

Psychological Treatment Using Virtual Reality Therapy for Different Anxiety Disorders

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ABSTRACT: Virtual reality, or VR, allows users to experience a computer-generated three-dimensional environment. Sensory information is delivered through a head mounted display which provides VR view to the user. This device track head movements and change directions or view of environment in a natural way with head motion, allowing for a sense of immersion into the Virtual World. VR allows for controlled delivery of sensory stimulation via the therapist and is a convenient and cost-effective treatment. VR is increasingly being used as a therapeutic solution for different psychological disorders. The Psychological disorders are Trauma and stress related disorders which involve the exposure to a stressful or traumatic event. VR is applied in the Exposure Therapy. This paper focuses on designing environments to treat some Anxiety Disorders like Acrophobia, Post-Traumatic Stress Disorder (PTSD), Schizophrenia. This therapy makes the patients feel comfortable and the recovering process is fast when compared to Exposure Therapy. In addition to this, different levels of environments can be created for different phobias.

KEYWORDS: Virtual Reality(VR), Virtual World, Exposure Therapy, Anxiety Disorders, Acrophobia, Post-Traumatic Stress Disorder(PTSD), Schizophrenia.

I. INTRODUCTION

The Anxiety Disorders affect both adults and children. These disorders show symptoms such as fear, worry, depressed mood, angry, hopelessness and feeling isolated. Virtual reality therapy is the use of virtual reality technology for psychological treatment in Exposure Therapy. VR provides solution not only for mental disorders but also for mental relaxation^[3]. VR allows controlled delivery of sensory stimulation via the therapist and is a convenient and cost-effective treatment^[7]. Patients receiving this therapy navigate through virtually created environments and interact with virtual form of fear stimuli in order to reduce fear responses^[2]. Virtual reality therapy has also been used to help patients to get back from many different phobias. A phobia is a type of anxiety disorder, due to an excessive fear of an object or situation. The phobia results in a rapid onset of fear and it lasts for atleast six months. The affected person goes to any extent to avoid that particular situation or object which makes them fear. If the fear causing object or environment cannot be avoided, the affected person experiences significant distress. Person with blood or injury phobia may faint. Usually persons have phobias due to a number of objects or situations.

Acrophobia is defined as an extreme or irrational fear or phobia of heights. Person with this fear avoid going to mountains, bridges, or the higher floors of buildings^[11]. Physical symptoms of acrophobia include, increased sweating, chest pain, and increased heartbeat at the sight or thought of high places, shaking and trembling when faced with heights. Psychological symptoms can include, having extreme fear of being trapped somewhere high up, worrying excessively about encountering heights in the future. This phobia can be developed without a known cause. It may be due to genetics or environmental factors.

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Post-Traumatic Stress Disorder (PTSD) can appear for someone who has survived after a horrific experience, such as war or sexual assault. A person with PTSD often experiences edginess and extreme emotional changes and may view anything that evokes the traumatic situation as a threat. Symptoms may include recollecting the memories about the event, bad dreams, severe anxiety and uncontrollable thinking about the event^[4]. PTSD symptoms may be seen within one month of a traumatic event, or sometimes symptoms may not appear until years after the event. These symptoms cause many problems in social or work life and also in relationships. They can also interrupt your daily routine tasks. Schizophrenia is a genetic and severe mental disorder that affects how a person thinks, feels, and behaves. People with this disorder may be like they have lost their touch with reality. They will be physically present in real world but mentally absent. The causes include environmental and genetic factors^[18]. This affects the persons memory power.

II. LITERATURE SURVEY

[1] In October 2019, Debra Boeldt, Mimi McFaul, Walter Greenleaf, Elizabeth McMahon, “Using Virtual Reality Exposure Therapy to Enhance Treatment of Anxiety Disorders” *Frontiers in Psychiatry*. Treatment focused on many phobias and disorders like acrophobia, autism etc. They suggested that creating the environment(VRET) in which the patients feel uncomfortable will make them feel comfortable and loss anxiety in various sessions.

[2] In July 2019, Mi Jin Park, Dong Jun Kim, Unjoo Lee , Eun Jin Na and Hong Jin Jeon, “A Literature Overview of Virtual Reality (VR) in Treatment of Psychiatric Disorders” *Frontiers in Psychiatry*. VR systems relatively easily deliver virtual environments with well-controlled sensory stimuli.

