Virtual Reality: A tool for treating phobias of heights

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ABSTRACT

The goal of this project is to design and develop a tool than can be used to detect or treat intellectual disabilities on a general population diagnosed with phobia to heights. The investigation consists on creating an innovative method that could be used to treatment of this population. As main tool we use Blender game engine; with this game engine we explore different ways to treat this mental conditions using a virtual reality environment for population with phobia to heights. As results of the first stage of the investigation we end up with an experimental design of the environment to treat patients with phobia to height. For the second stage we end up with a virtual reality environment that simulate a panoramic elevator to treat patients with phobia to height.

Keywords: Virtual Reality, Phobia, Blender

RESUMEN

El objetivo de este proyecto es diseñar y desarrollar una herramienta que se puede utilizar para detectar o tratar la discapacidad intelectual en una población general diagnosticados con fobia a las alturas. La investigación consiste en crear un método innovador que podría ser utilizado para el tratamiento de esta población. Como herramienta principal que utilizan el motor de juego en Blender, con este motor de juego se exploran diferentes maneras de tratar estas condiciones mentales utilizando un entorno de realidad virtual para la población con fobia a las alturas. Como resultados de la primera fase de la investigación nos encontramos con un diseño experimental del medio ambiente para tratar a pacientes con fobia a las alturas. Para la segunda etapa nos encontramos con un entorno de realidad virtual que simula un ascensor panorámico para tratar a pacientes con fobia a las alturas.

Palabras claves: Realidad Virtual, Fobia, Blender

1. INTRODUCTION

The project consist designing an application that simulates a virtual reality environment of the real world that can be used by therapist or specialist to bring therapy session to treat patients with phobia to heights. This tool will be use to make that fists step of preparing the patient before a real confrontation of his phobia (Castelnuovo et. al 2003). The application has a great utility because can prepare the patient in safely way without any physical injuries. The investigation is really important because actually in Puerto Rico do not exist any tool of virtual reality to bring any kind of therapy.

In Puerto Rico there is a high population that has problems with phobia. A phobia is defined as the unrelenting fear of a situation, activity, or thing that causes one to want to avoid it. The three types of phobias are social phobia (fear of public speaking, meeting new people, or other social situations), agoraphobia (fear of being outside), and specific phobias (fear of particular items or situations). For our investigation we focused on the

specific phobia of heights. Helping those who suffer from phobias is thought to be most effective when psychotherapy and medications that are specific to the treatment of phobia are both used. One form of psychotherapy involves the supportive and gradual exposure of the individual with phobias to circumstances that are increasingly close to the one they are phobia about (desensitization). These situations can either consist of actual exposure or virtual reality environment. The main goal of the virtual reality therapy is to expose the patient gradually to a virtual reality environment instead exposing the patient to a real world environment (Green, 2011). At the final stage that the patient feel confortable with the exposure in the virtual reality environment then the patient will face the real world situation based on his phobia (Miró J, Huguet ,2007) (Pérez-Salas, 2008).

2. VIRTUAL REALITY

Virtual reality (VR) is a term that applies to computer-simulated environments that can simulate physical presence in places in the real world, as well as in imaginary worlds. Most current virtual reality environments are primarily visual experiences, displayed either on a computer screen or through special stereoscopic displays, but some simulations include additional sensory information, such as sound through speakers or headphones.

Virtual reality is often used to describe a wide variety of applications commonly associated with immersive, highly visual, 3D environments. The development of CAD software, graphics hardware acceleration, head mounted displays, database gloves, and miniaturization has helped popularize the notion. In the book The Metaphysics of Virtual Reality by Michael R. Heim, seven different concepts of virtual reality are identified: simulation, interaction, artificiality, immersion, telepresence, full-body immersion, and network communication. People often identify VR with head mounted displays and data suits.

2.1 TYPES OF VIRTUAL REALITY

There is more than one kind of virtual reality; there are different schemas to classify different kinds on virtual reality environments.

