A Review Paper on 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. In this paper, we propose and develop virtual rendering of phobias using Unity and Google Cardboard. A dedicated virtual environment is programmed within which a user can interact with the environment. This interaction is called as Haptic Interaction. Using this technique it is believed that the phobias could be treated.

Key words: Virtual reality, Unity, Google cardboard, Haptic interaction, Phobia

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.

In the period between the late 90s and the early 2000s the research and development in virtual reality was carried on such a large scale that it became widely known. The media and the society used the term virtual reality often without knowing its proper meaning. The reason being that the technology which is used in virtual reality appeals to common people on a better and greater extent than the other present technologies like computer generated graphics. This has resulted into a blurry border between computer graphics and virtual reality [1].

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 of Olatunji et al [3]. In-vivo, exposure therapy has 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, fears of special objects or situations, namely fear of heights, spiders (arachnophobia), open spaces (agoraphobia), and flying. 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. VIRTUAL REALITY PHOBIA EXPOSURE THERAPY

The purpose of our proposed phobia exposure therapy is to use virtual reality to help patients overcome their phobias through the developed virtual environment. This virtual environment would be developed using Unity, Google Cardboard and an android device. These components allow in providing therapy at an affordable price.

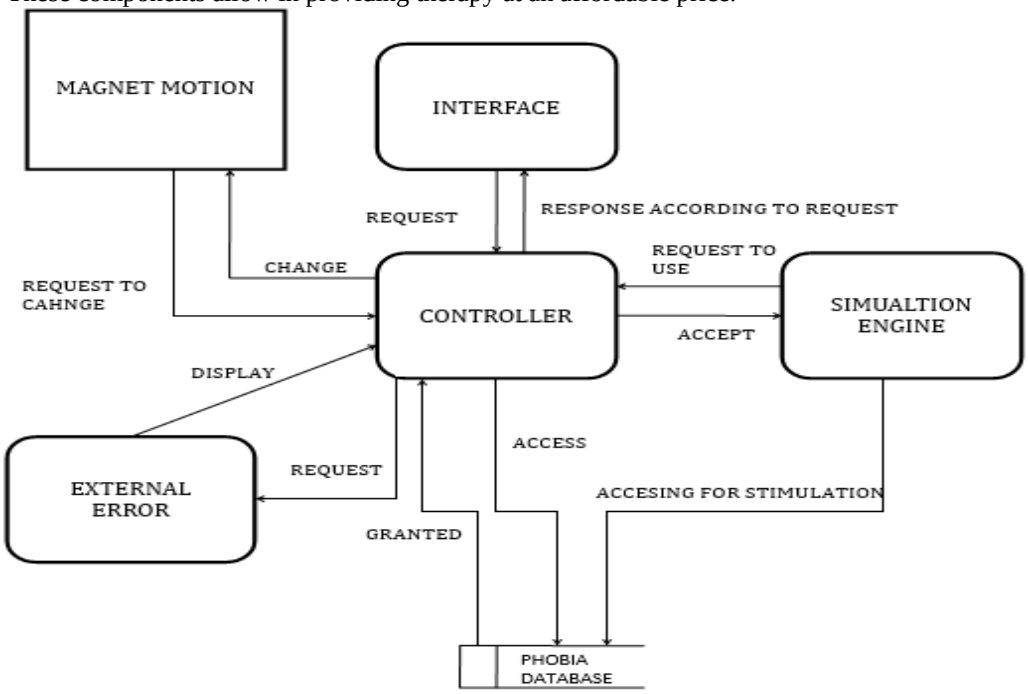

Fig. 1: Architectural Diagram

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. Magnet motion is the special component in the device used for rendering virtual reality environment and is used mostly for walkthrough within the environment. We would now be looking into the various components of the phobia exposure therapy.

A. Unity

Unity is a cross-platform game engine; which is developed by Unity Technologies. It is used to develop video games for PC, consoles, websites and mobile devices. It's a complete ecosystem to build a business on creation of high end content and connecting to their most enthusiastic and loyal customers and players. C# and JavaScript are the programming languages used in Unity.

The Fig. 2 gives an overview of an environment developed using the Unity software. It helps us to know the various features of the Unity software and its ability to provide high quality graphics without major complexities.

