Uncanny Valley Game in Virtual Environments

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Abstract. Nowadays, as VR technology is developing at an incredible rate, related topics such as the virtual environment, mobile equipment for VR, and metaverse are also becoming hot topics. The article will be depicting the process of researching the Uncanny Valley theory's demonstration in the virtual environment. We created a horror virtual reality game that simulates the environment in real life. In the early stage of making the game, we first discussed how to set a proper story background for the game to put in the environment we want for testing the theory. We got our inspiration from "Backroom". Based on our inspiration, we determined the art style of our game, and later, in 3D modeling parts, we designed several monsters. After finishing all the modeling and programming parts, we tested them in our group. Finally, we released it to the public with a questionnaire to test the public's response. After analyzing the collected data, most people will feel a feeling of horror with the environment we create. We can conclude that the Uncanny Valley theory might still be suitable for the virtual environment. It can show that the Uncanny Valley theory might suit more scales than we think. And for VR experiences, we can use this theory to better create a scary scene or experience, which could be used in in-game making or VR filmmaking.

Keywords: VR/AR; Game; Virtual Experience; Psychological Theory Virtual Reality.

1. Introduction

At present, the theory of "uncanny valley" is widely used in the fields of film and television, animation, and game production, such as the heroine AKI in Final Fantasy: The Spirits Within; There is also the Hollywood film The Polar Express, the world's first high simulation animation film that uses digital capture technology. Its characters approach real people, but it has attracted a lot of criticism [1]. Some people say that it gives people a creepy feeling, some people think that the characters are a bit like dead bodies, and some even think that the film should be named "Night of the living dead." In one of the most famous films, avatar, the director first gave the Navi people an "alien" setting, so that the audience would not treat them as humans psychologically [2]. At the same time, he redesigned the expression, action, language, and cultural expression of the Navi people through different ways of expression, making the "alien" characteristics of the Navi people more prominent and realistic.

VR games are also becoming more and more popular. More and more people own VR devices. According to the prediction of third-party research institutions, the sales volume of VR equipment will increase at a growth rate of about 50% year by year, and the total volume is expected to reach about a 100million units in 2023 [3-4]. The Chinese market accounts for 1/4 to 1/3 of the world. According to statistics, action simulation games are now more promising. But with the deep excavation of this kind of game, it will gradually become a VRRPG game, because it is playing other roles. In addition, with the improvement of the quality of VR devices, there will also be greater market demand for real scene experience games. So, we want to make a horror escape style role-playing game [5].

For the various games that have appeared in our lives and will appear in large numbers in the future, when we design them, we should also consider whether this will trigger the "Uncanny Valley" effect and consciously avoid or create this effect when we hope that they will become more and more

consistent with the game design concept. That's why we choose to create a VR horror game to examine our suspect. There is no doubt that, if this hypothesis is proved to be true, it can be widely used in the film-making and virtual environment setting process, which can have a significant influence on the design concept of virtual horror-making.

2. Related Work

The fundamental components of virtual reality technology are simulations of the environment, perception, and natural abilities. Sensing devices and other elements of the simulated environment are created by computers in real-time using dynamic 3D stereo realistic images. In recent years, virtual reality technology is a popular area of study in international computer fields [6].

Others use unity or unreal, the mainstream 3d game development engine, to make VR games. Some VR games are even "transformed" directly from 3D computer games (such as "The Elder Scrolls VR", etc.). For example, Job Simulator is a game in which players can play any profession and complete a series of jobs as they wish, and the fun part is that most of the things in the game are interactive. This game only uses simple models to represent objects, and there are no complex light and shadow effects. Because of its interesting task design and hectic operation, many anchors spread the game on YouTube, and the cumulative revenue reached $3.67 million [7-8]. Another example is Star Trek: bridge members. As a simulation cooperative driving game, its IP itself is a framework for exploring extraterrestrial galaxies, teamwork, and completing tasks. Players can experience a completely different life than originally existed in novels and movies. Besides, Five Nights at Freddy's is a horror game in which the gamer plays as a night guard who works at Freddy's Pizzeria, a pizzeria filled with teddy bears that turn on their own at night and try to kill the gamer. The gamer needs to spend five nights in this terrifying pizzeria. Its fragmented levels fit well with the duration limits of VR headsets. There are a lot of doubts about the foundation between generations 1 and 2 because the story is not complete [9-10].

