

The Impact of Virtual Reality on Gaming

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Abstract. Virtual reality (VR) as an advanced technology has had a profound impact on the gaming industry. VR technology provides an immersive experience, allowing players to fully immerse themselves in the gaming environment. With the continuous development and maturation of VR hardware, an increasing number of game developers have begun incorporating VR elements into their works. This paper aims to thoroughly investigate the impact of VR on gaming, exploring its role in game design, user experience, and technological innovation, in order to further integrate the gaming industry with VR technology. The purpose of this study is to further explore the components presented by VR and the lasting impact of this technology on the gaming industry. The paper will analyze the immersion and social impact of games in VR environments, as well as investigate the accessibility and educational implications of games on VR platforms. Through comprehensive exploration of these aspects, this paper aims to provide theoretical support and practical guidance for the integration of the gaming industry with VR technology.

Keywords: Immersion, Spatial audio, Social Interactions, Impact of VR.

1. Introduction

Since the 21st century, virtual reality (VR) technology has experienced exponential growth, particularly in its widespread application and usage in the modern world. Initially described by American computer scientist Ivan Sutherland in the 1960s, VR was envisioned as a technology that would render the boundary between the real and virtual worlds indistinguishable. Sutherland and his student, Robert Sproull, created the first augmented head-mounted display device, known as the "Sword of Damocles," initially only capable of displaying simple shapes within a room [1]. Over time, various industries, including film and gaming, began to adopt VR as a means to enhance user experiences.

The gaming industry took the lead in researching and experimenting with VR systems during the 1980s and 1990s. Nintendo introduced the Virtual Boy to the home market in 1995, which, similar to the Sword of Damocles, featured a tabletop design that allowed users to comfortably view the screen (Fig.1). Despite offering numerous games and controllers, the unique visual effects of the Virtual Boy, using only red and black hues due to the use of inexpensive materials and a single red shader, led to widespread reports of severe headaches among users, resulting in its classification as a failed product [2]. During this period, Sega also released its own VR system called "Sega VR," which, like the Virtual Boy, caused headaches and dizziness among players. However, despite these challenges, interest in VR continued to grow, prompting an increasing number of developers to create prototypes.

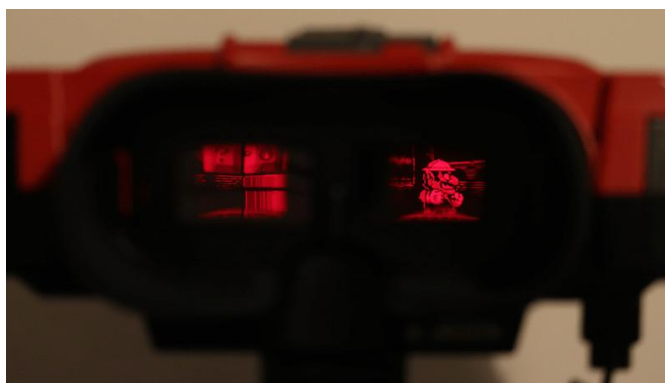


Figure 1. Nintendo's Virtual Boy System [3]

It wasn't until the 2010s that the next generation of VR systems was introduced to the public. The Oculus Rift, launched by Palmer Luckey's company Oculus and later acquired by Meta for \$2 billion, along with initiatives by HTC and Valve, ushered in a new era of VR gaming. By creating stereoscopic images and projecting them through lenses onto viewers' eyes, these devices offered a more realistic VR experience. VR gaming transcended traditional keyboard, mouse, and gamepad controls, leveraging technologies such as head-mounted displays, gesture recognition, and motion control to provide a more immersive interactive experience for players. Players could physically and gesturally interact with the virtual world, immersing themselves in a more lifelike game environment and emotional experience.

The application of VR technology in gaming has opened a new chapter in the gaming industry, transforming not only the content and experience of games but also profoundly impacting the direction of the industry's future development. The rapid evolution of VR technology continues to drive the gaming industry towards greater realism, interactivity, and immersion. Therefore, in-depth research into the impact of VR in gaming, exploring its role in game design, user experience, and technological innovation, is crucial for further integrating the gaming industry with VR technology. The purpose of this article is to investigate further into the components that VR presented and the everlasting impact that this device had on the gaming industry. The article will analyze much of the immersive and social impacts, as well as its accessibility and educational impact on the genre.

2. Immersive elements in VR gaming

One of the most major impacts that VR had on gaming is the ability to immerse the user into the game world. The user will experience the games differently than viewing it from a computer screen. Most virtual reality games try to replicate real life, for example generating houses or churches which many has seen in real life and could visit through the VR system. This part will explain in detail about how immersive elements are being incorporated through VR and how it affects VR gaming.

2.1. Visual Immersion

The basic requirements of a VR game is to have a good simulation of realistic graphics and a good setting. For the player, they would have the ability to explore everywhere around the area with ease. Games through a VR system usually requires a wide space and high graphical power to express immersion to the user.

