A Cost Effective Approach towards Virtual Reality: Phobia Exposure Therapy

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Abstract: Advances in the field of 3D graphics and the increase in computing power, the real-time visual rendering of a virtual world is possible in real world. Virtual reality provides new techniques of visualization, composing on the strengths of visual representations. In some instances, virtual reality can provide more accurately the detailing of some features, processes, and so forth than by other means, which allows it to perform extreme close-up examination of an object, observation from a great distance, and examination of areas and events unavailable by other means. Virtual reality exposure therapy is highly used in order to treat PTSD with a success rate of over 70%. Building further on this, we would be providing environments for phobias as varied as acrophobia, phasmophobia, nyctophobia. These environments would be developed on an android device and using a virtual reality headset based on Google cardboard we would carry out the virtual reality simulation. The three chosen phobias are the most widely recognized phobias whereas an android device is used since it has the largest user base in the world. The main aim of our application is to provide Virtual reality therapy apparatus at cheap and affordable rates without compensating on the quality to various therapists in order to expedite the treatment of patients.

Keywords: Virtual reality, Acrophobia, Phasmophobia, Nyctophobia, Affordable, Therapy.

I. INTRODUCTION

Virtual Reality (VR) has significantly developed over the past few years. This development in the field of Virtual reality can be attributed to the recent advancements made in the field of science and technology. Virtual reality can be stated as a computer simulated reality, which is capable of replicating the environment and simulating a physical presence of real world or a visualized world allowing the user to interact with that world. Virtual reality allows a sense of sight, hearing, touch and smell.

Phobias can be defined as dysfunctional fears of a person of a particular situation or object [2]. Large numbers of people experience a form of imprudent fear during their lifetime; there are many types of phobias like animal phobia (fear of snakes, slugs, rats, mice, spiders, cockroaches etc.), social phobia, hydrophobia, acrophobia, dental phobia or claustrophobia. In addition to the perceived threat, which most of the times consists of common disorders, many small animal phobias are visible to be related to a feeling of disgust (abominated response towards potential contamination) [2-4]. These animals persuading disgust, either because they have been historically associated with the outbreak of diseases which led to dangerous consequences (e.g. rats and cockroaches) or because they possess a natural feature that evokes disgust (e.g. slugs and snakes are perceived as slimy) [1]. The disgust associated with the fear is demonstrated in the case of arachnophobia by the study ofB. O. Olatunji, J. Huijding, P. J. de Jong, and J.A.J. Smits[3].In-vivo, exposure therapyhas produced better result than imaginal exposure, especially in the treatment of specific phobias [6].Exposure to emotional situations and continuous rehearsal are responsible for consistently activating the cerebral metabolism in brain areas associated with inhibition of maladaptive associative processes[7].

The involvement of identical neural circuits has been found in affective regulation across affective disorders [8-9].Systematic and controlled curative exposure to phobic stimuli may intensify the emotional regulation by altering the inhibitory operations on the amygdala by the medial prefrontal cortex during exposure and structural changes in the hippocampus after successful therapy [10].

II.BACKGROUND

Applications of virtual reality have been of growing interests due to issues in mental health. These issues mostly deal with specific phobias. Virtual Reality has its applications to basic set of symptoms such as post-traumatic stress disorder [11]. Each of these exploit the power of virtual reality to create situations in which a person can be immersed, but under the supervision of the psychologist, with most therapies include extensive exposure of the patient to the feared situation. Without the use of Virtual Reality, the exposure therapy is based on the interaction between the therapist and the phobic. Exposure therapy is grounded on the principles of respondent conditioning often termed Pavlovian Extinction [13]. The exposure procedures are divided into three types:

1. The first type of exposure is in "real life." This type of procedure uses a direct approach with procedures in different conditions. For example, if someone is suffering from Glossophobia (fear of public speaking) the person may be asked to address small group of people just to treat that fear directly [12].
2. The second type of exposure is imaginal, where patients are asked to imagine a situation that they are afraid of. This procedure is very useful for people who need to confront feared thoughts and memories [12].

3. The third type of exposure is interoceptive, which may be used for discrete disorders such as panic or post-traumatic stress disorder [12].

