Design with Virtual Reality in Mind

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Abstract

This paper features an analysis of how some games are better designed for virtual reality than others and what we can learn from the games that work better to improve those that do not work as well. The thesis will briefly go through some of the problems in working with virtual reality. Data was collected by letting ten participants play four different games with the Oculus Rift and then answer questions related to their experience with these said games. Did the game cause the feeling of discomfort or create a sense of presence and did the game somehow break that presence? Based on the collected data and the analysis, the results indicate that some types of games work better than others for virtual reality, but that some design decisions can carry over to other games, granted with some effort, but that it is better if a game is created with virtual reality in mind from the start of the development.

Sammanfattning

Denna uppsats presenterar en analys om hur vissa spel är bättre designade för virtuell verklighet än andra och vad vi kan lära oss från spel som fungerar bättre för att förbättra de spel som inte fungerar lika bra. Uppsatsen kommer också behandla vissa problem som uppkommer när man arbetar med virtuell verklighet. Data samlades in genom att låta tio deltagare spela fyra olika spel med hjälp av Oculus Rift och sedan svara på några frågor relaterade till deras erfarenhet av dessa spel. Skapade spelen en känsla av obehag eller skapades en känsla av närvaro i spelvärlden och bröt spelet någonsin den med närvaron? Baserat på insamlad data och analys, indikerar resultatet på att vissa typer av spel fungerar bättre än andra för upplevelser i virtuella verkligheter, men att vissa designval kan överföras till andra spel, dock genom viss arbetsinsats, men att det är bättre om ett spel skapas med virtuell verklighet i åtanke från början av utvecklingen.

Nyckelord: Tv-spel, Virtuell Verklighet, 3D-miljö, Oculus Rift

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1 Introduction and Purpose

I grew up playing a lot of different games on a lot of different systems with a lot of different peripherals. The first non-traditional game controller I ever got to play with was the NES Zapper. Later on in life I got to play with controllers I had never used before in the arcades. Then came the Guitar Hero craze and I got to play with plastic guitars that made me feel like a rock star. Motion control came shortly after and I had yet another way to experience video games. I knew after all this that there were different ways to play and experience video games. It was not just about the game, it was also about what equipment we used to experience the game. It always felt like these peripherals were there to enhance the player's immersion or sense of presence in the game.

In 2012 the Oculus Rift got funded on Kickstarter which is a virtual reality headset for 3D gaming. When I first heard about it I got really interested as I had never tried anything like it before. The only thing that was similar that I had only heard about before was the Nintendo Virtual Boy. But it was when I first had heard and seen people's reactions on the internet that I got really interested about this technology and that I knew that I had to try it for myself. When I ordered one and got to experience it first hand, I noticed different problems popping up. Some games worked better than others. There were some games where I got nauseous and some games that I felt that I had a better presence in than others. A question sprung to mind after having used the Oculus after a while. What solutions have developers come up with to solve the problems which came with this technology? This paper will look at different games and let a group of participants play them and then answer questions about them.

Virtual Reality has become more popular in the game industry since the funding of Oculus Rift on Kickstarter and due to the fact that this area is not as well researched as in other areas of game design, it is hard to know how to develop a game with virtual reality in mind for the first time. The purpose of this paper is to see how well different games work with virtual reality and compare them to see what the better games have in common. Can we use this knowledge to make the games that are not as good, better for virtual reality?

2 Background and Previous Works

There has not been a lot of work around the aspects of how games should be designed for virtual reality but a lot more about the hardware technology to use to make the best experience. However, I came across some interesting articles about creating virtual reality games which has been useful for this research.

2.1 Presence

Sébastian Kuntz describes virtual reality as being all about the presence in a virtual world (Kuntz, 2013). But how is presence measured? Sébastian Kuntz suggests that we try to evaluate if a player is responding naturally to situations in games. If a player with fear of heights is standing on a cliff in a virtual reality and that player is feeling actual fear, that player is responding naturally to that situation. A study made participants witness a violent incident in an immersive virtual environment where the victim would occasionally look at the participant as if looking for help and the more the participant believed that they were looking towards them for help the more often they would intervene (Slater, 2013).

2.2 Simulation Sickness

Sometimes during gameplay, players can start feeling nauseous or discomfort while playing in a virtual reality. There are different theories for the cause of simulation sickness and one of those is about perceptual or cue conflict. This conflict occurs when signals from the various spatial senses, the eyes, the balance organs and the non-vestibular position senses are in conflict with one another and do not correlate with signals received in past experience (Costello, 1997:17). If a screen covers a large portion of a person's visual field of view while there are motions of the images on the screen, a conflict will occur because the person's visual senses indicate that the body is in motion but the balance organs indicate that the body is static.

