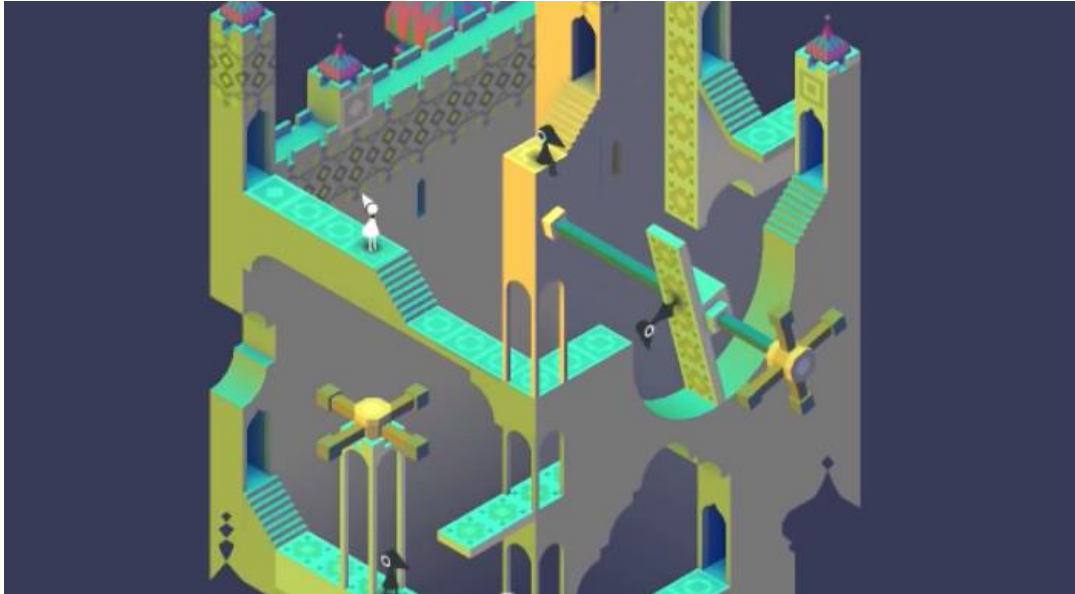


Figure 7 A wide variety of interactive modes in Monument Valley

At the same time, in order to provide enough visual stimulation for the player, each scene in the game has a new visual twist through interaction with the labyrinth. Although the first level teaches us how to move Ida by tapping our fingers, the future exploration is about changing the world itself. By tapping certain parts of the game's colorful levels, we can rotate or elevate platforms to open up new paths. For example in one particularly challenging level, there is a columnar creature with a shiny face that could be moved by sliding our fingers. By moving this creature to form new bridges - much like Escher's paintings create a logical way to go without a path - we were able to move on[8].

3. Areas Worth Improving

3.1 Braid: Most Players Today Prefer 3D to 2D

Although Braid itself has a very good gameplay design, and even the game itself is a series of interesting thought experiments[9], its 2D horizontal presentation in the current game environment may not be so attractive enough.

From the player's perspective, 3D games are a much higher priority for them today. According to a report by NetEase, in a survey of online gamers, 61.4% of players said that their favorite type of game graphics is 3D, and this number is increasing constantly[10]. The game genre favored by players nowadays is gradually approaching to 3D field. At the same time, there is a prominent 8-10% difference in the visual stimulation brought by 3D games and 2D games for players[11]. Therefore, we have reasons to believe that 3D puzzle games can bring players a stronger visual stimulation than 2D games and are more popular among players in the meantime.

3.2 Inside: Add More Exploration Elements

Even though Inside has a fascinating anti-utopian world view, its fixed and rigid linear game clear process does not give players a high degree of freedom. Players are unable to actively explore this worldview, which will largely affect the immersive experience of such games.