There are certain limitations to the existing system of phobia therapy, i.e., without the use of virtual reality:

1. Safety and control: The real environment is not uniform and in-vivo exposure therapy leaves much to chance.
2. Inefficiency in treatment and difficulty in scheduling: Standard exposure therapy can be very expensive because it usually requires leaving the therapist's office and therefore could lead to prolonged sessions. Getting an appointment to the therapist is also difficult.
3. Risk to patient's privacy: Since therapy is conducted in an open environment there is a potential risk of running into friends, relatives or family.
4. Limited repetitions of feared situations: The limitations of real world bound the standard exposure therapy, for example, only one takeoff and landing per flight is possible. Such situations cannot be repeated due to environmental limitations.

III. LITERATURE SURVEY

The literature we studied during the tenure of developing this project deals with feasibility, technique used and aftermath of the therapy. In [14] Merel Krijn, Paul M.G. Emmelkamp, Roeline Biemond, Claudius de Wilde de Ligny, Martijn J. Schuemie, Charles A.P.G. van der Mast tested the effect of various VR based phobia exposure therapy methods on the patients. They proposed two methods namely HMD and CAVE. Head mounted device or HMD is one of the two major techniques used for VR based exposure therapy It includes a headset which is connected to a computer, the patient wears the headset. The image processed inside the headset is developed in such a way that the it makes the image look distinct for both eyes thus asking the brain to create the image thus, this generates depth for the patient .Sometimes there is a sensor present on the headset for movement or updation of images. One of the major drawbacks that HMD provide was lack of presence and system lag. The method which was developed after HMD in this field was CAVE method. In this the phobia related environment is created in a specific room with walls acting like projectors. This type of therapy has more presence than HMD as entire environment is present inside the room. But the measured effects from both the therapies show no difference. Where CAVE fails to deal with economic and issues related to space of the program, this area where HMD scores pretty well.

In [5] the experiment showed a comparative study between the real situation and virtually created world for people suffering from arachnophobia in degree of their disgust and fear. In which people were asked to have a contact with real tarantula and virtually created spider at both occasion the patient's level of disgust and fear was calculated. This was also including the scenes or the occasions at which the fear was triggered. Thus it concluded that by the time there was decline in disgust of

patients towards the creature when they compared the levels. Thus proving a great degree of feasibility for this type of therapy.

IV. VIRTUAL REALITY PHOBIA EXPOSURE THERAPY

The purpose of our phobia exposure therapy is to use virtual reality to help patients overcome their phobias through the developed virtual environment. We have used Unity and Cardboard SDK to develop various virtual environments, VR headset with Bluetooth controller to maneuver within the virtual environment and an android device, which displays the virtual environment. The main idea is to provide the components required for virtual reality phobia therapy to various therapists at an affordable price without compromising on the efficiency. The reason we have used an android device is because it is one of the most widespread technologies of our generation that is available at cheap rates too.
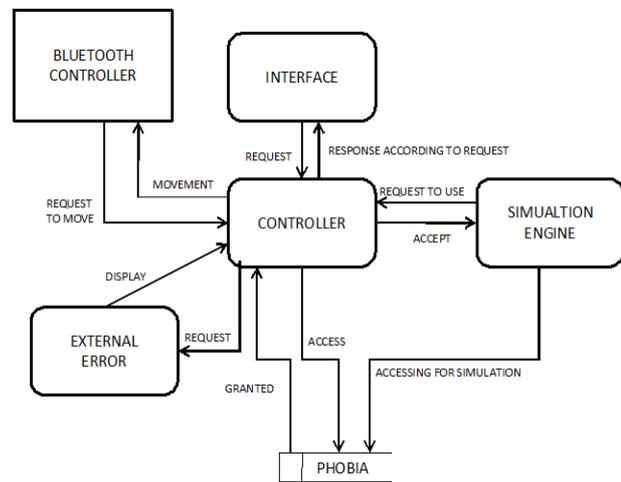

Fig. 1.Architectural Diagram

The diagram in Fig. 1 explains the architecture and internal working of interaction between the proposed model of virtual gear and the patient.

The controller in the above diagram works as a supervising component which governs all the processes occurring within the system and also acts as the only component which is connected to the user interface, any major/minor change in the system would be displayed on the screen through interface. Bluetooth controller is to be connected to the android device, which would be used to render the virtual environment. Once this connection is established the Bluetooth controller could be used in order to move within the virtual environment. We would now be looking at phobias which we developed using Unity. These three phobias have been specifically chosen since these are the most common kinds of phobias people face.