3 Materials and Methods

For this research I have let a group of people extensively play some different first person games using the Oculus Rift headset. These people have never played with the Oculus Rift or anything like it before the tests. The participants were then given questions about the experiences they had with the games afterwards. I asked them to write in English so that their answers would be in the same language as this paper.

3.1 Equipment

There have been different versions of the Oculus Rift available for purchase since it became available for the public. The one used for this research was the first development kit which has a 1280 by 800 LCD screen with a refresh rate of 60 Hz. It has three-axis rotational head tracking and a field of view of 110 degrees diagonal and 90 degrees horizontal. The more recent versions have larger resolutions, OLED screens and three-axis rotation tracking with three-axis positional tracking with a lower field of view and a higher refresh rate of 75 Hz.

The PC that was used was able to maintain a framerate of 60 frames per second. This was to eliminate as many hardware problems as possible that would show up which could break the sense of presence or cause discomfort. Participants were controlling the games with keyboard and mouse unless the game was exclusively using head tracking for input and a headset was used for audio.

3.2 Games

Team Fortress 2 is a first person shooter where the player battles against other players inside of different maps. The game has different settings for controlling movement and aim, which can be changed via the console command "vr_moveaim_mode". Mode zero lets the player both aim and steer with the face while the mouse rotates the base of the character. Mode one lets the player aim with the face and steer the character with the mouse. Participants will be using the default mode three where steering is done with the rift and the aiming is done with the mouse inside a dead zone which makes the mouse steer if it is outside of the dead zone. This game was not developed with the Oculus Rift in mind but was updated with support for it later.

Titans of Space is a virtual reality museum where the user can fly around in space through a set path with no control of how to move. The player can look around with the oculus rift in the game world and decide when to the game should move on to the next path. Participants only had to use the keyboard to decide to move on and the rest of the input was controlled via the Oculus Rift head gear.

Blue Marble is a short cinematic virtual reality experience where the player rotates around in a space suit around the earth. The player can only rotate the camera around with the head while the rest of the movement is done by the game. Keyboard and mouse was not used.

Skyrim is an open world roleplaying game. The player has the freedom to move wherever they want and set their own goals. This game needs third party software to be played with the Oculus Rift. The third party software used was Vireio Perception, which takes games that do

not have support for virtual reality technology, and adds head tracking functionality and stereoscopic 3D.

3.3 Tests

The Oculus Rift comes with a configuration utility program which can create profiles for different people. It will ask the user about gender, height and interpupillary distance, so the settings are ideal for the person using the Oculus Rift. All participants got to create their own profiles before they got to play any games. Players got to play one hour of gameplay for each game except on the games that had an ending before the hour and had to wait at least a day to go on with the next game. Participants got to play the games in the order that they are listed in the methods section. Directly after their play sessions participants got to answer some question about their experiences on the same computer on which they played on in a word document. The questions the participants answered can be found in Appendix A while the answers can be found in Appendix B through Appendix K.

4 Results

The results can be found in Appendix B to K. Each participant has its own Appendix. The results show that fewer participants got nauseous or felt some discomfort in the games that had been designed with the Oculus Rift in mind from the start. Eight out of ten people had some negative experience with Team Fortress 2 and nine out of ten had felt some discomfort while playing Skyrim at some time. All participants felt a sense of presence or that they were immersed in all of the games except from Skyrim. Most participants still had that presence but it was not as strong or apparent as it were in the earlier games they had tried.

When a game broke the player's sense of presence, it was often due to character animations, not lining up with the movement of their own bodies, camera movement, menus or the heads up display. It was not often that the participants would see a problem with the headset other than one person who thought that the pixels on the display were too easy to see. There were also some participants who thought that not being able to move your head forward to look closer on something or move your head backwards to get your head further away from something, broke their sense of presence.

5 Analysis

The games that seemed to work better according to the data I had collected were the games that had been designed for Oculus Rift from the ground up. They had for example menus and a heads up display, which made sense within the game world. But those games did not have a lot of information that the player needed. A game that could have been included in the tests is *Hawken*. Some of the information about the player's resources is shown via control panels in the mech-suit the player is controlling and some of it seems to be integrated to the player's visor. Can the same be done to *Team Fortress 2* and *Skyrim*? We can take the menu for leveling up skills in Skyrim as an example. The player has to first open a menu and then select skill which then covers the screen in a new menu where the player can put points in to different trees represented by astrological signs. To not break the sense of presence within the game, it would be ideal to not let the player change between different menus. An example for a solution could be to let the player use his head to look straight up in the sky and point to the middle of your field of view and on to the stars for a couple of seconds, which can be seen on the night sky. New problems would appear like for example if some stars could not be seen because they were hidden in day time, but it is a step in the right direction for making a better virtual environment for virtual reality.