The advantage of these games is to give players a strong sense of presence and real action. Telepresence means that players are surrounded by scenes in all directions and can experience the immersive feeling that plane games do not have. This makes the action for VR games; the posture of the character is consistent with that of the player in real-time. Moreover, the player himself is in the game scene, and this sense of "synchronization" is far from being realized by other game methods [9].

The disadvantage of these games is not that real. Especially for some horror games, the players tend to feel frightened by the sudden appearance of the monsters or nervous about the failure of the game rather than scared from the heart. It's because the monsters have a way to be killed no matter how difficult it is and the scenarios in the games seem will never happen in the reality. When the players realize it, the fear in their hearts and feelings of powerlessness will be greatly reduced.

3. Method

Our research is divided into two parts: In the beginning, we will create a VR game with a specifically designed environment. After testing them in our group, we will design questionnaires and release them with our game, to collect feedback from the public. And we will use the result to examine whether the Uncanny Valley theory is suitable for the virtual environment.

3.1 Game Design Parts

3.1.1 Game Story Background

In the game, the player will be acting like a mid-aged white man, who is being kidnapped and went into a coma. When the protagonist wakes up, the player will find himself in a totally strange building. It is a confined space, with little light that can give the player view of the surroundings. Players need to collect fragments of the building's map, and at the same time, he needs to hide and stay away from

the monsters that are roaming in the building. The principle behind the story is trying to guide the player into the role of the protagonist. After this stage, the player can accept the setting of the environment, and as the process of the game goes on, the player will gradually find out about the change in the environment of the game. And that can be used to examine whether our hypothesis is right.

3.1.2 Game Environment Setting

The building player is in is a totally confined and almost dark place. Inside the building, the player will find out that the environment surrounding them is similar to their real life. However, there will be some strange differences in details like the texture of the wall will be different. But generally, we are trying to simulate the real-world environment in the game to an extent to test whether the Uncanny Valley theory is suitable for the virtual environment. We can see our destination principle for the environment (Figure 1): The theme color is yellow and the surrounding is very dark. And as it was indicated, the layout of the building is much like the same in our daily life.



Fig 1. The game environment screenshot

3.1.3 Character Setting

The player does not have any specific identities. We set the player as a white mid-aged man. In addition, the monsters in the game will be described as creepy and out of shape in normal form. We are trying to make them scary, in case we can put the players into stress and anxious circumstance.

3.2 Other Design Parts

3.2.1 Music

The background music in the game will have the characteristic of silence, scary, and hopelessness. It is combined closely with the game process. For example, as the player is exploring a new and unknown area in the building, the music will change slowly and give the player implications about the dangers that are near them.

3.2.2 Atmosphere

The gamer will regain consciousness in a dark scenario. And the only light source is the faint red light from the overhead monitor. The goal is to make the gamer feel scared about the place and at the same time gamer needs to collect "clues" to find out the story behind the building. The player will have a feeling of anxiety, scared, and despair, and the only thing he can do is to fight against the unknown alone and find out the one behind the camera to survive. All of these things decide that our game will be strange, horror, and desperate. We believe, that under such stressful conditions, players can feel their emotional feelings changing much easier. Thus, it will provide us with a good opportunity to test Uncanny Valley theory.

Our game is being put in a relatively narrow zone, and we hope to use this to create an intense feeling for the player (Figure 2).



Fig 2. Screenshot of the gameplay demonstrate

3.2.3 Game Function Setting

The game will include a protagonist, and the player can control him and experience the game in first-person view in a very strange building. During the whole game process, the player needs to collect fragments of a map to find a way out, and at the same time, the protagonist will also need to hide from the monsters that are roaming in the building. The player can hold and collect fragments, and he can do basic things like running and jumping. However, he doesn't have the tool to fight against the monster, what he can do is collect the fragments, explore the building and finally find a way out.

3.3 Game Design Analysis

In our game design, our concept of the game can be generally divided into three parts.

Game environment: The whole game is full of darkness which gives the player scenes of scary. There are also multiple monsters inside of this scene chasing the player and giving the feeling of oppressing sensation. It also makes the game scary. These will put the player into a highly stressful condition. And as the player sees the surroundings around him/she, we can examine whether our hypothesis about the Uncanny Valley theory on the environment.