A.ACROPHOBIA
Acrophobia comes from the Greek words Akron and phobia, where Akron stands for summit or height and phobia stands for fear. Hence acrophobia can be defined as fear of heights. This type of phobia is triggered in the

minds of the patient by the constant mindset of falling when he reaches a particular height. We have created a dynamic environment for this phobia by using Unity that consists of virtual buildings. Each of these virtual buildings has walk routes at its sides on a certain height where the patient could walk around. This type of an arrangement was selected since it would allow enough time for the patient to get comfortable at such a height and look down from there when he feels comfortable as shown in Fig.2.

Fig.2 Acrophobia view from the VR headset

B.PHASMOPHOBIA

Phasmophobia comes from the Greek words phasma and phobia where phasma stands for ghosts and phobia stands for fear. Hence phasmophobia can be defined as fear of ghosts. Level design for this kind of a phobia was the trickiest for us since in most cases the idea of ghosts in individuals is not developed through actual experiences but rather through literature or graphical content that we listen to or read. In order to help patients overcome this phobia we decided that the main concept we would have to tackle is to making the patient believe that the idea of ghosts is a false concept.

Famous literatures and graphical contents use the idea of rocking chair, windows clanging and certain things falling down suddenly in order to elicit the fear of ghosts. In order to tackle this phobia we believed these widespread concepts could be used to explain the patients why they occur through scientific reasoning. Therefore, we created a number of rooms each consisting of one of the items mentioned. The patient would hear certain noises or see things and would need to go closer to these objects for a scientific reason to pop up. Fig.3. Shows us a rocking chair, the patient would have to go closer to this chair in order to view the reason for the chair to be rocking.
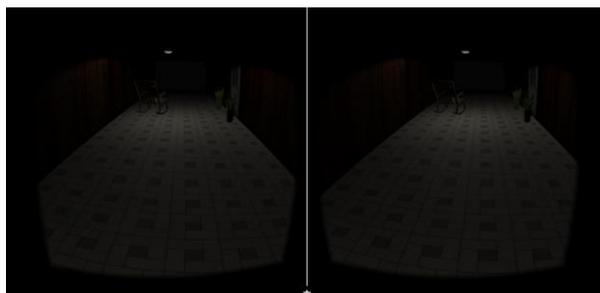

Fig.3 Phasmophobia view from VR headset

C.NYCTOPHOBIA

Nyctophobia comes from the Greek words nux or nukt and phobia, where nux or nukt stands for night and phobia stands for fear. Hence nyctophobia can be defined as fear of night or of darkness. A person might suffer from this phobia because of certain negative consequences that might have happened in complete darkness or some personal experience the patient might have gone through which could have scarred him leading to a fear of darkness or night. The environment that we preferred to design for this phobia was of the patient required to walk through a partially empty road with only few people around and having only streetlights to guide him. The task for the patient is to walkthrough this empty patch of road that he might feel uncomfortable with and reach his home, the most familiar environment for us. Repeated exposure to such environment,i.e., an uncomfortable area to his comfortable area would allow the patient to become friendlier to darkness. Fig.4. gives us a view of the environment generated for Nyctophobia.

Fig.4 Nyctophobia view from the VR headset

V. METHOD

We circulated a flyer asking students to test our developed application and selected 50 students to do so.
The students were asked to test the application in a silent room under the supervision of a therapist; the therapist would guide the students throughout the testing phase. After testing all three of our developed phobias each student was asked to fill out a feedback form. The questions ranged from asking them about how comfortable the VR device was to asking them whether they thought our application would work. One of the questions asked the students about their anxiety level during the entirety of their testing time on a scale of 1-5. Fig.5. shows the anxiety level graph of students.
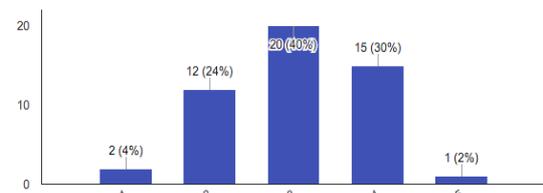

Fig.5 Average of Anxiety levels of students

From the graph we can conclude that around 70% of students experienced anxiety levels between 3 and 4. Thus proving the effectiveness of our experiment positively.