The games that seemed to be better suited for virtual reality had little to no gameplay involved. They were more like museums or cinematic experiences. The games often broke immersion when there was a lot of action happening. This can be the result of both technological issues with the hardware and the how the games themselves were made. When one of the participants wanted to back his head away from the tree, he could not, which broke the sense of presence. This happens because of limitations with the hardware. The two games that were designed for virtual reality did not have these problems because there were no situations like these created within the environments. To measure presence by evaluating whether the player's response is natural to certain events within the game can be hard. If a player sees a dragon in Skyrim, one would think that the natural reaction would be to fear the dragon, but because of the rules the game has set, it is encouraged to fight the dragon. The situations that were created when the player did not want to bump his head into the trees are easier situations to evaluate from as these are reactions players would have in real life as well. The problem was that players reacted as they were immersed in the game but due to limitations of the technology, it broke them out of the immersion instead. A problem that all the games had was that the body of the avatar did not perform the same actions which the player was performing with the body of the avatar. This was more apparent in the games which only used head tracking for controlling the character. Some players wanted to stretch out their hands into space but as they did, their immersion or sense of presence was broken. This problem can be solved with other hardware. Razer Hydra can for example help tracking your hands. Some of it also had to do that the camera was not always following the player's head. The more recent versions of the Oculus have also got the three-axis positional tracking which can help for instance the problem the participant had in appendix G in *Skyrim*.

6 Conclusion

Virtual reality can play a big role in enhancing some game experiences. This does not work for all games which are better experienced with a normal monitor. I came up with the conclusion that some types of games can, in theory, work better than others for virtual reality, but that some design decisions can carry over to other games with some work. In the analysis I tried to use what I had learned from the results and apply that the game *Skyrim* in my analysis. You solve a problem but then another one comes up. These games were simply not made with virtual reality in mind from the start. If you want to create a virtual reality game, the focus should be to create that sense of presence and then never take it away from the player. There are also some improvements that have to be done at a technology level with the head tracking gear and not only how game developers design their experiences.

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Games

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Appendix A

Questions:

1. Did you ever get nauseas or feel discomfort during your play through?
2. When did you start feeling nauseas in your play through?
3. Was there anything special happening in the game when you felt discomfort?
4. Did you feel immersed or a sense of presence during your play through?
5. Did something in the game ever break your sense of presence?

Appendix B

Participant 1

Team Fortress 2

1. Yes.

2. It happened a couple of minutes in. I was getting a feel for the controls first but when I then started playing and getting in to combat, I started to feel a bit queasy.

3. No I was just playing the game normally against other people.

4. Yes.

5. No.

Titans of Space

1. No.

2. I didn't feel ill.

3. Same as above.

4. Yes.

5. No.

Blue Marble

1. No.

2. I didn't feel nauseas.

3. I didn't feel discomfort.

4. Yes.

5. No.

Skyrim

1. Yes.

2. It looked horrible. I think everything was distorted.

3. Nothing special. Just playing the game.

4. Maybe if it didn't look distorted.

5. Yes. Everything looked wrong.

Appendix C

Participant 2

Team Fortress 2

1. No.

2.

3.

4. Yes

5. No.

Titans of Space

1. No.

2.

3.

4. Yes.

5. Yes.

Blue Marble

1. No.

2.

3.

4. Yes.

5. Yes.

Skyrim

1. No.

2.

3.