1. Immersive virtual reality is a hypothetical future technology that exists today as virtual reality art projects, for the most part. It consists of immersion in an artificial environment where the user feels just as immersed as they usually feel in consensus reality.
2. Desktop virtual reality refers to computer programs that simulate a real or imaginary world in 3D format that is displayed on screen (as opposed to immersive virtual reality).
3. Simulation Virtual Reality works using a virtual reality interface that brings together a 3D model of real apparatus and a virtual visualization of physical situations in an interactive manner.

2.2 ADVANTAGES OF VIRTUAL REALITY THERAPY

There are distinct advantages to using a therapist-controlled, simulated environment for the treatment of phobias and other anxiety disorders. These include:

- **Greater safety and unlimited repetitions** – The simulated (virtual) environment can be controlled easily to ensure that patients receive the appropriate experience in a safe manner, and the entire course of treatment can be completed within the security of the therapist's office (Rábago, W. J., 2011).
- **Better use of therapy session** - Patients don't waste time going into the real world in search of the experiences that cause them anxiety. By controlling all aspects of the simulated environment, the therapist can repeatedly expose patients to each phase of a fear-provoking event until it is mastered, which can greatly shorten the time required to overcome the phobia in comparison with traditional therapies (Resnik, et. al., 2011).
- **Easily scheduled, confidential sessions** – Because patients receive treatments in the therapist's office, each session fits within the standard 45- to 50-minute therapy hour, multiple sessions can be scheduled within the same week to accommodate our patients' schedules, and patients don't run the risk of running into friends or becoming panicked in a public place. Privacy is further protected with free, convenient,

privately accessed parking (Suarez, et. al., 2011).

- **Insurance reimbursement of fees** – Unlike many traditional treatment programs that require real- world experiences, VR sessions can be completed in less than an hour, with a full successful course of treatment often completed within six to eight sessions. For these reasons, VR sessions are often covered by medical insurance plans. Please note that except for participants in Duke employee-health plans, the Duke Virtual Reality Therapy Program is a fee-for-service clinic (Duke University, 2012), (Yang, et. al., 2011).

2.3 PREVIOUS WORKS

In the University of Georgia Tech they do a study of how important is the potential of the virtual reality in the therapy to heights phobia (Dryden, et. al., 2012), (Goleman, 1995). Two weeks later they evaluate the patient in anxiety and attitudes and then was compared to other students afraid of height that have not taken the therapy. Finally they find that the anxiety of the patient gradually were lower and finally surpass his phobia.

In Georgia Institute of Technology they conduct a research about virtual reality with patient afraid of heights (Mast, 2000). They create a 45-floor building with the transparent floor that pass from a river to another place. The reaction of the patients was that it was something very real. They apply the therapy by the need or phobia level has. Dr. Rothbaum expose their patients about 20 to 40 minutes in the situation because he believes that sooner or later the anxiety will disappear (Holmes, 2003). They end up with results that the patients can now go up a 75-building story with out fear.

The Human Interface Technology Lab (HITLab) is a multi-disciplinary research and development lab whose work centers on human interface technology. This lab makes different experiments on different kinds of department with the University of Washington. They work on a lady afraid of spiders and they apply virtual reality therapy to resolve that phobia. The results were impressive because no she can really touch a real. The phobia was cured spider (Hoffman, 2003), (Toon, 1995). This type of therapy has been seen all over the world.

3. DEVELOPMENT ENVIRONMENT

3.1 SOFTWARE

For the design of the virtual reality software we use a game engine called Blender 3D 2.62 for Windows 7 operating system (Blender, 2012). Blender is free open source 3D computer graphics software used for create films, visual effects, 3D application or video games. Blender 3D was released on 1995 and use python programing language for scripting. Python is a high level programming language, is used in Blender 3D as a scripting language, to be written and execute on the fly. We select Blender 3D as secondary graphical design tool because is very suitable to our needs of this project. Blender is an open source application this mean that we don't have to invest any money on the program (Microsoft, 2012). It's a powerful graphic engine used in popular movies and video games capable of crating beautiful graphic to our project need.

Has primary tool for game engine we use Unity 3D. Unity 3D is very similar to Blender 3D the only difference is that Blender 3D is very powerful for designing and Unity 3D is very powerful on game engine graphics side. What we do is that we design all the visual figures and objects in Blender 3D and then we export those objects to Unity 3D. Finally we create all the scripts in Unity 3D for all the functionality that we need in our virtual world design.

