



AUGMENTED AND VIRTUAL REALITY : A GLIMPSE INTO THE PAST, PRESENT AND THE FUTURE

Technology

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ABSTRACT

Augmented and virtual reality technology has redesigned the existence of our reality along being a part and parcel of our everyday life. Pairing with advanced artificial intelligence the applications of this technology are immense and much to our imagination and understanding.

Particularly in neuropsychiatry it acts as an instrument for exposure, detailed analysis and structures our treatment strategies. It allows us to assess the degree of psychosocial, cognitive and functional impairments, due to mental illnesses.

Ranging from depression, anxiety, specific phobias, obsessive compulsive disorder or psychosis in particular for deeper understanding of hallucinations and delusions, eating disorders and many more similar applications.

This technology has the potential to become a moderator between the environment and the patient and numerous outcomes of exposure to a particular simulation.

This article also shares details of future aspects of this technology.

KEYWORDS

INTRODUCTION-

There is an old saying that "the eyes only see what the mind knows." However with advent of advance artificial interface we can see the world with a whole new perspective.

Augmented and virtual reality is one technology that aces in utilities far beyond imagination and yet has soo much to research upon.

In virtual reality the user is immersed into a computer generated environment while augmented reality adds the virtual computer generated objects in real physical world scenario.

History of augmented and virtual reality-

The first setup augmenting imaging data registered to an object was described in 1938 by the "Austrian mathematician Steinhaus" who used it to point out the position of a bullet inside the human body.

The first head-mounted display (HMD)-based AR system was described by Sutherland in 1968. This is also referred to as optical see-through Head mounted display. The tracking was performed mechanically.

The term "augmented reality" was first coined by researcher Tom Caudell and Boeing in 1990.

The present day applications of this technology are-

- Anxiety disorders
- Specific phobias
- Post traumatic stress disorder
- Deaddiction
- Obsessive compulsive disorder
- Psychosis- evaluation and treatment.
- Autism spectrum disorders
- Sexual dysfunctions
- Pain distraction
- Stress management
- Psychological assessment and rehabilitation.
- Personality evaluation.
- Obesity

The important aspect of this technology is a three way interaction, that is

- 1) The artificial intelligence - that creates an environment for the user to be exposed to a particular stimulus.
- 2) The outcome of that exposure –the behavioral responses observed during the simulation.
- 3) Assessment and improvisation –to modify the environment as per the user and treat the underlying cause of a particular behavioral response.

The user gradually learns to rationalize the behaviour over successive sessions.

APPLICATIONS -

1) Anxiety, Panic disorder and Specific Phobias-

These are one of the very first in which was used for prolonged exposure therapy with its inception in early 90's. The potential to simulate real life experiences that can trigger Anxiety and associated psychological symptoms (sweating, nausea, palpitations) is used to provide exposure for desensitization.

Prolonged exposure therapy is based upon -

"Foa and Kozak (1986) emotional processing theory, Which posits that phobic disorders and PTSD involves pathological fear Structure that are activated when information represented in the structures Is encountered."

The fear can be of social gatherings (social anxiety), public speaking, crowded places (Agoraphobia), closed spaces (claustrophobia) heights, animals and insects or any particular situation that makes the anxious and panic.

Recurrent exposures to such situation make the person develop phobias and they start avoiding such circumstances.

Virtual or augmented environment can let the users face their fears, understand the rationality of it and the outcomes and removes all sort of threats out of the equation.

The virtual environment can be utilized to provide exposure to anxiety provoking situation and with an added advantage of not exposing the patient to any real life threats or harmful situation. The patient's response to a situation can be monitored and used for assessment and desensitization of the patient in a stepwise manner.

2) Obsessive-compulsive disorder-

Virtual or augmented environments including CAVE (CAVE AUTOMATIC VIRTUAL ENVIRONMENT, a cube shaped Virtual room where the floor, ceiling and wall consists of projectors) can let the user walk through an environment in which they feel distressed with the degree of contamination, the order or symmetry of the articles , their arrangements .

It gives a firsthand experience of all the situations that provoke anxiety in the patient and then after successive sessions, they learn to understand and rationalize their distress and this significantly reduces their obsessive thinking or compulsive acts.

"A South Korean research group presented first results of Virtual reality exposure therapy of Obsessive compulsive disorder.

Participants with OCD and healthy controls navigated through a virtual environment, consisting of a training, distraction, and main task phase. Anxiety rates as well as decreased ratio of anxiety during the main task were significantly higher in participants with OCD than healthy controls. Their assessments have shown significant reduction in anxiety levels over successive therapy sessions."

3) Post Traumatic stress disorder-

The application of Virtual environment especially in cases of war veterans suffering from post traumatic stress disorder has been established.

The users are exposed to the same circumstances provoking distress and the therapist has the controls to change the virtual experiences, important are not the memories of traumatic events but the emotions related to them that provoke distress.