VR achieves visual immersion by using Stereoscopic imagery. Every VR system contains 2 lenses, one for each eye. Each lens generates a different set of 2D imagery, which through the player's angle of view results in a 3D environment [4]. The eyes and brain work together this way to form depth perception, which consequently adds realism and immersion to the game.

VR systems such as the Quest 3 are better at handling high-definition graphics as the Quest 3 is able to produce a resolution of 2,064 x 2,208 pixels per eye (Fig.2). This is an increase of 20% from its predecessor, the Quest 2 [5]. The clarity from such systems can impact the users overall experience as they are able to freely look at objects and details from a specific spot. VR must also be able to create a 360° field of view for the player. Unlike a traditional computer game, which doesn't show anything except for the environment in front of the player, a VR game allows the users to turn around which can create further illusions on the subject of immersion.



Figure 2. A comparison between the Quest 2 (2020) and the Quest 3 (2023) [6]

Not only this, VR can immerse the players visually by creating dynamic weathers and lighting effects. In games such as Half-life Alyx, the player can experience an alien-infested earth looking for a superweapon. The use of lighting can create certain effects of curiosity and anxiousness, because the player can't see into the distance where an enemy might appear from. Making use of lighting is present in many horror games, as it often can be a way for the developers to put quick scares or terrifying moments in the most unexpected places. The addition of horror games to VR dives into this phenomenon even further, as the monsters could be jumping at you from point blank range, which can trigger a horrifying reaction for the player and scaring them even closer than from a PC screen or a TV.

2.2. Audio Immersion

Auditory immersion also grew immensely with the rise of VR gaming. In entertainment, audio creates another layer of emotion. Particularly in film-making and music, the directors must choose a piece of audio to compensate for the video. For example, if a sad story is told, they might find a piece of music that is slow and melancholy. If there are horror elements, the music might be fast and eerie, to create a layer of immersion. With VR gaming, audio adds on to the game exceedingly. Most VR consoles have audio built in, such as the Oculus Quest, and others rely on attaching headphones, such as the PSVR which uses earbuds.

The main way VR gaming deals with audio immersion is by using spatial audio. Spatial derives from the word space, as spatial audio creates surround sound that differs by the distance, or space [7]. It is a reactive system that changes the audio depending on your current location. For example, if the player is far away from an object that creates sound, they will feel further away because there would be little audio to pair the two. As the player gradually closes their distance, they will hear more volume of audio. Surround sound is also an important asset to spatial audio, because it simulates a 360° audio range. The player could be hearing sound from around them, from front to back. This is useful in VR games, which can give the player cues and tips on objectives, enemies etc. This helps the player be more present, which in turn helps the player's perception of the game's dimension.

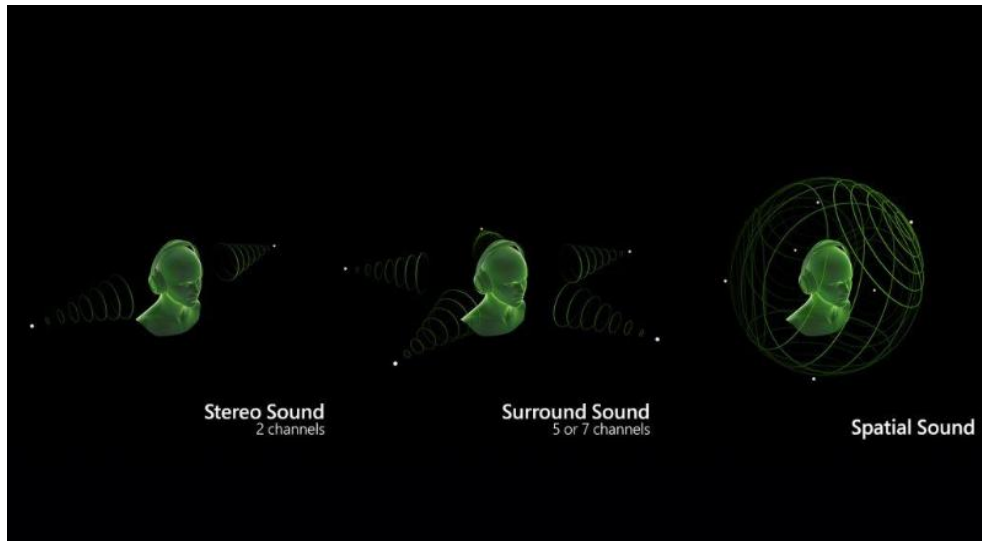


Figure 3. Demonstration of Sound types (Stereo, Surround, Spatial) [8]

In order to do this, developers must incorporate a head-related transfer function (HRTF). This helps the brain identify depth and provides help to better understand aspects of audio. This helps with sound source localization, which helps with identifying direction and position through different channels. HRTF tricks the brain into understanding where the audio is coming from (Fig.3). Although this is mostly unused in 2D games, in VR it is very important as it creates realism and tracks the head movement and makes the games more realistic. In games such as I expect you to die, sound is used very well as it mixes stealth and action as you play as a spy. With a wide variety of machinery to use, the game often directs the player's attention by creating sound cues.