3.2 HARDWARE

For the hardware we are using a gaming computer. This computer is normally configured for gamer because it gives the advantage on the computing power and graphics power that we need. In addition we have the Vuzix WRAP 1200 3D Glasses (Vuzix, 2012). This glasses creates an illusion of a virtual reality for the user.

3.3 INTERDISCIPLINARY WORK

In our investigation about virtual reality we find out that exist three types of virtual reality. The three types are: immersive virtual reality, desktop virtual reality and simulation reality. For our project we choose that the best choice that adapt our need is the desktop virtual reality. Why the desktop virtual reality? Because we would like to have the immersive but we don't have money to archive that kind of virtual reality. To archive virtual reality that a patient that is going to take a therapy session can feel the sensation of reality of the real world virtually.

We worked with the Department of Psychology at the University of Turabo and attended the recommendations of experts in the area of phobias and the most relevant recommendations are:

- Make the virtual reality with an option of pause.
- Use motivational effects like applause, voices, cheers, etc.
- Read the heartbeat to measure the stress.

The virtual reality therapy can be an effective tool to use. Both says that this is a very new concept but they are certain that this kind of tool really works and can be used for their patients to test it (Wong, et. al., 2012).

4. ANALYSIS OF RESULTS

4.1 STAGE I. DESIGN

To give good simulation of a real world environment we decided to use Blender 3D software. Our design concept is to design an environment that uses first person view to give more reality and feeling to the participant, Figure 1and 2. The design consists on a 3D world where the patient will see plants, sun or lights, landscape, parking slots and a building with panoramic elevator. At the initial state of the therapy the patient will see the landscape and the building from the parking, this will help in the mental preparation of the patient before start gaining height inside the panoramic elevator, also, the patient can move inside the virtual world and look what is around.

Figure 1: Screen Shot of the actual design in Blender 3D

The main object on the design is the elevator that will make the patient confront the phobia in a safety way.

4.2 STAGE II. DEVELOPMENT

In our second stage of design we decide to implement a new virtual reality environment. This idea comes because the previous design has some limits to archive our goal. We continue to use Blender 3D software has software of design the virtual reality environment and the logic programing side. Our design concept is to design an environment that uses first person view to give more reality and feeling to the participant. The design consists on a 3D world where the patient will see plants, sun or lights, landscape, parking slots and a building with panoramic elevator. In this second stage of the therapy software the patient will see the landscape and the building from the parking, this will help in the mental preparation of the patient before start gaining height inside the panoramic elevator, also, the patient can move inside the virtual world and look what is around. The main object on the design is the elevator that will make the patient confront the phobia in a safety way. The way we would do it is giving the therapist the way to start the elevator going up and down by hitting a key in the keyboard and the ability to pause or stop the elevator in case of any emergency. A heart beat monitor that the therapist will have to monitor the patient anxiety measures this.

Figure 2: Screen Shot of the actual design rendered in Blender 3D

This design include:

- Design the first person view
- Design the panoramic elevator
    - Shape and transparent panoramic view
    - Elevator controls
    - Sounds
- Integrate elevator to building design
- Design and code the software that will serve as interface between the user and the graphic design

4.2.1. FUNCTIONS

As mention before Blender game engine is a powerful tool to game programming and design. One of the key features that Blender has is the ability to use Python code to manipulate behaviors in the design and game logic. With this feature we were able to implement some functions and behaviors in Blender game engine to archive our goal. One of the key features that we start developing was the first person view. The firsts person view is the key feature for the patient feel the virtual reality environment like it is on real life. The key idea is when the patient use the glasses it would see like it is in real life.

In figure 3 we can see that we are using a box as the player. Why use a box? We use a box because the player will never see it so we don't need to focus on creating a visually good player design. In the upper part we attach a camera that becomes the player eyes to the virtual world. Now that we have the player and the player view we need to create the logic to make possible the player navigate the virtual world. To do that we use the logic that Blender game engine has.