We can introduce the concept of "Lighthouse Attraction Point" from open-world games into puzzle games, thus enhancing the degree of freedom and explorable elements of the genre. By setting up eye-catching strong attraction objects in the game, the player is guided to plan a linear path through this eye-catching abruptness. The distribution of each attraction point is designed to be balanced, so that the next attraction point can be easily found at one attraction point, as a continuous attraction force invisibly pushing the player to explore[12].

3.3 Monument Valley: Nowadays, Labyrinth is Somewhat Uninspired

Since the publication of Gotcha, which is a maze game developed by Atari in 1973, the labyrinth element has been a part of puzzle games for almost 40 years[13]. Even though Monument Valley has excellent performance in both maze design and visual design, maze is still maze, and after nearly 40 years of development and innovation, people's enthusiasm for maze games is no longer the same as it was before. If we can create a new puzzle that has not yet been gamified, with excellent level design and visual design, it will surely be favored by most puzzle players.

4. Project Design Outline: Unknot

4.1 Overall Statement

In Unknot, the player will play as a spirit with the ability of "shadow seeing" who travels around the lifeless earth. By collecting the diffuse human consciousness, the player unravels the "neural net" attached to each key item, so as to obtain the memories of the owner of the item related to this item. In the process, the entire world view, the motive of the genie to find memories, and a touching memory related to the past Earth will be shown to the player.



Figure 8 Design reference, from OPUS: The Day We Find Earth

4.2 World View Design: Near-Future Post-Apocalyptic Themes

The future Earth due to rampant infectious diseases, nuclear crisis, war, alien invasion and other factors, the sea level rises, the earth's axis distorted, natural disasters take place frequently, economic disintegration, the Earth's population plummeted to 10% of the early 21st century. Even though it suffered such a major blow, human beings did not become extinct like the dinosaurs and still live strongly on this planet.

In order to strengthen the bonds between existing humans and maintain the fragile human society, post-disaster humans created the "Cyberspace", which linked the consciousness of human beings scattered all over the Earth with the mechanical intelligence existing on each object through digital interconnection technology. People's memories and consciousnesses began to merge and could be shared with each other and gradually visualized in digital form. People can choose to upload their memories and consciousness to Cyberspace by fusing them with the mechanical intelligence on their personal belongings, or they can choose to add a "Cyberlock" to their private memories that they do not want to share, which is commonly known as a "neural net" among humans. In this way, humans rely on each other in a virtual space, surviving on a planet that has lost its vitality[14].

But eventually, the cosmic pulse from the Milky Way reached Earth, shattering the data structure of Cyberspace, and the human consciousness and memories stored in Cyberspace gradually dissipated with the data, and the connection between humans and others disappeared from then on. The arrival of the cosmic wave shattered most people's lives in an instant, and the survivors were enveloped by the despair of losing their emotional attachment, human society began to become fragile and soon humanity disappeared from Earth...

4.3 Narrative Design

4.3.1 Story telling design: Tree Narrative Mode

For the story telling design, we choose tree narrative mode to present our story and world view. There is a main story that runs through the entire game, which serves as the player's goal and presents the general worldview in front of the player while driving the player complete the game. At the same time, in each section of the main story there will be one or several subplots, players are free to choose to explore the side story or continue with the main story, such freedom of exploration to ensure that players can choose their preferred way of playing the game at the same time, but also in the process of exploring the side story to enhance the immersion of the game, while complementing the worldview of the main story design.

