Virtual Reality Tool Simulates Elevator Experience

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Abstract

Elevators are an extremely useful tool for navigating tall skyscrapers and ensuring the disabled members of society are able to get around independently. Although people can benefit from the use of elevators, claustrophobia is a major issue in some cases. This fear alone can lead to cancellation of job interviews in some cases because it is too high of a floor or people with disabilities are unable to get where they need to go. To alleviate these problems, I have been in the process of developing a virtual reality (VR) tool to educate people about elevators and simulate the experience of being in an elevator. The tool is immersive and incorporates both the visual and auditory sensation that patients encounter while being in an elevator. This VR tool not only educates patients about elevators, but also allows them to virtually experience what it is like in an elevator.

1. Introduction

According to the Elevator Escalator Safety Foundation [3], over 210 billion people ride in elevators in the US and Canada each year. Virtual Reality (VR) therapy has become an effective treatment for dealing with phobias. This research specifically pertains to VR therapy to deal with claustrophobia in an elevator. Claustrophobia can be disruptive to daily life, and has been noted as one of the most impairing phobias. Claustrophobia is a form of an anxiety disorder, which is an irrational fear of having no escape or being closed in and it can lead to a panic attack. People who suffer from this phobia may avoid everyday situations that would trigger their anxiety, such as taking an elevator. One who suffers from claustrophobia may not be able to get to their job interview or doctor's appointment because it requires getting into an elevator.

However, in prior works, the theme of researchers using VR therapy in elevators has been a simulation of claustrophobia where the claustrophobic person is unable to escape from the elevator. In addition, the elevator has a few other riders in it but they are cartoon-like.

This research was intended to run 360° viewing experiments in VR to collect an audience behavior dataset to compare and prove my hypothesis. My hypothesis is that the more times the users interact in the VR elevator the less claustrophobia and discomfort they will experience.

2. Methods

I first used the Garmin VIRB 360° camera to take 3 videos in the Park dormitory elevator at Connecticut College. The first video had zero people in the elevator, the second video had 5 people in the elevator, and the third video had 10 people in the

elevator. Then I created a virtual environment using Unity and Visual Studio to watch the videos using the HTC Vive, a head mounted display.

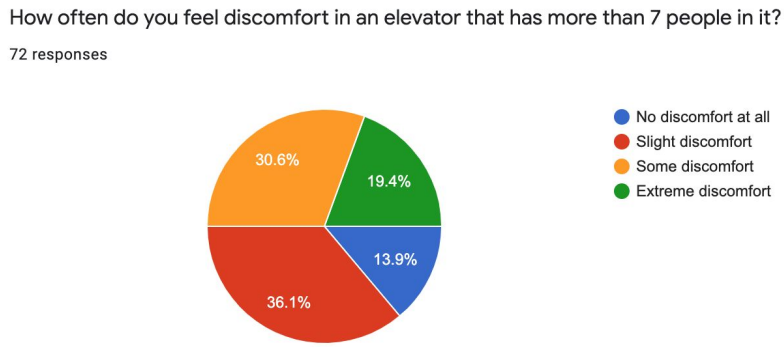

Figure 1: A survey taken by 72 Connecticut College students

In addition, I sent out a survey at Connecticut College in order to determine how much discomfort students sense in elevators. In Figure 1 above it has been noted that 62 out of the 72 participants in this survey feel some sort of discomfort when in an elevator. 14 out of the 72 said they feel extreme discomfort, 22 out of the 72 said they feel some discomfort, 26 out of the 72 said they feel slight discomfort, lastly 10 out of the 72 said they feel no discomfort at all.

The application is made up of four components: a sphere in Unity, a custom shader(Figure 2), a material that will use the shader, and the 360° video.

```
Shader "Flip Normals" {
    Properties {
        _MainTex ("Base (RGB)", 2D) = "white" {}
    }
    SubShader {

        Tags { "RenderType" = "Opaque" }

        Cull Off

        CGPROGRAM

        #pragma surface surf Lambert vertex:vert
        sampler2D _MainTex;

        struct Input {
            float2 uv_MainTex;
            float4 color : COLOR;
        };

        void vert(inout appdata_full v) {
            v.normal.xyz = v.normal * -1;
        }

        void surf (Input IN, inout SurfaceOutput o) {
             fixed3 result = tex2D(_MainTex, IN.uv_MainTex);
             o.Albedo = result.rgb;
             o.Alpha = 1;
        }

        ENDCG

    }

      Fallback "Diffuse"
}
```