3. Social Impacts

This section of the article looks at how VR created virtual spaces for people to communicate and interact. For many people who play games, they often have friends online who enjoys playing games together. As opposed to a traditional voice call on Discord or a party chat on Valorant, VR users can interact with others more easily through created spaces and multiplayer opportunities.

3.1. Worldwide opportunities

The growth of VR reached everywhere in the world. More and more people are using VR as a way of communicating with others. Many can even make friends through this space. There is a place for everyone with different interests and hobbies. Games such as VR chat and Rec Room popularized this genre of VR (Fig.4). These games allow for personal customization. For example, the player can choose whether they want to be a person, an animal, and much more. This way, people with social anxiety and awkwardness can still be in touch with others who might look like a banana. It is a great way to gather with your friends and engage in fun minigames and eventually have tons of fun in user-generated areas for a good session of enjoyment.



Figure 4. Gameplay from VRchat (2014) [9]

Many VR games can also help build events and communities. In 2018, Oculus launched their own platform for performances and concerts titled Oculus Venues, which allows the user to watch performances from popular singers and artists through VR [10]. This has been expanded to comedy, exploration and more. This is created with the intent of including virtual presence to the performances that you are watching. For people who are unable to travel, this is a great way to still be with their favorite songwriters. There are also many metaverse created for many real-life explorations with the uses of Google earth VR can help the players wander around and see infrastructures and landscapes the user might not have access to.

Virtual Reality also offers the opportunity for cultural exchange and global understanding. Through language localization and real-time translation features, people from different countries and language backgrounds can communicate and interact seamlessly in virtual environments. This promotes inclusivity and breaks down language barriers, allowing individuals to explore and appreciate different cultures.

3.2. Virtual Education

In virtual reality, players are able to freely explore environments and interact with others, making it an ideal tool for virtual learning through gaming and entertainment. Through virtual reality technology, everything can transform from staring at a page in a notebook to a lively and interactive experience, with the ability to physically move to observe and explore details and surroundings.

Educators can regularly use virtual reality games to capture classroom attention and encourage easy peer competition. For instance, in games like Prisms' "Epidemic," users are tasked with creating algebraic equations and applying them to real-life scenarios using information from graphs, thus promoting learners' critical thinking and practical application skills.

Furthermore, games such as "The Great Painting VR" allow users to closely observe famous artwork like the "Mona Lisa," providing magnifying tools for users to closely examine textures and protrusions, offering a deeper understanding of art while making the learning process more engaging and interactive.

4. Conclusion

This study delved into the profound impact of virtual reality (VR) on gaming and explored its crucial role in game design, user experience, and technological innovation, emphasizing the significance of further integrating the gaming industry with VR technology. The purpose of this paper was to further investigate the components presented by VR and its lasting influence on the gaming

industry. The analysis encompassed the immersion and societal impact of games, as well as the accessibility and educational implications of games on VR platforms.

To begin with, in terms of game design, VR technology provides a more realistic and immersive gaming experience, enabling players to become fully immersed in the virtual world. Game developers have the ability to utilize VR technology to create more engaging and challenging game environments, appealing to a larger audience and elevating the entertainment value of games. Moreover, VR significantly impacts user experience by enabling players to interact with and freely explore the game environment through VR devices. This heightened sense of presence not only enhances player engagement but also deepens emotional involvement, resulting in richer and more unforgettable gaming experiences. Furthermore, VR technology fosters substantial breakthroughs in technological innovation within the gaming industry. Developers can leverage the interactivity and immersion of VR to introduce innovative game mechanics and gameplay styles. This not only enriches the content and format of games but also propels the advancement and evolution of gaming technology. Lastly, this study analyzed the immersion and societal impact of games, as well as the accessibility and educational implications. It was observed that the application of VR technology enhances immersion, bridging the gap between virtual and real-life experiences and yielding profound social consequences. Additionally, VR technology contributes significantly to improving the accessibility of games, enabling a broader audience to engage in the gaming world and promoting inclusivity and diversity within the industry. Moreover, in the field of education, VR technology holds immense potential in providing vivid, interactive, and captivating learning experiences.

In conclusion, a thorough exploration of the impact of VR on gaming is crucial for further integrating the gaming industry with VR technology. This study analyzed the components presented by VR and its enduring influence on the gaming industry, while also examining the immersion and societal impact of games, as well as the accessibility and educational implications. These findings provide theoretical support and practical guidance for the development and integration of the gaming industry with VR technology and offer new directions and perspectives for future research and innovation.

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