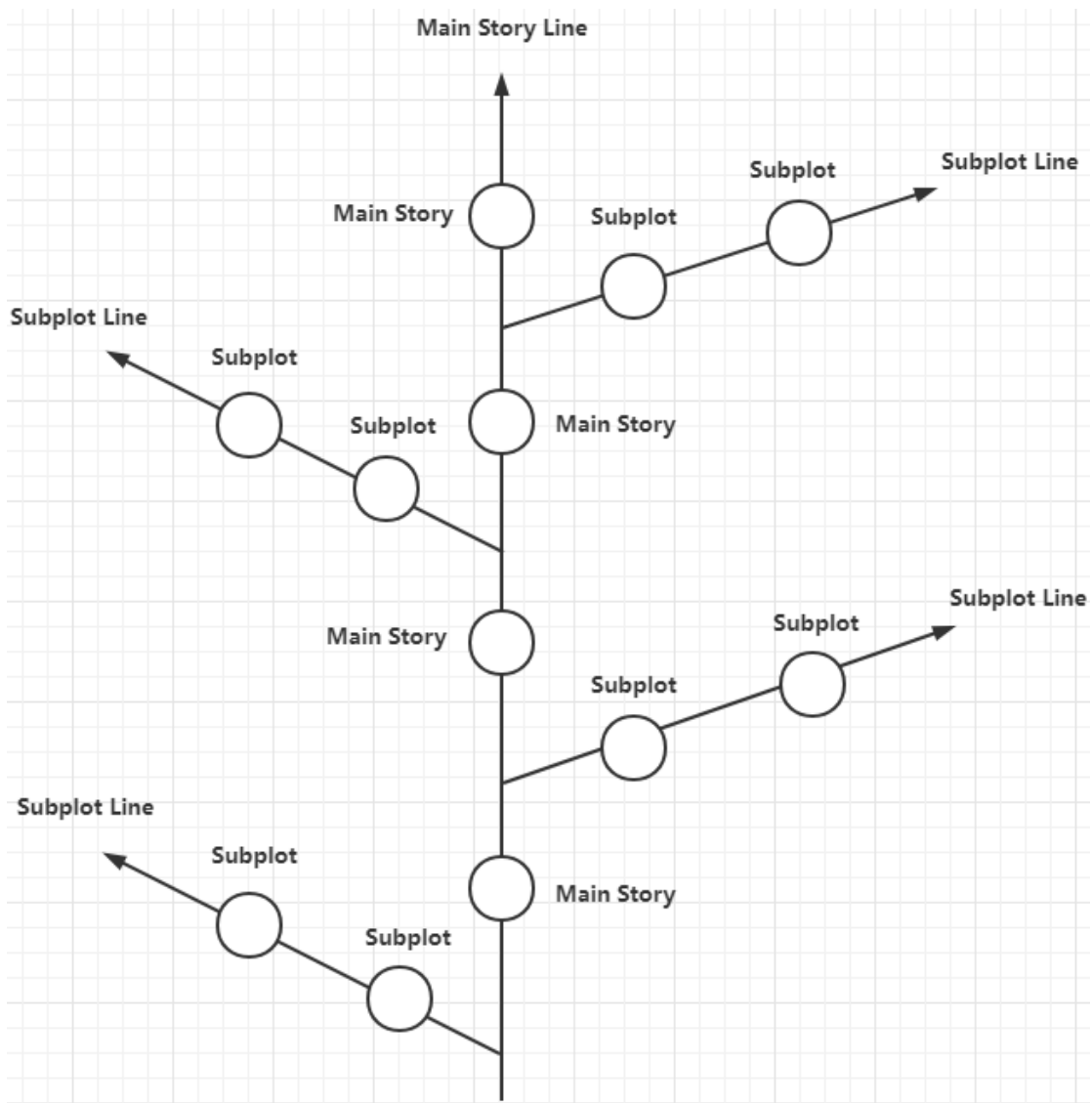


Figure 9 Story telling design reference: tree narrative

4.3.2 Level design: Lighthouse Attraction Point

Cause we have a relatively free story telling mode, so for the level design, we use lighthouse attraction point to indicate where the player should go next. Key items in the main story will emit a different color of light from key items in the side story, thus providing the player with information to decide their next action.

At the same time, in order to encourage players to go deeper into the puzzle, we set a reward mechanism: if the puzzle is perfectly solved, additional side stories will be unlocked, so that players who invest more time can understand the story and world view more comprehensively, thus giving players enough positive feedback.