[3] In March 2015, Syeda Sarah Abbas, Sehrish Kiran, “ People with fear of Height”. Acrophobia develops in response to a traumatic experience involving heights, such as: Falling from a high place, Watching someone else fall from a high place, Having a panic attack or other negative experience while in a high place.

[4] In June 2014, Jennifer Lunt and Ruth Hartley, “Literature Review of Post-Traumatic Stress Disorder”. Characteristic symptoms are grouped under persistent mental re-experiencing of the event, reminder avoidance, hyperarousal and social functioning disruption categories.

[5] In Nov 2010, Wildgust H.J., Hodgson R., Beary M, “The paradox of premature mortality in schizophrenia”. Schizophrenia is a chronic mental illness which affects approximately one percent of the population worldwide and is a leading cause for disability and premature mortality in developed countries.

[6] In July 2010, A. Carlborg, K. Winnerback, E.G. Jonsson, J. Jokinen, P. Nordstrom, “Suicide in schizophrenia”. Symptoms of schizophrenia consists of separation from reality with delusion formation, hallucinations, emotional dysregulation and disorganized behavior. Over time, a slow decline in mental function and social relationships occurs.

[7] In July 2007, Marco M Picchioni from the Institute of Psychiatry, “Schizophrenia”. People with schizophrenia typically hear voices (auditory hallucinations), which often criticize or abuse them. The voices may speak directly to the patient, comment on the patient’s actions, or discuss the patient among themselves.

III. ARCHITECTURE

The proposed architecture is implemented in Unity gaming engine and Google VR Software Development Kit(SDK) with C# libraries is used to write code in Visual Studio IDE for the movement of the objects in virtual world.

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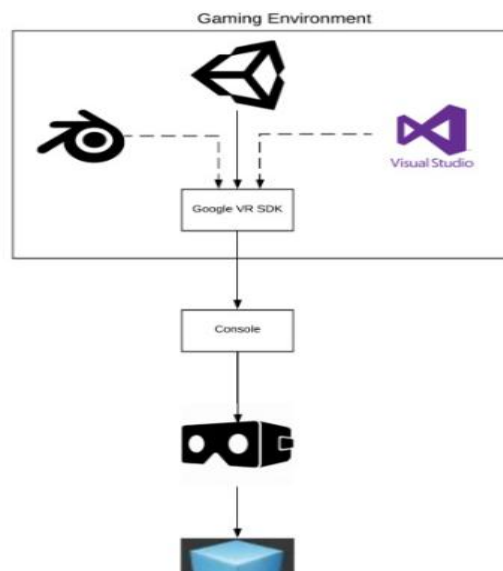


Fig 1. Architecture Diagram

A. GAME ENGINE :

The main software used in the system gaming engine and modelling environment. A game engine provides a software framework which is used to build and create video games. There are five components in gaming engine. They are, main game program, rendering engine, audio engine, physics engine and artificial intelligence.

Unity is the easiest game engine due to its simple interactive interface. Unity is a cross-platform with a built-in IDE developed by Unity Technologies. Programmers widely use unity as a gaming engine to develop user interactive games because of the C# scripting API and built-in Visual Studio Integration.

Unity opens Visual Studio as an external editor whenever C# script is accessed and passes the correct arguments to it. C# scripts are generally use for the movement of the objects in virtual world.

Blender is an open-source computer graphics software tool. This can be used for creating animated films, visual effects, interactive 3D applications and video games in a more realistic way.

B. SOFTWARE DEVELOPMENT KIT :

Software Development Kit brings together a group of tools that are enabled for the mobile application programming. The google has provided SDK for the development of virtual environment as an open source. SDK is a set of tools that can be used in the development of software applications. This contains libraries, documentation and sample code that would help a programmer to develop an application.

C. VR HEAD GEAR :

The system hardware comprises of node through which the user interacts with the virtual environment. The node can be any computing devices like personal computers or even smart phone devices. For virtual environment the user need to use VR head gears because it comprises of stereoscopic head-mounted display which will separate the

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image for each eye. The VR environment game without any VR assistance it will be awkward to see because it produce 360° view which cannot be implemented in any other devices.



Figure 2. 360° view of VR head gear

There are various models of VR headsets. Some have button and some may not. The headsets without buttons are called viewer glasses in which VR remotes can be used as controller.

IV. DISORDERS AND TREATMENTS

The anxiety disorders considered in this system are Acrophobia, Post Traumatic Stress Disorder and Schizophrenia. By gathering the information about the causes of these disorders, game environment for each disorders can be designed and created.