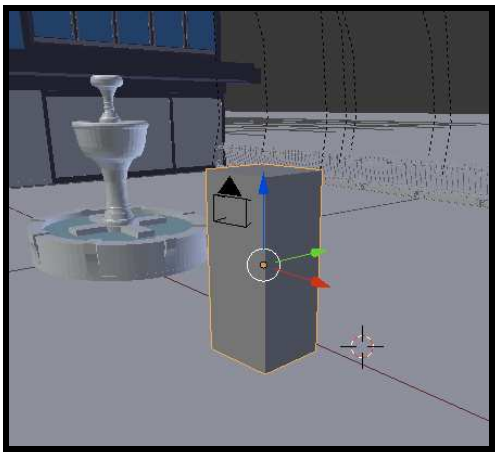

Figure 3: Screenshot of the player

Blender game engine logic design comes in three flavors. One is the sensor; here you can add many types of sensor for the game engine can monitor some behaviors. Second we have the controllers; this one is curtail for us because is the one part that becomes the bridge to add our code in python to manipulate the data. And finally the actuators; the actuators are responsible of controlling animation and frames with many different manipulations.

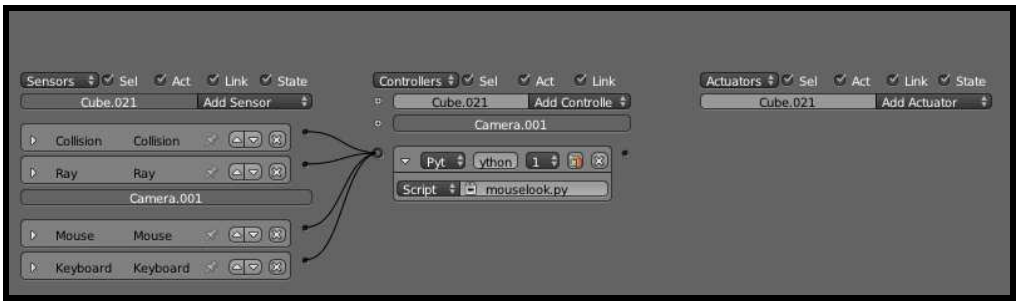

Figure 4: Game logic that acts on the player

For the game logic of the player we are using four sensors has shown in figure 4. Two sensors to control the gravity and collisions and one to enable the keyboard and another to enable the mouse. These four sensors are connected to a python script to control the mouse, keyboard keys to move, jump, gravity and speed of the player. Finally when we add these parts all together we end up with a player with natural movement around the virtual world.

Figure 5: Automatic doors opening to enter the building lobby

Another finally functionality that we add for the user feel more real the virtual reality environment is automatic door opening of the lobby shown in figure 5.

To create the automatic door opening we create a script using animation and the logic editor in Blender game engine. First we create a simple animation of 100 fps that is equal to 4 seconds to open the doors. Second in the logic editor we add a near sensor. A near sensor monitor when a player is around 3 ft. from the doors. With this activate the sensor sends a signal to the controller and then passes to the actuator. In our case the actuator is action. The action that we attach to the sensor was the animation. With all together connected every time a player is near the doors will open automatically and when the player get out from the near sensor range the doors will automatically close.

The most important functionality is the elevator. The elevator is the one that is going to give to the patient the feeling to surpass the phobia. We design a panoramic elevator, this means it has crystal wall all over the elevator. What want to present to the player or patient is the feel of fear to heights. How? We create has we mention earlier very height building with a panoramic elevator. Has the elevator start going up the patient will notice the height because we add buildings around the virtual environment. The more higher the elevator he or she will fell the building higher. The features that we add to the elevator are door opening because we what the player feel the sensation of calling an elevator. The other ones are the abilities to go up and down between floors and make an emergency stop. The emergency stop is an important feature because the patients becomes nervous or anxious we can stop the elevator at any time and go down to the lobby.

