

Researching Visual Immersion Elements in VR Game <Half-Life: Alyx>

Chenghao Wang, Jeanhun Chung*

*Doctor's Course, Dept. of Multimedia, Graduate School of Digital Image and Contents
Dongguk University, Korea*

**Professor, Dept. of Multimedia, Graduate School of Digital Image and Contents
Dongguk University, Korea*

*how9951@gmail.com, * evengates@gmail.com*

Abstract

With the development of VR technology, the visual immersion of VR games has been greatly enhanced nowadays. There has been an issue that has been troubling players in previous VR games, which is motion sickness. Therefore, VR games have been limited in terms of game mechanics, game duration, and game scale, greatly reducing the immersive experience of visual immersion. However, <Half-Life: Alyx> is different from previous VR games in that players can actually perform spatial displacement in the game scene, rather than being fixed in one place for 360-degree observation and interaction. At the same time, compared to traditional games, VR games no longer need to rely on screens, and the complete visual immersion enhances the fun and playability of the game. This research focuses on the VR game <Half-Life: Alyx> to explore its immersive factors in terms of visual perception. Through in-depth analysis of elements such as color, texture mapping, lighting, etc. in VR games, it was found that the game creates a strong sense of visual immersion in these aspects. Through analysis, it is helpful to gain a deeper understanding of the factors that contribute to visual immersion in VR games, which has certain reference value for game developers and related professionals.

Keywords: *Virtual reality, visual immersion, game, color, texture mapping, lighting*

1. Introduction

1.1 Research Background

Nowadays, with the development of VR technology, there have been good attempts and successes in many fields, including VR games in VR video content. As a form of entertainment, the development of games has

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Corresponding Author: evengates@gmail.com(Jeanhun Chung)

Tel: +82-2-2260-3, Fax: +82-2-2260-3766

Professor, Dept. of Multimedia, Graduate School of Digital Image and Contents, Dongguk University, Korea

come a long way, from early text-based games to 2D and 3D games, with a clear upward trend in visual immersion. However, due to the inability to detach from the screen, players still experience a sense of being outside of it in terms of visual immersion. With the emergence of virtual reality technology, gaming has begun to evolve in a whole new direction. Unlike traditional games, VR games do not rely on a screen, and players can enter the virtual world through devices and truly immerse themselves in it. This allows players to have a more immersive visual experience, bringing the visual immersion of VR games to unprecedented heights. As people's interest in VR gaming continues to grow, there are constant innovations and breakthroughs in the field of visual immersion technology. As a result, many excellent VR game titles have emerged, such as <Half-Life: Alyx> <Beat Saber> and <The Room>.

1.2 Scope and Method of the Research

The core of virtual reality is immersion, and vision is a key factor in achieving this immersion. This article aims to explore how the elements of visual immersion in the VR game Half-Life: Alyx can enhance players' visual immersion by analyzing these elements. Based on existing research on visual immersion, this study also aims to deepen understanding of the role and impact of these elements.

The research results of modern neuroscience show that people's experience of the world is input through different sensory channels such as vision, hearing and touch, and processed by the brain to form cognition and response to things.

And vision, as the most direct sense, receives the richest information among humans' many senses and is one of the most important forms of human perception. Therefore, in VR games visual factors are crucial in creating visual immersion. Based on previous research, this article uses a literature review method to search, collect, and analyze in detail the relevant literature on visual immersion elements. The main focus of this study is to explore the visual immersion elements and characteristics of the VR game <Half-Life: Alyx>, and to provide useful references and guidance for understanding the visual immersion of VR games.

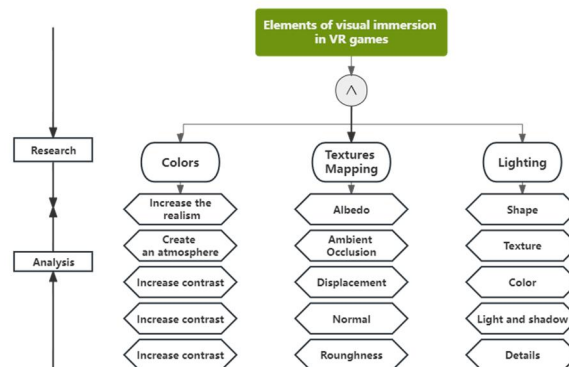


Figure 1. Research Process

2. Theoretical Background

2.1 VR Game <Half-Life:Alyx>

<Half-Life: Alyx> is a virtual reality game that supports all Steam VR compatible devices. The game has a science-fiction adventure theme, where players explore an environment similar to an abandoned city, fight enemies, solve puzzles, and use various weapons and tools. <Half-Life: Alyx> won "Game of the Year" at the 2020 VR Awards. At The Game Awards 2020, it was nominated for "Best Game Direction", "Best Audio Design", and "Best Action", and won for "Best VR/AR" game. The game has received unanimous praise from players and is considered a masterpiece in the field of virtual reality games. Its success has also propelled the development of VR games and opened up new possibilities for future game design.

Table 1. Basic information of the VR game <Half-Life:Alyx>



Source: <https://half-life.com/zh-cn/alyx>

Release	March 23, 2020
Company	VALVE
Platform	Windows (Steam VR)
Game Engine	Source 2
Country	United States

2.2 Visual Immersion

Visual immersion is the experience of a player feeling present in a computer-generated world as if it were real, creating a sense of presence or the feeling of being there in the player's mind. In a virtual environment, players interact with scenes and objects through visual experiences, giving them the sensation of truly existing within this virtual world. The achievement of visual immersion is typically accomplished by creating a continuous, realistic environment visually, which can be either a physical real-world environment or a virtual digital environment. In VR games, various techniques such as 3D modeling, texture mapping, lighting, and dynamic simulation are typically used to create a realistic environment. Additionally, visual immersion can be enhanced by increasing player interactivity.

