

Research on improving efficiency in VR game development

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Abstract

Currently, hardware companies such as Oculus, Samsung, and HTC are producing virtual reality devices, and game software development companies are developing or servicing VR games using these devices. Accordingly, the VR game market is expected to continue to grow in the future.

However, in order for the VR game market to become active, various problems raised during game development and service must be resolved. This paper investigates solutions to problems raised during the development and service of VR games, such as cyber sickness, risk of injury due to environmental restrictions during play, and reconnection induction problems.

Cybersickness can be alleviated by utilizing multiple GPUs for each display processing to achieve higher frame rates and optimizing play space design. Environmental constraints during play can be mitigated by optimizing space design, and the problem of inducing reconnection can be solved by continuously providing the motivation and purpose used in existing game methods.

Through this, we were able to apply it to develop VR content that can be played continuously.

Keywords: *VR game, game methods, VR content*

1. INTRODUCTION

VR is a compound word of Virtual Reality and can be directly translated as virtual reality.[1] VR uses a method of implementing virtual reality using an HMD worn on the head.

HMD (Head Mounted Display) is a representative 3D display device for implementing virtual reality.[2]

Because VR has a display right in front of the eyes, users can experience the same thing as being in the space themselves. Therefore, immersion in the content is higher than using a TV or monitor.[3]

Because of these advantages, research and production on VR devices and VR content have been conducted over a long period of time, and they are becoming popular with the release of VR devices such as Oculus.

Based on a survey conducted by the Korea Creative Content Agency, the founding year of businesses developing VR game content is 33.3% before 2011, and 66.7% after 2011, meaning that many companies were founded relatively recently.[4] The results of a survey on the opening times of VR game centers located across

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the country showed that the proportion of respondents who answered that they opened after 2017 was significantly higher at 90.7%. [5]

On the other hand, 44.2% of all companies responded negatively regarding the future outlook as very or somewhat worse. [6]

Problems that arise when creating VR devices and content such as cyber sickness, safety issues when playing, and reconnection induction problems are suggested as reasons why VR content has not yet been popularized. [7][8][9]

Here, we will look at three of these problems and find ways to solve them.

To do this, first analyze the cause of the problem and then find a way to solve the problem using methods suggested or used by hardware and software companies.

2. Current status research on VR game development

2.1 Cybersickness

Motion sickness is a phenomenon that occurs due to differences in information received by the body's other senses, excluding vision. This kind of motion sickness also occurs when using virtual reality devices such as VR devices, and this is called cyber sickness. [10]

For reference, game users call this 3D motion sickness because it often occurs when enjoying 3D content, but this is not strictly speaking correct since motion sickness sometimes occurs in 2D content as well. [11]

There are many causes of cybersickness. Among these, experts working at a virtual reality content development company suggest that resolution, frame, and viewing angle issues are the factors, and they believe that even if these issues are resolved, the occurrence of cybersickness can be greatly alleviated. It is claimed that it can be seen. [12]

2.2 Safety issues when playing

Content using VR devices generally consists of content that the user directly moves and uses. Therefore, in order to use a VR device, a safe space and safety device of a certain size are required, and if this space is not provided, a problem arises in which the user cannot play smoothly. [18]

The causes of this problem include the inability to see outside when a VR device is installed, and the difference in moveable areas due to the gap between virtual space and real space.

VR devices are used by wearing a Head Mounted Display (HMD) on the head. Due to the nature of the device, the HMD completely excludes external visual information and projects only virtual reality onto the display.

Therefore, the user wearing the HMD only knows about the external environment before using it, and is not aware of any changes in the environment thereafter.

If a user selects VR content that moves and plays without being able to see the outside, the following problem occurs.

First, because you cannot see outside, the risk of injury increases when playing while wearing an HMD. The following is an example



Figure 1. VR play user's behavioral progress

In this example, the user uses the HMD and controller to move his body according to the situation provided in the content, then falls backwards and touches the ground.

As a result, when the line connected to the HMD becomes tangled, the staff behind the user holds the line to prevent a dangerous situation.

In this situation, there is a staff member who can handle the problem if it arises, but if the user cannot prepare for this, he or she must deal with the risks that may arise when using it on his or her own.

Second, if sufficient space is not secured to use the VR device controller, the user may not be able to determine the location of obstacles in the play environment and may be damaged by hitting the obstacle when using it.

Additionally, in the case of a wired controller, a problem arises in which the connected string may become tangled, which may limit the user's actions.

Third, although walls in virtual space cannot be passed through using devices, real users can pass through walls by moving directly. The following example illustrates this graphically.

Collision checks are applied to walls in virtual space, so when you use the controller to explore an area, you will not be able to pass through objects such as walls and will collide with them.

On the other hand, the real body does not apply here, so if the user walks directly to the wall, the problem of going over the object and going out of the uncreated space occurs.

In this case, the user may momentarily lose their sense of direction.

2.3 Inducing reconnection

Content such as games can generate steady sales only when users have to log in and play again after playing for the first time. Therefore, during development and service, game structures and policies must be established to ensure that users continue to reconnect.