4.2.2. CONTROLS

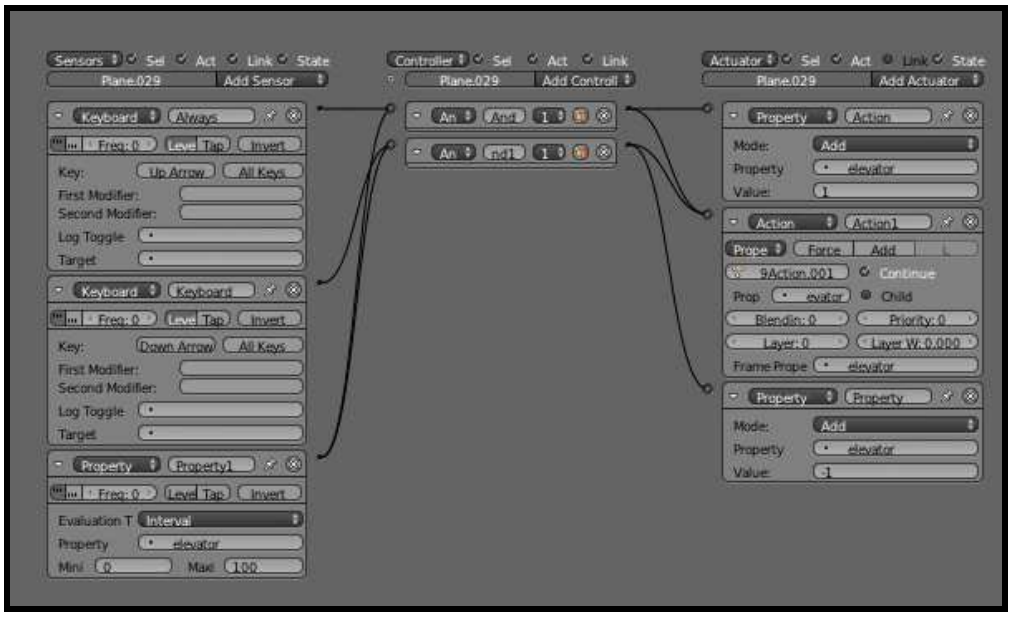

Figure 6: Game logic for the elevator

To navigate the virtual reality world we assigns different keyboard keys. To move front, back, left and right we use the keyboard keys W, S, A and D. To jump we assign the space bar. For looking around 360 degrees you can use the mouse. Finally to control the elevator we have two functionalities. The first is to open the door we assign the key O in the keyboard and to close the elevator door the key P. Now for the elevator can go up and down we assign the key ∧ for up and ∨ for down. All these keys explained are pictured in figure 6 and figure 7.

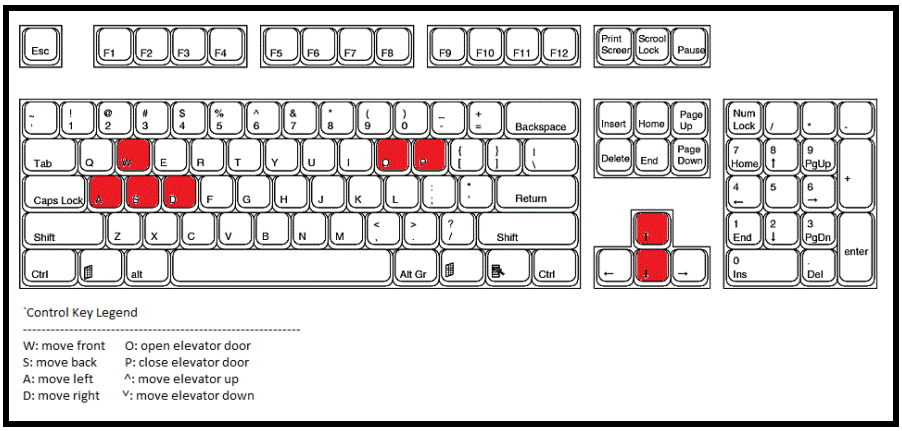

Figure 7: Control key functions

4.2.3. PROTOTYPE / TESTS

In stage III we take the design to a whole new level. We decide to change or migrate our Blender 3D design to a new game engine. This decision was made because Blender 3D game engine have to many graphics problems when running the game engine. This new game engine used is called Unity 3D. Unity 3D is more pure game engine that deliver very powerful graphics details. For our case this migration resolves every detail with problems from Blender 3D design.

