



The Research On Virtual Reality Sickness With Advancing Color And Receding Color

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The Research on Virtual Reality Sickness with Advancing Color and Receding Color

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ABSTRACT

In order to verify the effect of the advancing color and the receding color on VR sickness, I designed an experiment about the familiar tunnels in our daily life. The software uses unity, and the tunnels have three colors, gray, red, and blue. I choose the objective evaluation method: Wii balance board, it can measure the trajectory of the center of gravity shift, indicate the coordinate points in the excel and make the center of gravity movement chart, the center of gravity is more intensely, the dizzy of the personnel body's feeling is more stronger. The experimental results show that red can bring a instability feelings to the experimenter.

CCS CONCEPTS

• Bstraction • Procedural animation • Scenario-based design

KEYWORDS

Virtual reality, Sickness, Color, Balance

1 Outline

In recent years, the market sales of VR equipment have been increasing, and more users have access to VR equipment more conveniently. However, if you use a VR device to use image content or games, it can cause sickness or discomfort to the users. So I think reducing VR sickness is an important subject^[1].

Virtual reality sickness occurs when exposure to a virtual environment causes symptoms that are similar to motion sickness symptoms. The most common symptoms are general discomfort, headache, stomach awareness, nausea, vomiting, pallor, sweating, fatigue, drowsiness, disorientation, and apathy. Other symptoms include postural instability and retching. Virtual reality sickness is different from motion sickness in that it can be caused by the

visually-induced perception of self-motion; real self-motion is not needed.

Therefore, I investigated the reasons that affect VR sickness. Oda indicate that keeping the visual distance can slow down the viewing discomfort to some extent^[1]. According to the research on psychological effects of color, the definition of the forward color and the backward color can be seen^[2]. Based on the results of these two papers, we aims to clarify and verify the impact of color on VR.

2 Previous Studies

According to the research by Zhang et. al.^[3], the advancing color in the work environment has better movement accuracy and the whole body reaction time than ordinary light. Anii^[4] suggest that colors have some influence on distance (depth) perception in a long jump situation under limited conditions. In addition, many researchers described the cause of VR sickness, and how to defense it^{[5][6][7][8]}.

According to previous studies, advancing colors are the more dominant colors within an interior and advance "into" the space, and appear as thought they are coming towards you. Any of various colors (as greens, blues, violets, and their variations) that tend to appear farther from the eye than other colors lying in the same plane. the relation of the color and the movement has been cleared, but it has not applied in the VR aspect, and the relation of the color and the VR sickness has not been learned.

3 System

In order to verify the effect of the advancing color and the receding color on VR sickness, we designed an experiment about the familiar tunnels in our daily life. We used Unity as game engine and create three types of tunnels which have three different color wall such as gray, red, and blue. We implemented these animation using Oculus and evaluate sickness using Wii balance board. Figure 1 shows sample image of each tunnel.

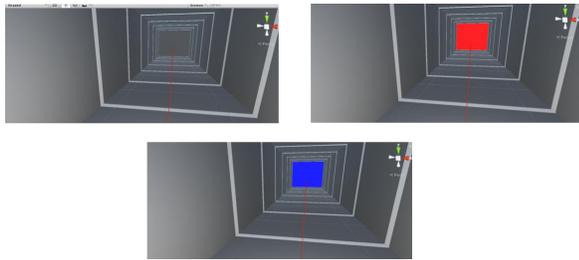


Figure 1: Three types of tunnel

3.1 Implementation

According to the previous research, people can maintain the balance of the body in the unconscious situations. Once humans have the feelings of sickness, it will break the balance of the body and the center of gravity will shift. The Wii balance board can measure the degree of gravity shift of the human body. In this experiment, we added the area measurement functions in the evaluation system of the balance board, it can measure the degree of the center of gravity movement of the experimenter. The area is larger, the feelings of sickness is stronger, and we can evaluate the degree of the sickness more intuitively.

3.1.1 objective evaluation method.

With regard to the measuring method of the Wii balanced board, according to the research by Kawaita^[9] and Anii^[4] and according to the credit and experimental procedures of the balance plate, it shows that the correlation between visual inducement and center of gravity shaking is very high, and people will keep the body balance. And the Wii Balance board center of gravity shaking measurement is also used in the field of basic research and rehabilitation training.

4 Experiments

In this Section, we analyze the relationship between the color and dizziness in the VR environment. In addition, we use the advancing color and the receding color to verify whether the advancing color or the receding color can reduce or aggravate the VR sickness.