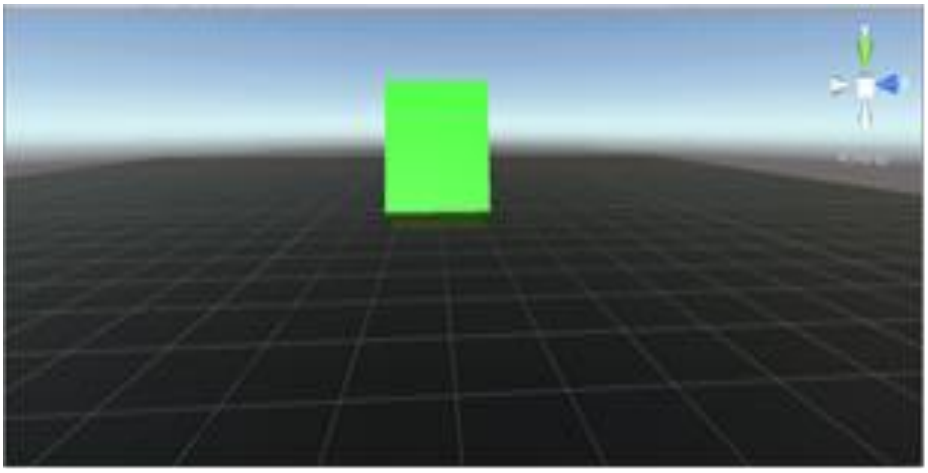

Fig. 2: 3D Cube developed using Unity Software

OpenGL is another software which is used for developing virtual reality environment. It is a platform independent application programming interface used for generating graphics.

The TABLE 1 provides us with the information about how OpenGL differs from the Unity software. OpenGL is an Application Programming Interface (API) whereas Unity is used for developing high quality graphic components using APIs. Unity's user friendliness has made it a popular choice over OpenGL.

	UNITY	OPENGL
High performance	✓✓	✓
No Limitation	✓	✗
Easy to use	✓	✗
Low level Interference	✗	✓
Manual	✓	✓
Documentation	✓	✓

Table 1. Comparison between OPENGL and UNITY

B. Google Cardboard

A fold out cardboard mount for mobile phone was developed by Google which is a virtual reality platform called as Google cardboard. Google provides guidelines for making the cardboard. It consists of focal lens, magnets, a hook and loop fastener such as a velcro. At first the user would accommodate himself with the virtual reality device, then the user would select the phobia he wishes to encounter with help of vertical movement arrangement on the UI (android device). As per the choice, the data would be retrieved from the data module in relation to the selected phobia. This would be the input to the simulation engine. Later, this simulation engine would start processing the virtual environment and the user would confront his/her phobia through the environment rendered on the screen. Thus, user can also judge his/her ability to withstand fear by degree and time of being exposed to the phobia. Cardboard SDK allows us to reconfigure the environment created through the Unity software into the required configuration of the cardboard.

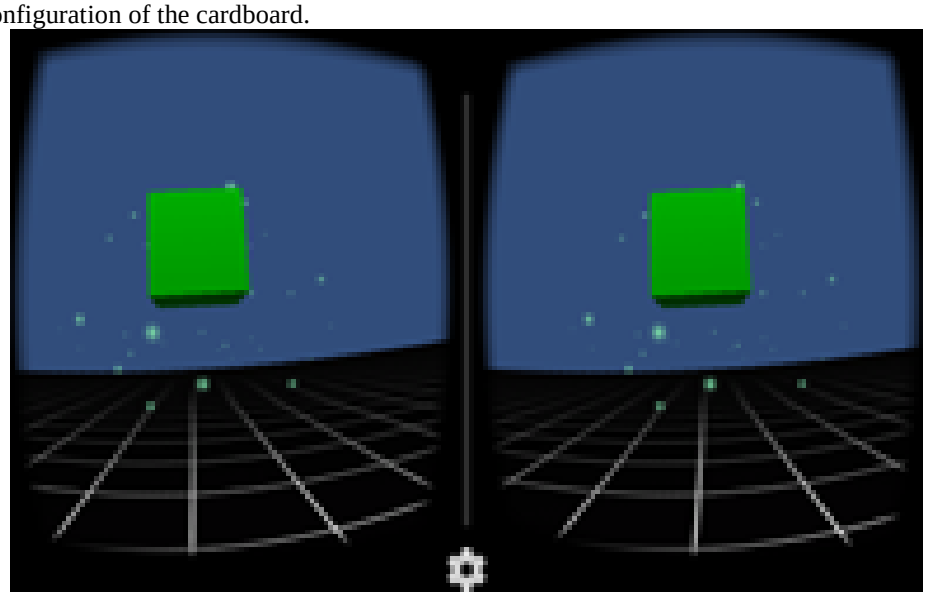

Fig. 4: View through the Cardboard

The Fig. 4 explains pictorially the environment patient would see through the virtual reality gear.