4. A little.

5. Shadows moved wrong.

Appendix D

Participant 3

Team Fortress 2

1. Yes.

2. It was when I did a rocket jump.

3. I did a rocket jump.

4. It felt really real even though it was a cartoony game.

5. I don't think so.

Titans of Space

1. No.

2. See first answer.

3. See first answer.

4. Yes. I thought it was amazing how everything looked so big and it made me feel so tiny.

5. I could see my leg but I could not move them which looked a bit out of the ordinary.

Blue Marble

1. No.

2. See first answer.

3. See first answer.

4. Yes. It was similar to the other space game but more cinematic instead of informational.

5. I felt like a wanted to stretch out my hand but when I did I expected the character to do so but he did not.

Skyrim

1. Yes.

2. As soon as I started playing.

3. I started playing.

4. I felt like I was in the world but It felt wrong.

5. I don't know what was wrong but I didn't feel connected to the world. Game looked buggy.

Appendix E

Participant 4

Team Fortress 2

1. Yes.

2. I had to quit playing the game after 15 minutes.

3. Not sure. There was a lot of stuff happening in the game.

4. It actually felt like I was there which I didn't actually expect.

5. It was unusual moving around compared to what I am used to but then I got used to it.

Titans of Space

1. Yes.

2. When I had finished the game.

3. When I had finished the game.

4. Yes. This is something I wish they would use in schools.

5. Everything felt natural.

Blue Marble

1. No.

2. --

3. --

4. Yes. I thought I was going to hit my head on the satellite.

5. No, I felt very immersed.

Skyrim

1. Yes.

2. I got a headache after playing only for a little while.

3. I don't know. I was just playing.

4. I liked being in a fantasy world.

5. When I was fighting, the character was moving but I didn't move with it.

Appendix F

Participant 5

Team Fortress 2

1. I felt weird after some time in the game.

2. I started playing scout which is a fast character.

3. I played scout and his fast movement made me feel weird.

4. I really felt like I was in the game world.

5. Not that I can think of.

Titans of Space

1. No. This was easier to play than Team Fortress.

2. I did not feel nausea.

3. I did not feel nausea.

4. Yes. Everything felt so vast. I saw how it looked on the normal monitor and it was a huge difference.

5. Cannot think of anything.

Blue Marble

1. No.

2. I did not feel nausea.

3. I did not feel nausea..

4. Yes. It was very atmospheric.

5. I wanted to move my whole body but the only thing I could move was my head.

Skyrim

1. Yes.

2. I started feeling ill in combat.

3. Yes in combat.

4. I would say so even if it didn't look as good as the other games.

5. Aside from the game looking a bit messy, I don't think so.

Appendix G

Participant 6

Team Fortress 2

1. No.

2. I didn't feel nauseas.

3. I didn't feel discomfort.

4. Yes.

5. No.

Titans of Space

1. No.

2.

3.

4. One of the most interesting things I've experienced.

5. No.

Blue Marble

1. No.

2.

3.

4. I felt like I was in a space movie.

5. No.

Skyrim

1. Yes and I thought I could fight through it but it didn't get any better.

2. Maybe after half an hour.

3. Just playing the game.

4. Yes. It made me want to explore the world.

5. I went close to a tree and I thought I was going to hit my head so I pulled my head back but my character did not.

Appendix H

Participant 7

Team Fortress 2

1. Yes.

2. When game started lagging.

3. There was lag on server. Like rubber banding.

4. Yes. It was really cool.

5. The menus put me off a little. It was also easy to see the pixels on the screen.

Titans of Space

1. No.

2.

3.

4. Yes, I even got goosebumps testing this.

5. I felt sometimes that I wanted to move around more. It was the same as before with the pixels.

Blue Marble

1. No.

2.

3.

4. Yes, it was very awe inspiring.

5. I wanted to move around more naturally like in the game before.

Skyrim

1. Yes.

2. Shortly after I had finished the prologue.

3. I think it was just from playing the game.

4. Yeah. It was cool moving in the open world. Skyrim is my favorite game and it was really awesome feeling like I was in the world.

5. Combat did not feel as good as I wanted it to.

Appendix I

Participant 8

Team Fortress 2

1. A little in the end.

2. At the end of the hour.

3. Nothing special.

4. Yes. Everything looked so big compared to when looking at the monitor.

5. Maybe it would have been better without all the things on the screen.

Titans of Space

1. No.

2. See above.

3. See above.

4. Yes. The sense of scale was amazing.

5. My character looked very stiff.

Blue Marble

1. No.

2. See above.

3. See above.

4. Yes. This game reminds me of the movie Gravity.

5. No.

Skyrim

1. Yes.

2. When I got to Whiterun in the game.

3. I was running and jumping all the way to Whiterun as I normally do when I play this game.

4. Yes.

5. When I leaned back my character didn't lean back and when I wanted to look closer on something I couldn't lean forward.

Appendix J

Participant 9

Team Fortress 2

1. Not very much. It was fine.

2. Somwhere near the end.

3. Don not know.

4. Yes. I thought I was going to bump in to other people in real life.

5. It was small things here and there but nothing special.

Titans of Space

1. No.

2.

3.

4. Yes. It was better than the last game.

5. It would have been better if there was a device which could motion capture my body movement and not just my head.

Blue Marble

1. No.

2.

3.

4. Yes and I thought it was neat that I could select what music to play during the game.

5. No.

Skyrim

1. Yes.

2. A short while after I got control of the character.

3. I was running around in the first section when the dragon comes.

4. Yes.

5. I naturally wanted to crouch in the chair to crouch in the game but it did not work. I got used to it.

Appendix K

Participant 10

Team Fortress 2

1. Yes, but only a little bit.

2. Don't know.

3. Don't know.

4. Yes.

5. Didn't think of it.

Titans of Space

1. No.

2. The game did not make me ill.

3. The game did not make me ill.

4. Yes. I wanted to try another round.

5. No.

Blue Marble

1. No.

2. The game did not make me ill.

3. The game did not make me ill.

4. Yes.

5. No.

Skyrim

1. Yes.

2. After switching between menus and gameplay.

3. I was switching between inventory and game.

4. Yes, but not all the time.

5. I think shadows were moving as I rotated.