Assignment

"USER PERCEPTION OF DISTANCE"

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Introduction

The goal of this work is to determine if a user can better estimate a distance in a simple environment, with simple colors and simple objects, or in an environment in which the visual scene is richer. In other words, I will have to prove that **users of virtual environments can better estimate distance in a more visually enriched scene**.

To do so, I will build two environments on Unity. These environments will have the same shape, but one of them will be very simple, with almost no design ; and the other one will have a richer design, with different objects. In these two environments, the user will have to move to an arrival point (that he doesn't see at the beginning), by interacting with two objects before. In order to have objective results, I will ask at least two people to test my environments.

State of the art

As you can imagine, I'm neither the first, nor the last, to perform such an experiment.

An article, written by Fatima El Jamiry and Ronald Marsh, of university of North Dakota, explains that an experiment was made by Waller and Richardson had interesting results. In this experiment, subjects had to interact with an immersive virtual environment, and then assess distances in the physical world. The result was quite simple : subjects overestimated distances in the real world, because interacting with the VE had effects on the perceptual system. This article conveys that the main reason behind the underestimation of distances is the fact of seeing the world through Virtual Reality HMD.

Another article, from Ilja Feldstein (Harvard Medical School), Felix Kölsch (Technical University of Munich) and Robert Konrad (Stanford University), tells about a new study that compares verbal distance estimates within real and virtual environments. Contrary to a lot of experiment, this one didn't show a significant difference between distance estimates in the real environment and in the virtual one. However, it might be possible that the order in which participants were exposed to the real and virtual environments may affect the outcome.

Design

In order to perform my experiment, I built two environments : one "raw" with only simple walls and shapes, and one more decorated. In both cases, the user will have to interact with two objects before being able to go to the end of the path.

I didn't want to build a complicated environment, because my only constraint is to make sure that the user doesn't see the end. That's why I opted for a "shorten-U" shaped environment. In other words, It's a U but with a side a little bit smaller than the other one. This experiment should be done on Unity, with or without a VR HMD. I made sure that there were no fast light-changing objects, so that people suffering from photosensive epilepsy can still undertake the experiment.

My decorated environment is made of assets that I downloaded from Unity's asset store. I changed the sky, the ground (to make it "green grass" color), and I added some objects (trees, bushes, flowers, etc...).

In fact, this is a very simple environment that anybody can use, whatever their medical history can be. There are no complex moves, no complex commands, even a 6-year old child could test it.

Implementation

My environment is a "U"-shaped path. The user starts at the entrance of the U. First thing he does is walking on a cube in the ground. This cube doesn't do anything but being there and make the user go a little bit up. Then, the user will see the floating capsule, which is the first interactive object. After clicking on it, the wall appears, and the user must turn left. From there, he might see the floating sphere, which is the second selectable. Finally, after clicking on it, he should be standing in front of the finish button. If everything occurred as is should be, the button turns from red to green when clicking on it.

To perform my experiment, I will do both qualitative and quantitative evaluations. I will ask him/her the following questions :

- In which environment do you feel that you travelled the most ?
- Where did you feel more comfortable ?
- For the raw environment, how long did you feel to travel ? How confident are you, on a scale of 1 to 10 ?
- Same question as before but for the decorated environment.

I will also ask them to record their screen while testing my environments (if they are unable to, I will simply call them, make them share their screen and record the screen share).

Evaluation

I chose not to give the name of the students who tried my environment. I will give each subject a number and the results associated.

IN WHICH ENVIRONMENT DO YOU FEEL THAT YOU TRAVELLED THE MOST ?

Subject 1 : Let's consider that I'm not aware of the fact that both environments are the same. I feel that the raw one was a little bit longer. It felt that it was a long corridor and that anything could happen to me here without being able to call for help.

Subject 2 : It was in the raw one. For sure. Maybe a small difference but still a difference.

WHERE DID YOU FEEL MORE COMFORTABLE ?

S1 : As I previously said, the first one was kind of anxiety-inducing. It's just a blank path with floating objects that disappear when you click on it. I was like a nightmare : I was just waiting for this world to collapse or for the monster to appear ! So, I'll go for the decorated one.

S2 : I like the second one, because I'm really into nature : I love forests, big gardens, parks... That's why I felt very comfortable in the decorated one. Would I still have if the design was different ? I don't know. Perhaps. But thanks for asking !

FOR THE RAW ENVIRONMENT, HOW LONG DID YOU FEEL TO TRAVEL ? HOW CONFIDENT ARE YOU, ON A SCALE FROM 1 TO 10 ?

S1 : I would say approximatively 7 seconds, and maybe 7 steps. But I'm not very confident, for me it's a 7/10.

S2 : Same here, but I'd be more confident and say 9/10.

FOR THE DECORATED ENVIRONMENT, HOW LONG DID YOU FEEL TO TRAVEL ? HOW CONFIDENT ARE YOU, ON A SCALE FROM 1 TO 10 ?

S1 : Something like 5 or 6 seconds, I guess ? And this time 8 steps. Confidence of 8.5/10.

S2 : It was shorter. 9/10.

Discussion

As we can see, both subjects felt they travelled the most in the raw environment. This is a quite satisfying result for me, as it means that the way I wanted to evaluate my hypothesis was the right one.

I think I could have done this experiment on two more subjects, but by changing one little thing : I would have let them get familiar with the raw environment before sending them the second one. It would have helped me getting more precise results.

The answers also pointed out the fact that feelings play a role in this experiment. I voluntarily made the raw environment look like something unreal because I wanted parallelly to prove that there is a direct link between the feelings, the time, and the distance. If you are not comfortable in your environment, you'll feel that the time goes a little bit slower, and, thus, that you move a longer time in this environment, which implies a longer distance. After finding these results, I found out an article from Albert Lee and Li-Jun Ji (Queen's University), saying that indeed, feelings have an influence on relative time.

The fact that the path is a short one also helps : if the question wasn't asked, maybe the two persons would have found out that both environments have the same distance. But I voluntarily played on that ambiguity to make my interlocutor doubt. This leads to another conclusion and another question : can the result be biased by the way the questions are asked ?

Conclusion

Based on my experiments and on my results, to the hypothesis "users of virtual environments can better estimate distance in a more visually enriched scene", my answer is yes. My observations can provide two more hypothesis :

- "Feelings have an influence on relative time"
- "Results of a survey can be biased, depending on the way questions are being asked."

These two hypotheses could make the objects of another work, which would improve the accuracy of the results.

Even if I'm quite satisfied, I feel that I could have done more things for this experiment. First, as mentioned in the Discussion section, I could have changed my methodology just once and see if the results were the same. I would also have

appreciated to have more participants to my experiment, in order to have a bigger sample, on which I could apply normal statistics (Hypothesis testing). Also, I should have tried more things in my assets, such as adding sounds, lights, maybe more effects...

In fact, all these problems could have been solved if I had a quite important sample of subjects, who would have given me information about them, who could perform the experiment in the same conditions on the same machine in the same place.

Finally, this experiment was made for PC users. But we could extend it to VR HMDs, or even Smartphones.

Bibliography

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