IV. CONCLUSION

Virtual reality phobia exposure therapy would allow 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. It would also permit ease of scheduling, i.e., standard exposure therapy can be very costly since it usually requires leaving the clinic and leading to extended sessions. It would also lead to less risk of patient's confidentiality, i.e., since therapy is conducted within the clinic, there is no risk of running into friends, family or relatives and lastly it would allow the therapist to carry out unlimited repetitions of feared situations, i.e., the use of virtual reality grants the therapist ultimate control over stimuli for the perfect exposure; standard exposure therapy is bound by real world limitations.

After studying all the research, we come to know that the benefits of using virtual reality for phobia exposure therapy overcome the drawbacks of the primitive method of exposure therapy. The current system depends very much on the imagination of the patient, which could be very difficult in certain cases, with no such issue in virtual reality. Hence, the use of virtual reality eliminates many of the difficulties in phobia treatment.

V. FUTURE WORK

We are currently testing our model experimentally by developing the environments for a few phobias namely, arachnophobia (fear of spiders), acrophobia (fear of heights) and claustrophobia (fear of dark places). These phobias are considered to be the most common types of phobias. Depending on the outcomes of the testing phase, more phobias and their environments would be added to our database providing help to patients suffering from varied conditions. Along with additional environments, we would also be adding a login framework. This would provide increased confidentiality to the users and allow us to have unique data about each individual patient.

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REFERENCES

[1] Tomasz Mazuryk and Michael Gervautz, "Virtual Reality:History, Applications, Technology and Future",Technische Universitat Wien 1996
[2] G.C.L. Davey, "Psychopathology and treatment of specific phobias", Psychiatry, vol.6, no. 6, pp. 247-253, 2007.
[3] B. O. Olatunji, J. Huijding, P. J. de Jong, and J.A.J. Smits, "The relative contributions of fear and disgust reductions to improvements in spider phobia following exposure-based treatment", Journal of Behavior Therapy and Experimental Psychiatry, vol. 42, pp. 117-121, 2011.
[4] J.M. Cisler, B.O. Olatunji, and J.M. Lohr, "Disgust, fear, and the anxiety disorders: A critical review", Clinical Psychology Review, vol. 29, pp. 34-46, 2009.
[5] J.A.J. Smits, M.J. Telchand, and P.K. Randall, "An examination of the decline in fear and disgust during exposure-based treatment", Behaviour Research and Therapy, vol. 40, pp. 1243-1253, 2002.
[6] Emmelkamp, P. M., Krijn, M., Hulsbosch, A. M., de Vries, S., Schuemie, M. J., & van der Mast, C. A. (2002).Virtual reality treatment versus exposure in vivo: A comparative evaluation in acrophobia. Behavior Research and Therapy, 40, 509–516
[7] Schwartz, J. M. (1998). Neuroanatomical aspects of cognitive-behavioural therapy response in obsessive–compulsivedisorder. An evolving perspective on brain and behaviour. The British Journal of Psychiatry(Suppl.), 38–44
[8] De Raedt, R. (2006). Does neuroscience hold promise for the further development of behavior therapy? The case of emotional change after exposure in anxiety and depression. Scandinavian Journal of Psychology, 47, 225–236
[9] Mineka, S., Watson, D., & Clark, L. A. (1998). Comorbidity of anxiety and unipolar mood disorders. Annual Review of Psychology, 49, 377–412
[10] Hariri, A. R., Bookheimer, S. Y., & Mazziotta, J. C. (2000). Modulating emotional responses: Effects of a neocortical network on the limbic system. Neuroreport, 11, 43–48.
[11] Rothbaum, B.O., Hodges, L.F., Alarcon, R., Ready, D., Shahar, F., Graap, K., Pair, J., Herbert, P., Gotz, D., Wills, B. and Baltzell, D. Virtual Reality Exposure Therapy for PTSD Vietnam Veterans: A Case Study. Journal of Traumatic Stress 12,2, p.p. 263-271, 1999.
[12] Foa, E. B. (2011). Prolonged exposure therapy: present, and future. Depression and Anxiety, 28, 1034-1047.
[13] Marks, Isaac Meyer (1981). Cure and care of neuroses: theory and practice of behavioral psychotherapy. New York: Wiley. 0-471-08808-0.