Acrophobia, Fear of Height, can be treated by exposing the player to the height place in virtual world where height can be incremented gradually. This makes the player to feel the height and come out of the fear.

Post-Traumatic Stress Disorder (PTSD) is a psychological disorder that is caused by a terrifying event either experiencing it or witnessing it. This can be treated by exposing the patient to the same event which caused this disorder. But game environments cannot be created for all the events. So the designer can consider the events where the people got affected the most such as bomb blasts, natural calamities for this therapy.

Schizophrenia is a mental health disorder where the people will have abnormal mental behavior, strange speech and decreased ability to understand the reality. The person with schizophrenia often will have confused thinking, hearing strange voices and they interact with illusion characters. They will lose their consciousness of the reality and their memory power will be affected. So, this can be treated by playing memory games.

V. MAIN IDEA

The main idea of this proposed system is to develop a three level game for each disorder. The player can select the disorder name to play that game. In this game developers create different levels for Acrophobia, PTSD and Schizophrenia.

By selecting the game, player can move to level one environment. At the end of the level player gets the screen showing that the level is completed and a button to next level. After completing all the three levels of a selected disorder, the player gets the menu screen. The player can continue with next game or can go out of the game by giving exit on top left corner.

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A. TREATMENT FOR ACROPHOBIA :

The treatment for acrophobia is to expose the patients to high places. In this game designer develop three levels of height. First level is the elevator scene where the player is positioned in the balcony of a building. The player can increase the height by pressing the button.

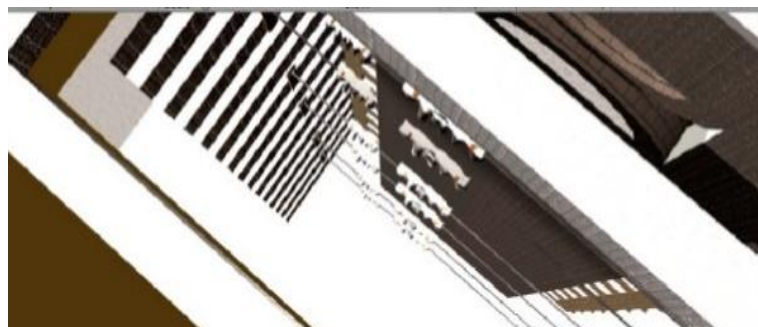


Figure3. View of player from the building

In the next level, player is placed in the bridge. The player can move forward and see the virtual world objects and experience that height.

In the next level, player is positioned in an open rope car. This makes them feel like flying in height. They can view down and this may reduce their fear of height.

B. TREATMENT FOR POST-TRAUMATIC STRESS DISORDER :

The treatment for Post-Traumatic Stress Disorder requires the patient to experience the event which affected them to recover from it. Here the levels are based on the events that cause this disorder. From the research made, the major events that cause this disorder are accidents, bomb blasts and natural calamities.

In primary level, the player is made to expose to a car accident scene. Here the player experiences the accident where the car hits the tree and still there is no danger to the player. This will recover the patients from the disorder by reducing their anxiety levels.

Further in the secondary level as the bomb scene where the bomb is set in a place and player is asked to defuse the bomb. If the player is not able to defuse the bomb in time, time out occurs and the player is asked to try again.

The next level is related to natural calamity earthquake where the player is positioned inside a room. The player can experience the earthquake and can look around after the earthquake is over. By this game, the player can experience the earthquake without any physical injury and also without loss of life.

C. DATA ANALYSIS :

Post-Traumatic Stress Disorder usually cause due to an incident. The developer can create an environment for PTSD once the causes and symptoms are known. Thus the datasets of traumatized patients receiving treatment^[6] is collected.

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Table 1 Overview of PTSD symptoms from four clinical samples