In conclusion, visual immersion is the most fundamental and crucial factor in VR games, providing better entertainment and learning experiences, and finding extensive applications in various fields. In the future, with the continuous development of technology, visual immersion will be further expanded and enhanced.

3. Analyzing the Visual Immersion Elements of <Half-Life:Alyx>

3.1 Colors

In VR games, color is an extremely important visual element that can directly impact a player's perception and emotional response. As a result, players often pay more attention to and provide more feedback on color than other visual immersion elements. Different from traditional games, the player's vision is completely immersed in the virtual environment, and they can freely look around for viewing and interactive experience. Therefore, color provides the most direct sensory and psychological stimulation for players, allowing them to quickly perceive the atmosphere of the game scene. Proper color processing can make the game scene more realistic and enhance emotional expression, guiding players' emotional experience.

Table 2. Analysis of Scene Colors

	Increase the realism	Create an atmosphere	Increase contrast	Send message	Guide the player
Warm tone					
Cool tone					

Increase the realism. Colors can increase the realism of a game. For example, they can make game scenes look more realistic and natural, thereby enhancing the visual immersion.

Create an atmosphere. Colors can create different game atmospheres by conveying different emotions and feelings. For example, warm tone can bring a cozy and romantic feeling, while cool tone can bring a calm and serious feeling.

Increase contrast. They can enhance the three-dimensionality and sharpness of game scenes, thereby increasing the realism and visual immersion of the game environment.

Send message. Different colors can represent different meanings and information. For example, red usually indicates danger or warning, green represents safety or legality, and yellow can indicate warning and attention.



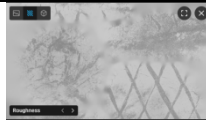

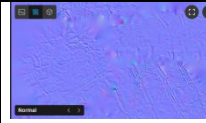
Guide the player. Colors can help players quickly locate or identify objects or areas. For example, using eye-catching colors to identify target areas or items can guide players to find the target more quickly.

3.2 Texture Mapping

Texture mapping is a shading technique for image synthesis in which a texture image is mapped onto a surface in a three-dimensional scene, much as wallpaper is applied to a wall. The advantage of texture mapping is that it adds much detail to a scene while requiring only a modest increase in rendering time. Texture mapping is an important technique for achieving realism and detail in VR games, allowing object surfaces to appear more realistic and textured. Different surface textures, such as roughness, smoothness, coldness, softness, etc., can affect people's emotional experience. Soft things often give people a warm and comfortable feeling, while

hard things may give people a cold and tough impression. Therefore, the creation of texture materials often has a direct impact on the form of the work, and in VR games, materials, as elements that the audience can directly perceive visually, have a huge impact on the player's visual immersive experience.

Table 3. Basic Information of Texture Mapping

Image	Albedo	Roughness	Displacement	Ambient Occlusion	Normal
					

3.3 Lighting

Light can effectively convey information, emotions, and atmosphere in games, creating a sense of space through changes in light and shadow and the virtual structure, further shaping the scene's spatiality. At the same time, light can also illuminate the structure, color, and texture details of objects, thereby enhancing visual immersion. Give life to game scenes, making players feel as if they are in the game, enabling them to experience and enjoy the art and thus achieve immersion.



Figure 2. Left_light Right_Unlight

Creating a reasonable lighting is also necessary in the visual scenes of <Half-Life: Alyx>. Adjusting the atmosphere of the scene through the intensity, direction, and color of the lighting to make the environmental atmosphere of the game scene consistent with the setting, achieving the effect of attracting players' attention and promoting visual immersion. Therefore, light has a direct or indirect influence on factors such as shape, texture, color, light and shadow, and details.

Shape. Lighting can highlight or weaken the shaping features of a scene by illuminating it in a certain way. It can emphasize the object's contour lines and changes in surface light and shadow, thereby enhancing the visual immersion effect.

Texture. Highlighting the texture and material texture of an object's surface through changes in the angle of illumination and different light sources, making it more three-dimensional and realistic.

Color. Lighting can adjust the overall color and emotion of a scene by changing the color, thus achieving emotional expression and visual effects.

Light and shadow. It can create strong contrast and shadows, causing dynamic changes on the surface of the

object and enhancing the visual effect.

Details. Lighting can emphasize important details in the scene through its illumination, allowing players to better notice these elements.

4. Conclusion

The immersive visual experience always takes place in a virtual environment, whether it is a story world created by text or a digitally generated virtual environment. This study aims to explore the key visual immersion elements in VR games, analyze the characteristics of these elements, and how they guide and maintain the audience's visual immersion. The analysis results show that the main visual immersion elements include color, texture mapping, and lighting, among which color is an extremely important visual element that can directly affect the player's perception and emotional response. Texture mapping is an important technique for achieving realism and detail in VR games. Finally, lighting can effectively convey information, emotions, and atmosphere in the game.

In conclusion, by analyzing VR games, it is necessary to use visual elements to guide and maintain the audience's visual immersion. This can help players more clearly experience the realistic virtual environment and interactions, and improve their engagement and visual immersion. Based on these research findings, we hope that more studies in related fields can be conducted in the future to provide better visual immersion guidance for the production of VR games.

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