Unity resolves the occasionally not transparent pieces that we have in the building. Another issue resolve is the ceiling of the lobby. Before in Blender 3D the ceiling was transparent but in Unity 3D the ceiling is not transparent, how it's suppose to be. And finally in Unity the game engine runs more smoothly with less computing requirements.

When we migrate the design from Blender 3D to Unity 3D game engine we encounter a new challenge. This new challenge is the scripting code that we have on Blender 3D. In unity the migration don't include the scripting because Unity 3D don't use Python programing language for scripting. Unity 3D use C# programming language for scripting. This means to us that we need to create a whole new scripts to make work the functions that we already have in Blender 3D. The only advantage is that we have is that we understand better C# programming language, and that give us an advantage in creating new scripts easily with the programming reference that Unity 3D has. The functions that we have in Unity 3D game engine design are pretty much the same that we have for the Blender 3D game engine design. One of the most important is the first person view. This is one of the most important because it let the player move around and see the virtual world. To archive that we use a figure that Unity 3D recommend. It's a figure cylindrical to attach the camera that becomes the eyes of the player. Show in figure 8.

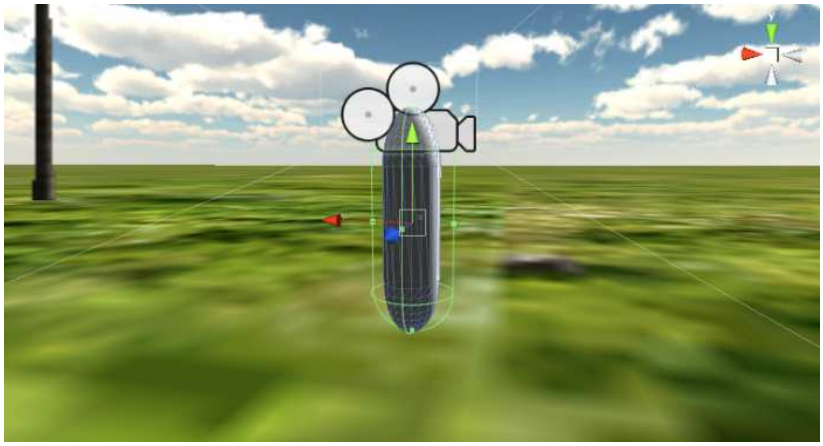

Figure 8: Player screenshot

This camera attach to the figure becomes what we called the player. Now to move around and see the virtual world we create a script to make that possible.

Next we made the scripts for the elevator. This is the most important part of the design. Because we change to Unity 3D and we have now real transparent windows simulating a panoramic elevator. For this we have to do the same has the player, migrate the logic made in Blender 3D to Unity 3D. This part it was made easier that we tough because Unity has some function for translation of object in his reference. We only modify those values to work only with an assigned key from the keyboard and create a limit for how high and low the elevator can go. In addition the elevator can be pause just by releasing the key while going up or down.

To navigate the virtual reality world we assigns different keyboard keys. To move front, back, left and right we use the keyboard keys W, S, A and D. To jump we assign the space bar. For looking around 360 degrees you can use the mouse. Finally to control the elevator we have two functionalities. The first is to open the door we assign the key O in the keyboard and to close the elevator door the key P. Now for the elevator can go up and down we assign the key U for up and J for down.

When we finish the design in Blender 3D we start doing some tests. These tests include running and moving around the virtual world, testing the functionalities and test the glasses. Immediately we find out that our design in Blender 3D would not work because it has a lot of problems. These problems include graphics and gameplay not smooth. To resolve these problem we decide to take the risk and migrate to Unity 3D.

After finishes the migration we start doing the same test. We found that our design was ok the problem was the game engine. All the graphics runs good and very smoothly. Testing the glasses with the virtual world and taking the elevator test you can feel the altitude of the building.

5. CONCLUSION

In conclusion we can say that all the goals of our project were met. We can say that virtual reality is a new way to start treating people with many problems safely. The virtual reality has a lot of potentials but the only problem is that is very expensive. Now the next step could be start using the software a make real test with people with phobia to heights. This could bring to the University of Turabo and us a new era of innovation in the field of therapy.

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