Game characteristic: The whole game is a cycle, which means the character will find out there is always a way out and he will just keep following the rules of the game and get trapped in it again and again. The player will be so rushed trying to find the way out but will fall into despair again.

Game effect: This game is a realistic game, which means the player will play in a familiar environment in the game. It will create the scariest outcomes for the player as the player blurs the edges of reality and games and feels like they are actually inside of this scene in the real world.

4. Result

To have a more objective view of our game, we decided to have the public play our game and listen to their feedback based on a questionnaire we made. We mainly divided the questionnaire into eight parts and released them on social media with our project file. After two weeks, we collected data from 237 people, and after analyzing them, we concluded serval results.

4.1 The Atmosphere Making of the Whole Game

The verification of our suspect highly depends on our object of study's feelings towards the virtual environment. Thus we set three indexes to test our environment setting. They are "Immersive

experience“, “sense of horror“ and “playability“ parts. First, is the immersive part. Since the target of our design for the environment is to make the players be personally on the scene, the feedback about the immersive experience is of importance. From the data we collected, we can see that about 96.9%(68.2%+28.7%) can reach our expectations (Table 1). This indicates this part of the game is suitable for research. And for the Sense of horror and Playability part, they are set to make sure after the players sink into the game experience, they can have proper feedback from the game that makes them stay in that experience and enter the state of flow.

After analyzing the feedback, we can see that most of the players can have a relatively good experience during the gaming process. To sum up, the atmosphere is suitable for our research.

4.2 The Gaming Experience

For the following parts, the reason for us to set them is to make sure players can focus on the game part, and at the same time, they can still be able to find the changes in the surrounding environment. The data of “difficulties“ and“length of process“ mainly concluded the information we want to know. From the feedback, we can infer that our game is still not good enough to balance the difficulty. And that may lead to a possible result: players focus on the game process, not on the environment change. These data inspired our group that, we need to change some of the settings in our game to create a better test environment for the theory. In addition, we will also put more indices in our game to better examine our hypothesis.

In all, from the data we collected, we can see that our game created a relatively good test environment.

Table 1. Data collected from invited players (200 people standard)

	Immersive experience	Sense of horror	Playability	Difficulties	Play feeling	Length of process
High	68.2%	74.5%	69.2%	48.2%	47.2%	64.5%
Medium	28.7%	23.6%	21.3%	37.6%	19.7%	32.7%
Low	3.1%	1.9%	9.5%	14.2%	33.1%	2.8%

And we released Table 2 to test players’ emotional feedback. After analyzing these data, we can see that players were playing the game under high emotional pressure. And this lead to they can feel their emotion change precisely. Based on the Uncanny Valley theory [2], we mainly designed three parts to examine our suspect. The “Negative emotion feeling“ part, the „Feeling of awkward in surrounding part“ and the “comprehensive degree in horror“ part. And as shown in the table, the surrounding in the game do make players feel weird and scary. And considering there is a high percentage of people show this reaction, we can initially consider our hypothesis to be right.

Table 2. Emotional testing feedback

	Sense of pressure	Negative emotion feeling	Feeling awkward in surrounding	comprehensive degree in horror
high/	79.4%	78.6%	86.7%	82.4%
average/	7.2%	20.2%	11.4%	16.2%
low/	13.4%	1.2%	1.9%	1.4%

5. Conclusion

Under the need to research the uncanny valley theory, we made “cycle” this game. In the game, we created an environment that is highly similar to the real world but same time, a bit different. The player will stay in first-person view and experience the whole game process. After releasing the game

with a questionnaire to the public and analyzing the data we collected, we found out that the theory of uncanny valley might still be suitable for the environment represented in games. And there are amount of people who indicate that environmental design is of importance in horror atmosphere making. However, we still have things to complete in our plans. First of all, according to the result that questionnaire got for us, our game still has aspects that can be improved to better create a horror atmosphere. In addition, we have not found the climax similarity value of our environment uncanny valley theory, thus there will be designed experiments in the future that can help us find that specific value. We are considering the way we release the new versions of our game and better-designed questionnaire that can fit more invested people. VR games bring people a new platform to interact and feel the environment surrounding them, if our theory is proven to be true, then it can be a good way to create horror games and scenes

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