The role of therapist here is to guide the user through the environment and counsel and reassure him to reduce his distress and enable him to cope up with the emotional turmoil due to those traumatic events.

"A case report describes the first application of Virtual reality for Vietnam veterans suffering from PTSD As a result of VR treatment, they significantly improved on all PTSD measures and those gains remained stable at six months follow-up .Participants showed significant PTSD symptom reductions on the Clinician Administered PTSD Scale (CAPS) at six months follow-up, declaring symptom reductions ranging from 15 to 67% in an interview."

4) Attention Deficit Hyperactivity Disorder-

Virtual environment can be used to assess attention impairments in Attention Deficit Disorder.

A classroom where students interact with a virtual environment which analyzes their attention span, concentration and capabilities to carry out various assigned tasks.

National Aeronautics and Space Administration (NASA) have developed a neuro-feedback system that is integrated into games to improve the attention levels of children with ADHD.

The system was initially developed to improve the concentration of pilots while on long flights. Electroencephalogram (EEG) data gathered from the brain waves of the individual were used to give feedback on the performance in terms of level of concentration.

The games are integrated into standard games for children, for example, the Gran Turismo computer game with the most brain waves generated, the faster the car goes. With training, it is intended that the child's level of concentration is improved, as the game provides added motivation for the child.

5) Schizophrenia-

Schizophrenia is a mental condition that presents with suspiciousness, hallucinations and various kinds of delusions. The task of virtual reality is not only to screen the patients but also to assess them.

Their behavioral responses in presence of virtual avatars, the degree of paranoia and also exploring the patient's delusions , tracing it all the way back to the primary delusion.

"Sorkin et al. (2006) have used Virtual environment to diagnose schizophrenic by setting a navigational task within a 3D Environment and assessing participants' performance. The study used 39 schizophrenia patients and 21 healthy patients, the result of the study was that 85% of the schizophrenia patients were detected using the VR system."

VR scenarios can be individually tailored to simulate patient's hallucinations, such as voices or walls appearing to close in etc. And they teach patients to ignore hallucinations in real life. Their fear, anxiety, distress are significantly reduced once they learn to establish the nature of their hallucinations and ways to cope up with them.

6) Deaddiction-

The treatment of addiction by means of VR is promising as well. Similar to exposure therapy in specific phobias, repeatedly showing cues of various substances of abuse (alcohol, tobacco etc) leads to

extinction of craving. Virtual environments presenting virtual cigarettes or bottles and glasses of alcohol were used and over successive therapy session significant reduction in craving was reported.

7) Psychosis – evaluation and treatment –

Psychosis is one of the areas in which virtual environment can play an important role by screening the patients, detailed assessment of their delusions and the triggering factors which can range for psychosocial stressors, childhood experiences, substance induced or any other cause.

For a deeper understanding of the symptoms the patient can be presented with interactive avatars and their behavioral responses can be analyzed.

"Valmaggia et al. - their research to explore the role of stress in the development and maintenance of psychosis, and the psychological processes and mechanisms believed to be involved."

He proposed various theories for assessment of psychosis and once the patient is immersed in the environment, it can be manipulated to cover various spheres on one's personality, their hallucinations and how they act upon them, their delusions and its content.

The therapist's role here is to develop a deeper understanding of the patient's personality and psychotic symptoms and counsel the patient with monitoring of improvements over the therapeutic sessions.

8) Autism-

Virtual systems can be used to assess, screen and diagnose children with autism spectrum disorders by providing simulations that consists of various tasks that would analyze their attention span , concentration, intellectual capabilities and higher functioning (in relation to academics, art, music and many other spheres of interest).

For the treatment of children with autism, frequent use of the systems is required and children would be far more comfortable with a virtual reality system for evaluation and assistance in learning.

There are some researchers who quoted-

"Jung et al. (2006) argue that autistic children have problems integrating motor and sensory experience and used it as the basis of their VR system.

"The VR systems looked at the aspects of sensory integration such as the visuomotor process for co-ordination and social skills. Children without autism and children with autism were compared in performance of the VR tasks, and the researchers suggest that the VR system was accurate in eliciting the difference between autistic children and non-autistic children."

"McComas et al. (1998) also suggest that VR systems have the benefit of restricting the amount of stimuli to autistic people which may cause them confusion in the real world."

9) Pain distraction

VR has also been used as a distraction technique to reduce the levels of pain experienced by patients. The level of presence within a VR system can distract an individual from the pain that they are experiencing, for example, during a medical procedure.

"Gold et al. (2006) conducted a study to evaluate the effectiveness of pain distraction using VR to divert children's attention for intravenous (IV) placement.

The study consisted of two conditions, one condition with no distraction and one with the VR condition used as distraction (playing a game). The children reported a four-fold increase in the perception in pain without distraction than those using VR for pain distraction."

"Hoffman et al. (2007) also examined the analgesic effects (pain relief) in the use of VR with the introduction of thermal pain simulation on 9 subjects.