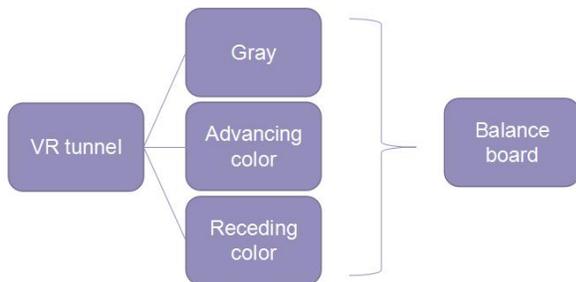


Figure 2: Experiment outline

First, we measure normal gravity measurement. Participants stand on Wii balance board about 15 seconds. After a minute rest, they

play “gray version”, “advancing color version” and “receding color version”. They take a minute rest between each version. During each play and after each play, we measure the shaking area and compare them.

- (1) Normal gravity measurement (15 seconds)
- (2) 1 minute to rest
- (3) Center of gravity test (gray) (Measurement of shaking area)
- (4) Measurement of stacking area (after play)
- (5) 1 minute to rest
- (6) Center of gravity test (advancing color) (Measurement of shaking area)
- (7) Measurement of shaking area (after play)
- (8) 1 minute to rest
- (9) Center of gravity test (receding color) (Measurement of shaking area)
- (10) Measurement of shaking area (after play)

According to the data of the measurement, we can get the balance board barycenter displacement measurement, blue line is center of gravity shaking (Figure 3). Figure 4 shows a sample result of calculation of shaking area.

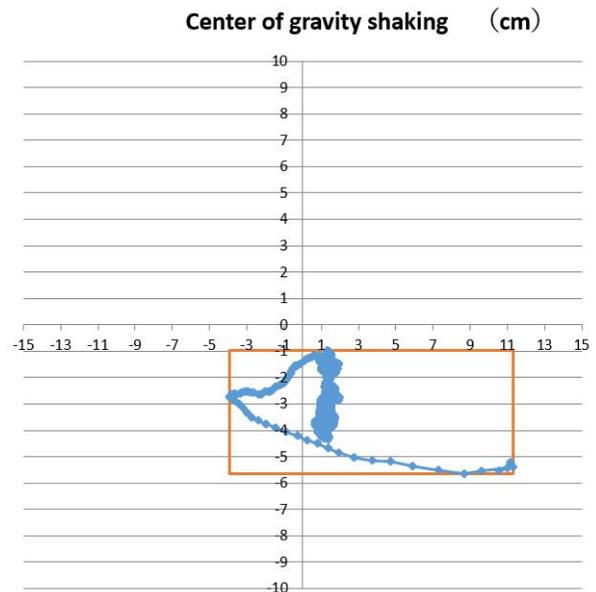


Figure 3: Example of balance board barycenter displacement measurement

	X (cm)	Y (cm)	Rectangle		
			X (cm)	Y (cm)	
Average	0.1812	-3.1662	0.89224	-3.8362	Lower-right
Standard Deviation	0.14761	0.26081	-0.2396	-3.8362	Lower-left
MAX	0.89224	-2.5554	-0.2396	-2.5554	Upper-left
MIN	-0.2396	-3.8362	0.89224	-2.5554	Upper-right
Area (cm ²)	1.449609698		0.89224	-3.8362	Lower-right

Figure 4: Area Calculation System

experimental data, and we expect to increase the Simulator Sickness Questionnaire (SSQ) in the next experiment^[11].

5 Result and Summary

In this section we will describe the results and summarize the experiment.

5.1 Result

According to the existing research, there may existing error values (abnormal values) in the data^[10], for the error value, we usually choose the method of removing the maximum value and the minimum value. There are 6 people in the experiment (5 males and 1 female). I tailored their data and removed the maximum and minimum values, calculated the average area of the center of gravity movement of the six experiencers. Table 1 shows a result.

Timing Color	While watching	After watching	Normal
Gray	3.19cm ²	2.49 cm ²	2.91cm ²
Advancing color	9.41 cm ²	2.98cm ²	
Receding color	4.67cm ²	3.02 cm ²	

Table 1: Result of test

5.2 Summary

From the result of while watching, advancing color and the normal environment less impact center of gravity shaking. From the result of after watching, receding color make the strong sense of instability research subjects, and the gray environment less impact center of gravity shaking.

Target result is Advancing color > Gray > Receding color > Normal. The advancing color will make the strong sense of instability research subjects, and the receding color will make research subjects fell calm down. This is the preliminary experiments, we found the problem of experiments, first is rest time is not enough, if 1 min to rest, the research subjects maybe feel tired; second the evaluation system is not specific enough.

6 Future Work

The estimate result is that the advancing color will bring uncomfortable feelings to the experiencer, and the receding color can keep humans calm. Through this experiment, we proved that color can influence the VR sickness. The advancing color will bring uncomfortable feelings to the experiencer, but there exist some differences from the expected results. We analyze the reasons of the differences is two points: (1) The middle rest time is too short. The rest time of the next experiment is increased from the original 1 minute to 3 minutes. (2) The evaluation system is not specific enough, we expect to increase the measurement function of the center of gravity moving distance in the next experiment. The measures can increase the reliability of the

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