One of the questions in the feedback from asked the students to guesstimate the number of sessions it would take to treat someone who experiences the phobias they tested under similar circumstances of a silent room and a therapist to guide the patient.
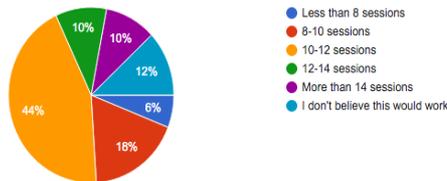
Fig.6 Feedback on required number of sessions

Fig.6. gives us a rough estimate about how many sessions would it take for a patient to overcome his fears. Duke university suggests that it could take anywhere between 6 to 12 sessions for exposure therapy to achieve maximum benefits. 44% of the students believed that our application would require 10-12 sessions,18% believed that our application would require 8-10 sessions and 6% believed would require less than 8 sessions to provide maximum benefits. Since only 32% of the 50 students selected believed it would take more than 12 sessions for our application to provide maximum benefits. Hence, we believe these results are favorable enough to move forward.

VI. CONCLUSION

Virtual reality phobia exposure therapy has the following benefits: 1) increased safety and control, i.e., the use of virtual reality would grant more control to the therapist for the treatment leading to a more efficient treatment. 2) Allows ease of scheduling since these sessions or no longer than 45 to 60 minutes. 3) Protects the confidentiality of the patient, most of the patients do not want other people to know about their fears and since this therapy is conducted within the clinic itself there is no risk of running into friends, family or relatives. 4) Lastly, the most important of these benefits is that it allows the therapist to carry out unlimited repetitions of feared situations.
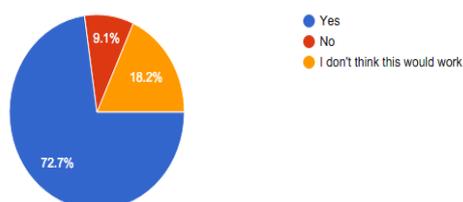

Fig.7 Feasibility of our application

Fig.7. gives us a detailed response to whether a patient would like to use the device again in order to overcome/face their phobia. We received a highly positive response of over 70% feeling they would like to use the application again. Thus bolstering our application's position further as being feasible in the real world. Finally the last question in the feedback from asked the patients about their overall experience.

In order to fully understand whether the application has been entirely accepted we need to take into consideration all the aspects that influence the overall experience of the patients that includes the VR headset, the UI used to switch between various phobias and the level design of these phobias. Fig.8. Certainly answers this question, where 84% of the students have rated the experience between 3 to 5.
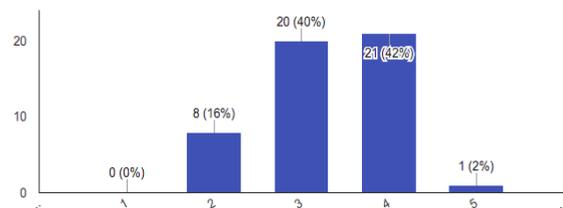

Fig.8 Overall experience

After studying all the feedbacks and interacting with the students themselves, we observe that there are certain aspects of the application that need to be improved as suggested by the previous figures in this paper but since the benefits of using our application clearly outweigh the flaws pointed out we conclude that our cost effective method of using an android device along with a VR headset and a Bluetooth controller would be successful in being implemented in the real world.

VII. FUTURE WORK

We currently have a virtual environment for three phobias in our application, nyctophobia (fear of night/darkness), acrophobia (fear of heights), phasmophobia (fear of ghosts).
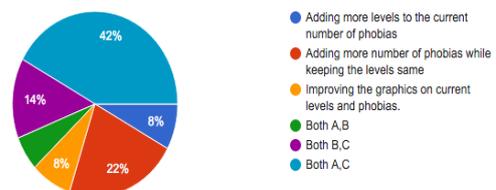

Fig.9. Improvements suggested

In the feedback form provided to the students after they used our application, we asked a question regarding the suggested improvements for our application. Fig.9.

provides a graphical representation of their answers. On analyzing the results we can conclude that 42% students feel that we should add more levels to the phobias already included in the application and also improve the graphics. Though our graphics were limited by the hardware specifications of the android device at our disposal we believe that improving the graphics would not prove to be a major hurdle.

Along with adding more levels to the current phobias, we would also be adding a login framework and connecting a database to our application. This would provide increased confidentiality to the users since each of them would have their own Login ID and password but also would provide a unique data set for each patient.

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