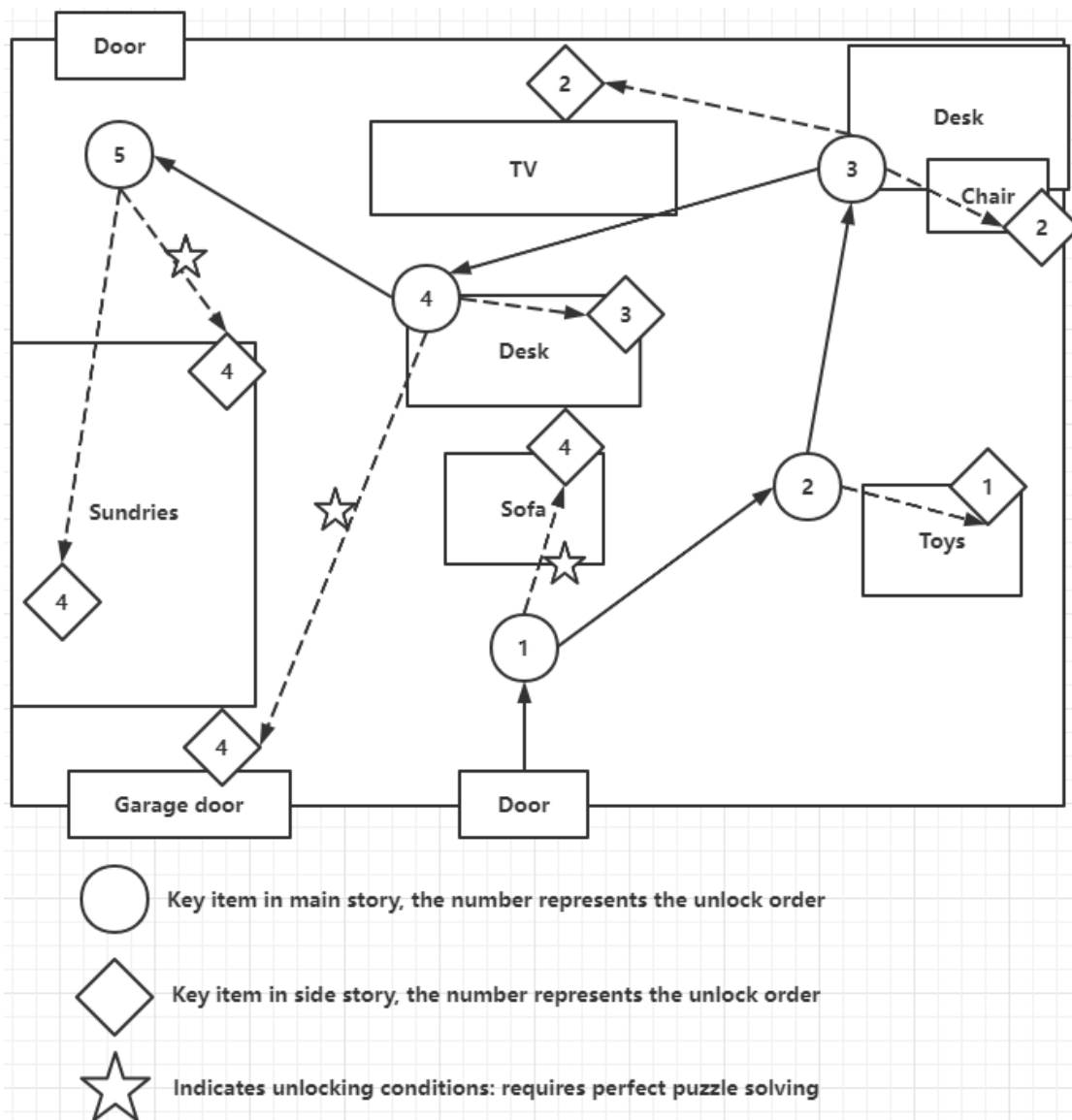


Figure 10 Level design reference

4.4 Puzzle Design: Knot Puzzle

For the most important core gameplay in our game: puzzle solving, we designed a form of puzzle that has never been ported to video games: knot puzzles.