#	Symptoms	Short-codes	Means (sd) data 1	Means (sd) data 2	Means (sd) data 3	Means (sd) data 4
1	Intrusions	Intr	3.10 (0.91)	3.15 (0.86)	2.41 (1.08)	3.43 (0.68)
2	Nightmares	Nightm	2.66 (1.12)	2.45 (1.02)	1.97 (1.15)	3.33 (0.76)
3	Flashbacks	Flash	2.61 (1.08)	2.60 (0.97)	1.76 (1.04)	3.19 (0.81)
4	Physio-/psychological reactivity	React	2.84 (1.01)	2.86 (0.89)	2.35 (1.11)	3.47 (0.66)
5	Avoidance of thoughts	AvThought	2.78 (1.03)	2.85 (1.10)	2.18 (1.17)	3.05 (0.95)
6	Avoidance of situations	AvSit	2.74 (1.10)	2.38 (1.09)	1.85 (1.14)	3.26 (0.87)
7	Amnesia	Amnes	1.96 (0.99)	2.26 (1.09)	1.90 (1.14)	2.34 (1.13)
8	Disinterest in activities	Disint	2.77 (0.97)	2.76 (1.08)	2.62 (1.13)	3.18 (0.87)
9	Feeling detached	Detach	2.80 (0.94)	2.52 (1.02)	2.70 (1.11)	3.24 (0.87)
10	Emotional numbing	EmNumb	2.39 (1.05)	2.43 (1.05)	2.47 (1.12)	2.56 (1.07)
11	Foreshortened future	ShortFut	2.79 (1.07)	2.95 (1.07)	2.07 (1.17)	3.42 (0.84)
12	Sleep problems	Sleep	3.08 (1)	3.20 (0.97)	2.98 (1.14)	3.51 (0.67)
13	Irritability	Irrit	2.65 (0.98)	2.45 (0.90)	2.68 (1.07)	3.30 (0.80)
14	Concentration problems	Conc	3.12 (0.88)	2.87 (0.91)	2.86 (1.02)	3.48 (0.70)
15	Hypervigilance	Hyperv	3.05 (0.94)	2.81 (0.99)	2.72 (1.17)	3.21 (0.87)
16	Startle response	Startl	2.91 (0.94)	2.61 (0.93)	2.26 (1.18)	3.31 (0.83)

Table 1 lists all symptoms and short-codes, means and standard deviations for all datasets collected by observing PTSD affected patients. For each symptoms the developer can create different environment as therapy to cure patients.

D. TREATMENT FOR SCHIZOPHRENIA :

Schizophrenia is a mental related disorder. People affected by this disorder often loss their concentration and live in their imaginary world. So the best game to treat this disorder is memory game to improve their concentration level. In primary level the player is made to play 'Cups and ball' game, where the player need to pick a cup that contains the ball. Once the game is started, the player can follow the cup that contains the ball, at last the player needs to pick the correct one. This game will increase the concentration of the player.

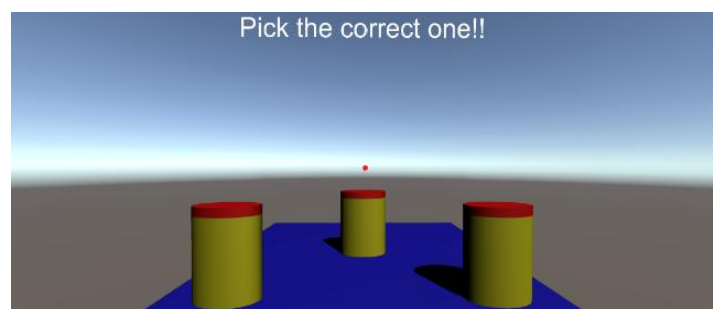


Figure 4. Player view in 'Cups and ball' game

The next level is 'Find the sequence'. The player can see the order in which cubes are pressed. And the player is asked to select the cubes in the same order shown.

Level three is 'Pair the pattern', The player can see even number of cubes in the screen. Each pair of cubes have same pattern in it. The player can turn the cube by clicking it and see the pattern. The player has to pair the cube with same pattern. By focusing in the game, their memory power will be increased.

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VI. FUTURE ENHANCEMENT

The game therapy can be enhanced by adding games for different anxiety disorders. Different environments can be created for different disorders with reference to its causes. And to know the effect of game over the user, feedback can be collected from the player at the end of the game. Buttons at the end of each level to move to next level can be replaced with the voice controller. When the player is asked to move to the next level, they can reply by saying yes or no.

VII. CONCLUSION

The Virtual Reality is big today. It can also be said that it is still in its infancy but slowly it is getting to the top. Exposure therapy involves exposing the target patient to the real anxiety source that cause the disorder to them. Patient fears of exposure therapy due to danger/safety issues. The drugs prescribed in conventional treatment may cause side effects in the near future to the patients. So the virtual reality therapy can help the user to get the treatment easily and affordably compared to conventional treatment. Repeated exposures of the user to virtual environment ensure that they can practice how to be non-anxious in anxiety causing situations.

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