Figure 2: Custom shader used to flip the normals on the sphere

The planned next step was to complete the Research Application Review Form for Human Subjects Institutional Review Board (IRB) in order for users to test my application. Study participant would don the HTC Vive and navigate through the virtual environment in a standing position. Participants would move around, simulating a real elevator by moving their head around. They were automatically placed in the middle of the elevator and would watch the first video which has zero people in it. Then the user would watch the second video with five people in it. Then the user would watch the third video with ten people in it. They would navigate through the elevator with 10 people in it a total of 3 times. After each time in the elevator they would have been given a Discomfort Questionnaire (Appendix A) in order to measure any feelings of claustrophobia or discomfort.

During testing I was hoping to prove my hypothesis that the more times users used the application as if they were in a packed elevator the less discomfort and claustrophobia they would feel. However, I was not able to carry out the user study for my application due to the unexpected Coronavirus pandemic. I will be predicting what my results would have been by comparing my research to other research that has been done in the field of VR therapy.

3. Related Works

In the past, a lot of VR therapy experiences pertaining to claustrophobia have been studied in ways that do not include an elevator. Students at the University of Michigan[3] created a VR tool that simulates a magnetic resonance imaging(MRI) experience. They found that with the fear of claustrophobia, it was leading patients to cancel the scanning procedure and in other causes lead to conscious sedations. Their goal is to have the patients use the VR tool prior to their MRI scan to determine the effectiveness of decreasing patients' anxieties, claustrophobic cancelations, and the need for conscious sedation. They are still in the process testing their app to see if it will help patients. They are hoping to find that the more times the patients use their help the less anxieties they will have before they get to the real MRI which would also lead to less cancelations because the patients know what they are walking into.

Most researchers have created videos online where you are in a packed elevator but the people that are in the elevator with you are cartoon-like (Figure 3).The benefits to my research is the people in the elevator are real as you can see in Figure 4.

Figure 3: Visual of cartoon-like elevator experience

Figure 4: Visual of my real-life like elevator experience

Another researcher used virtual reality exposure therapy to help with claustrophobia[1]. This environment consisted of four interconnected rooms with an increasing number of claustrophobia cues. The first room was a bright, spacious, normal room and the fourth room was dark, small, and windowless. They found that as users moved between the rooms they became more and more anxious especially as they reached the third and fourth room. They reported anxiety decreased on the successive use of the system.

I expect that my tool would have been successful the more times users were immersed in the claustrophobic elevator. Based on this research the users were not walking through a real looking room. Once again they were walking through a cartoon like room(Figure 5). Even though they were in a cartoon like room the research was still successful.

Figure 5: Visual of interconnected rooms

4. **Conclusion**

   Over all, I was able to create a hypothesis, a 360° video, and a VR tool to render the video in. My hypothesis is that the more time users immerse himself in the VR elevator the less claustrophobia and discomforts they will feel. For future works, I would like to carry out a user study to test my hypothesis. I would also like to perform data analysis on what my results would be from the user students.

5. **References**

[1] Bruce, M., & Regenbrecht, H. (2009). A virtual reality claustrophobia therapy system - implementation and test. *2009 IEEE Virtual Reality Conference*. doi: 10.1109/vr.2009.4811020

[2] Elevator Escalator Safety Foundation. (n.d.). Retrieved from https://www.eesf.org/

[3] Richard Brown-Sean Petty-Stephanie O'Malley-Jadranka Stojanovska-Matthew Davenport-Ella Kazerooni-Daniel Fessahazion - https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6173786/

Appendix A

Discomfort Questionnaire (DQ)

Instructions: Circle how much each symptom below is affecting you right now.

1.	General discomfort	None	Slight	Moderate	Severe
2.	Nausea	None	Slight	Moderate	Severe
3.	Rapid Breathing	None	Slight	Moderate	Severe
4.	Weakness	None	Slight	Moderate	Severe
5.	Sweating	None	Slight	Moderate	Severe
6.	Shaking	None	Slight	Moderate	Severe
7.	Rapid Heart Rate	None	Slight	Moderate	Severe