Such form comes from a mathematical puzzle called knot puzzle. We believe that mathematical puzzles are closely associated to puzzles in life that there is no fundamental difference between them. Thereby we chose the knot puzzle and ported it to the game. The player has to manipulate the knot in dragging, pulling, flipping and so on to turn it into its simplest state that eventually unravels, the final untied state of the string will be shown on the side of the screen.

At the same time, the knot puzzle also has a strong fit with the Cyberlock (neural net) setting of our world view, which ensures that the knot puzzle can be perfectly ported into our game while giving players a strong sense of immersion.

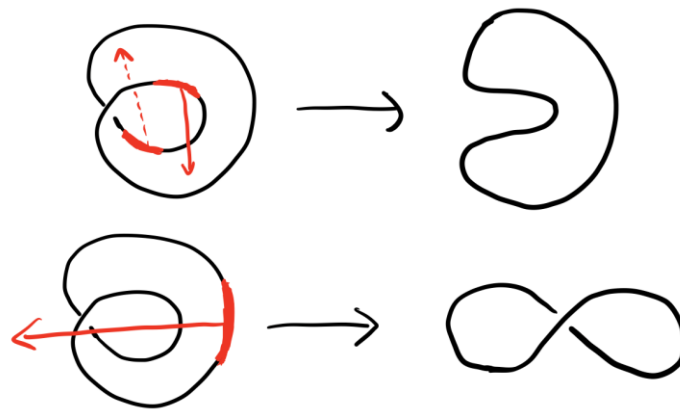
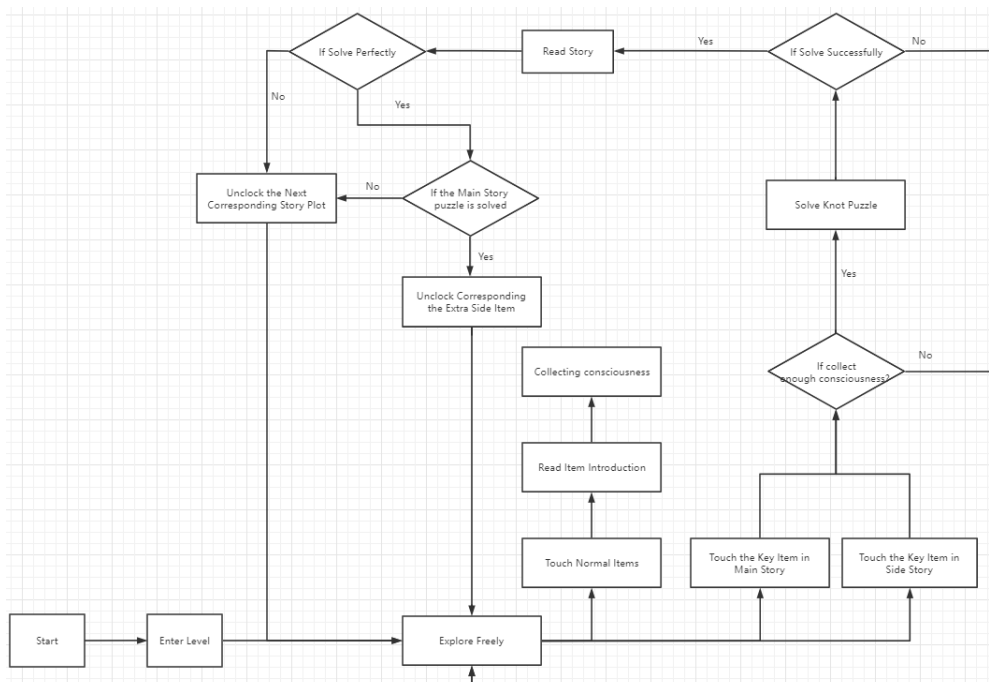


Figure 11 The operation schematic of knot puzzle

4.5 Interactive Flow Chart:

The interactive flow chart is shown below:



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