Content using VR devices also requires encouraging users to reconnect. However, compared to PC, console, and mobile platforms, VR devices have a problem with reconnection rates being lower than other platforms due to the problem of poor accessibility to the device.[19]

In order to encourage users to keep re-connecting to content created using a specific platform, the device must be easy to access and maintain.

However, access to and maintenance of VR devices is not progressing due to the following problems.

First, most VR content is an arcade genre centered on action shooting. According to the [Virtual Reality Game Business Survey Report], shooting and FPS/TPS games account for the highest proportion of sales by genre generated in virtual reality (VR) game rooms at 46.6%.[20]

The reason why sales are focused on this genre is because users intuitively perceive it as a genre suitable for VR games, and in fact, it is the genre most suitable for VR.[21]

However, the action shooting FPS genre is one of the most prone to cybersickness, and because the content is simple, it is difficult to motivate people to reconnect.

Second, the play time is short. According to the 2016 mobile/VR game market review, the average play time of VR games is 10 minutes per play, and the average play time of all content is 40 minutes to 3 hours.[22][23]

In the [VRAR Use and Production Safety Guidelines], the recommended time is set at 30 minutes due to the risk of causing physical and mental side effects.[24]

Because the play time for one play and the play time for the entire content are short, there are cases where VR content rapidly increases the difficulty level after the beginning to extend the play time.[25]

Third, there are problems that occur when wearing it. [VRAR Use and Production Safety Guidelines] mentions that problems may occur in areas of contact with the body due to heating issues when wearing a VR device.[26] Additionally, VR devices weigh at least 200g, which prevents them from being worn for long periods of time.

3. Efficiency improvement research on VR game development issues

3.1 Improvements in hardware performance and content development methods

In order to alleviate cybersickness that occurs when using VR content, improvements in hardware that implements content and content development methods must be carried out simultaneously.

At VR Experience Day, NVIDIA, a GPU development and manufacturing company, is suggesting a method to improve performance by allocating two GPUs to each display by improving the SLI (Scalable Link Interface) method, which combines two or more GPUs to perform parallel operations.[27]

Using this method, the necessary frames can be obtained, but there is a problem that hardware costs increase. Therefore, research on level design to design an optimized play space to stably achieve 90 frames even with low specifications must be conducted.

Specifically, in the recommended implementation specifications for VR content, standards and limits for the size and shape of the space where 90 frames can be output must be set, and methods for controlling the shape and number of objects that appear in each area must be studied to arrive at results. . Using this method, you can secure a stable frame.

3.2 Establishment of safety measures

In order to mitigate the risks that occur during play, the structure and form of the space that ensures safety must be determined.

The play space needs to be equipped with shock absorbers on the pillars and floor, and the walls must be made of a flexible material like a net to reduce injuries or damage to equipment even if touched.

However, this method can be used in businesses such as VR rooms, and is difficult to apply at home.

Therefore, in order to ensure safety when playing VR content at home, the content must be designed so that the user can select a safe range and play only within it, and play is restricted when going outside.

3.3 Strengthening reconnection rates using other platform success stories

In order to increase the reconnection rate of VR content, content providers must provide reasons and motivation for users to behave that way.

There are successful cases of inducing users to reconnect on PC, console, and mobile platforms, so there is a need to study these cases for VR content as well.

There are three main ways to encourage users to reconnect to the platform.

- ① Continue to provide continuous stories and challenges with a long flow and encourage users to complete them.
- ② Induce competition with other users, rank the results, and announce them by period.
- ③ Provide objects to collect and encourage users to cultivate them.

Among these, for item 2, onlineization of content is an important requirement, and if items 1 and 3 are also online, they can be linked to item 2.

Considering that the action shooting FPS genre for platforms such as PC, which had a low average play time and low reconnection rate before going online, has gone online, the reconnection rate and average play time have increased, VR content is also moving towards becoming online in the long term. There is a need to induce it.

The following is a table of suggested methods to improve efficiency for the three problems presented.

Table 1. Main parameters

problem	Efficiency improvement plan
cybersickness	Improvements to hardware and content development methods are underway together.
Safe when playing	-Establish the structure and form of space to ensure safety. -Encourage users to select a safe range and play. Set to restrict play when you leave the area.
Inducing reconnection	-Continue to provide continuous stories and challenges with a long flow and encourage users to complete them. -Induce competition with other users, rank the results, and announce them by period. -Provide objects to collect and encourage users to cultivate them.

4. Conclusion

It can be said that the current VR content market is in its early stages and has not yet become widespread.

In order to spread this market, hardware and software technology must be mature to solve problems that arise during VR content development, and design standards must be established for facilities that can ensure stability during play and the systems and spaces required for play. do.

Additionally, in order to strengthen the low reconnection rate, the story structure must be strengthened and competition, collection, and cultivation methods must be introduced to provide incentives to encourage users to reconnect.

In the future, in order to diversify the genres of VR content that are fixed in specific genres and forms, research is needed on model structures and production methods appropriate for each genre and measures to deal with problems that arise during development.

Depending on the results of this study, the expansion and activation period of the VR content market will be determined.

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