VR and opiod (morphine like substance) were evaluated for pain relief; the pain was measured through a subjective rating and blood oxygen level-dependent assessments of brain activity in five specific, pain-

related regions of interest (using magnetic resonance imaging). The results indicated that VR significantly provided pain relief for the participants in terms of a subjective rating and their brain activity. These authors have also reported the successful use of VR to distract burn patients from pain while receiving daily wound care and during physical therapy following skin grafts.”

“Magora et al. (2006) produced a study to assess the use of VR to control ischemic pain. The study consisted of healthy participants who would experience pain through the use of a blood pressure cuff. The duration of their tolerance of the pain was measured as well as a subjective questionnaire concerning their experience of the pain. The study’s results indicated that there was a significant difference between those with VR exposure and those without.”

10) Psychological assessment and rehabilitation

VR can be used in the psychological assessment of mental problems such as schizophrenia or cognitive abilities as well as being used for the rehabilitation of cognitive abilities that may have been caused by brain injuries.

“Rose et al. (2006) pointed out brain related illnesses such as dementia are on the increase and described them as a ‘silent epidemic’. The researchers argue that VR can aid in addressing this problem by providing a stimulating environment. The use of VR for a number of brain related problems such as ‘executive dysfunction’ (problems sequencing and organizing behaviour), ‘memory impairments’, ‘spatial abilities’, ‘attention deficits’ and ‘unilateral visual neglect’.

“Marusan et al. (2006) described the development of VR systems to aid individuals who suffer from traumatic brain injuries by providing mental rotation tasks within a VR environment. The authors argued that the use of mental imagery is fundamental to cognition and VR can be used for neuro-rehabilitation for those with serious brain damage.”

11) Obesity-

Obesity is a growing problem amongst children around the world and can lead to health problems later in life.

“Manzoni et al. (2008) have suggested that in some cases, overeating is commonly associated with stress, and relaxation methods using a virtual reality system could reduce this level of stress and as a consequence the overeating.”

The VR system provided a relaxing environment with relaxing narrative, and this was compared with imagining relaxing images and those that did not have any relaxation methods. The study found that the VR system improved the obese participant’s perceived self-efficacy (belief of their capabilities).

EATING DISORDERS

The first use of Virtual reality in treating eating disorders was accomplished by an Italian research group.

VR programs are present that focus on the improvement of body image, body satisfaction and physical acceptance in obese patients and reduction of perfectionisms, body dissatisfaction and negative attitudes towards the body in anorectic patients. There are studies that have demonstrated the effectiveness of VR in the treatment of eating disorders.

The future Aspects of augmented and virtual reality technology-

1) Greater human connectivity-

Thinking of a virtual world where people can make their own unique avatar that inculcates their personality. They can express themselves and connect with other avatars at both emotional and mental levels. Share their distress, hardships without fear of disclosing their identity and seek help.

2) Brain to Brain network

Pairing the virtual / augmented environment with a brain computer interface can enable one to transmit information from one brain to another. As per the research conducted by a research team in Washington, they used Brain computer interface with Trans-magnetic stimulation.

On stimulating one of the brain, the same movement was recorded from the other researcher connected to the system.

This is mere scratching the surface, transmission of information from one brain to another means greater connectivity. with Artificial intelligence which opens a Pandora for research into human brain functioning and its neuroanatomical correlations, deeper insight of mental illnesses and improvement in rehabilitation techniques.

Furthermore development of implants that can help in cognitive impairment (Dementia, Alzheimer’s disease, Binswanger’s disease, progressive supranuclear palsy and many more similar neurological disorders).

3) Correlation of thought process with brain activation-

This is the very inception of a technology that grants us the age old wish to processes with the functioning of the brain. The idea is to understand it at a deeper level and analyze it for gaining knowledge about the mental illnesses and its effects on the brain.

4) Memory tracing-

The chances of tracing the exact memories, the thought process during their formation, their inference and bearing on the patient is a near possibility.

The extent to which this would revolutionize psychiatric evaluation and treatment is immense.

This is somewhat reverse engineering the present technology and to let the users create the whole scenario with details from their memories.

This would enable us to understand the distortions in the memory, the thought process at that exact moment and the basic inception of delusions in cases of schizophrenia and delusional disorders.

5) Education and research –

A world where education would be available to everyone, an environment that would enable even children with learning disabilities, attention deficit disorder, autism spectrum disorder to learn under one roof, enables them to explore their ideas and imaginations.

They can develop skills and this also means greater participation in research activities.

From the very basic formation of a hypothesis developing methods of research to possible outcomes of the test can be done being assisted with artificial intelligence, that would save both time and resources.

CONCLUSION-

The technological advancements we have gained in the last few decades is substantial. The upgradations in the present enables us to get a deeper insight into various psychiatric illnesses and effectively treat them.

Artificial intelligence cannot match the level of functioning of human brain but can aid in our own understanding of its functioning.

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