

VIRTUAL REALITY- A REVIEW**Rajalakshmi G.*, Dr. Sundhararajan R. and Mahesh Kumar B.**

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Article Received on
06 March 2018,Revised on 26 March 2018,
Accepted on 17 April 2018,

DOI: 10.20959/wjpr20189-12003

Corresponding Author*Rajalakshmi G.**Mohamed Sathak A.J
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600119, India.**ABSTRACT**

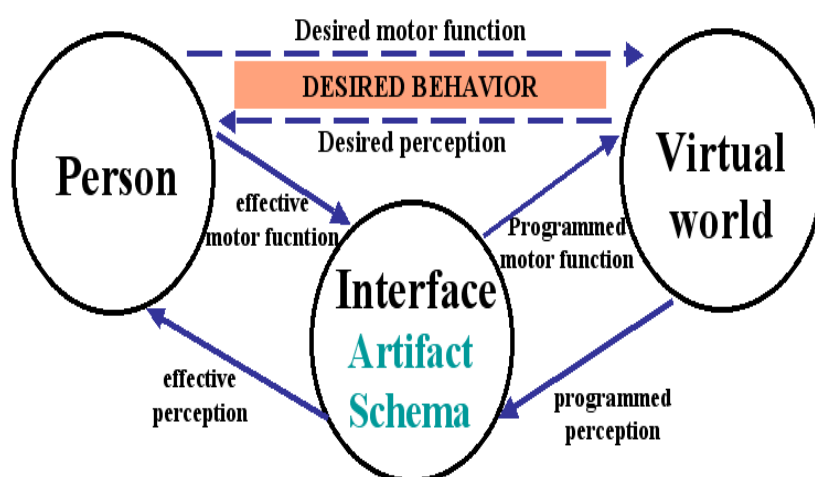
Sight and sound play a crucial role in our life. They serve as a tool to lead a better living. Without these, enjoying the beauty of life is impossible. It is a boon from Almighty to everyone. The values of these are very well known by the people who lack it. Researchers and scientists are extending their hands and minds in both natural and artificial ways to utilize them to the maximum. The hinderances for the well-being nowadays, are the disabilities and diseases. The research has marked its footprint in almost all the areas. One among them is by utilizing the wonderful gift of God, i.e. sight and sound through a phenomenon called virtual reality. It is by producing sight and sound,

an artificial environment is created by a computer, which decides the patient action to the environment. A high-end user interface that involves real-time simulation and interaction through multiple sensorial channels (vision, sound, touch, smell, taste). A computer-generated, immersive, multi-sensory information program which tracks a user in real time is known as "Virtual Reality (VR)". This review article gives a brief insight on the origin, scope and various medicinal applications of virtual reality. Virtual Reality is an emerging field of applied science. VR is first a technology. Virtual reality is an immersive, interactive system based on the computable information.

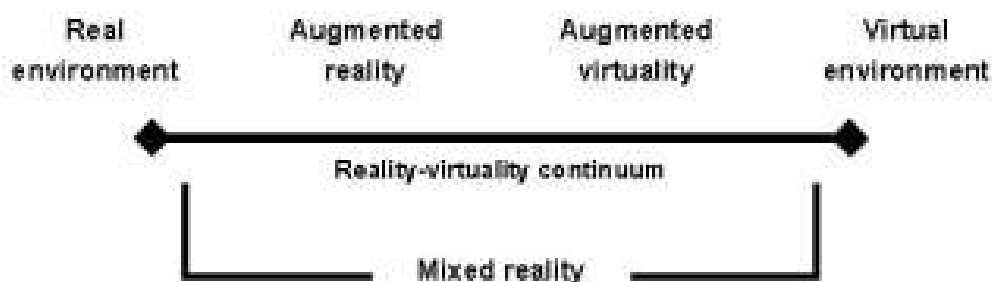
KEYWORDS: Interactive system, sensorial channels, simulation.**INTRODUCTION**

Human being life has undergone different changes of development right from the primitive stage, where we dwelled along with animals in the forest, and then the slow development of culture made us to move to different civilizations. Development of science brought an incredible change. Science has occupied its own footprint from agriculture to space research. We are slowly accustomed to a three-dimensional world without our knowledge. Objects

surrounding us became an eminent part in our day to day lifestyle. We can move in the world, grab objects, and look around. Virtual Reality (VR) enables a different visual paradigm: viewers are inside the world looking around them as the vision is the dominant sense; human cognition is oriented around the vision. This new paradigm is the key to achieve total immersion in virtual environments. Creating the illusion to the participants is the goal in the virtual world. We should note that providing a sense of immersion does not necessarily mean being isolated from the real world. In fact, for some applications, real-world isolation can be highly intrusive and disorienting because, even though, viewers cannot see the real world, they are still aware of the physical surroundings, fearing events such as tripping over a cable or running into a wall. This isolation and awareness of the real world can ruin the immersive experience.^[1]



Both virtual reality and augmented virtuality has no difference in which real objects are added to virtual ones, replacing the surrounding environment by a virtual one. Local virtuality is by AR(Augmented Reality).^[2]



Early tracking techniques are restricted to indoor use as they require special equipment to be placed on the user. The first HMD by Sutherland [1963] was tracked mechanically through

ceiling-mounted hardware also nicknamed the “Sword of Damocles.” Devices that send and receive ultrasonic chirps and determine the position, i.e. ultrasonic positioning, were already experimented with by Sutherland and are still used today. Tom Furness [1963] developed display systems for pilots who are regarded as Grandfather of Virtual Reality. Brooks developed force feedback GROPE system in [1967]. Virtual environments have existed before that, as telerobotic and teleoperations simulations. Magnetic trackers introduced by Raab et al which measures distances between electromagnetic fields are used still in Virtual reality.

A limited three-dimensional virtual workspace was used interactively at MIT, in the beginning of the 1980’s. This manipulates 3D graphical objects spatially corresponding to hand position. The VIVED project (Virtual Visual Environment Display) and the VIEW project (Virtual Interactive Environment Workstation) was started by NASA in 1984. The objective of the research at NASA Ames was to develop a multipurpose, multimodal operator interface to facilitate natural interaction with complex operational tasks and to augment operator awareness of large-scale autonomous integrated systems. The application areas on which NASA Ames focused were telepresence control, supervision, and management of large-scale information systems and human factors research. Virtual reality was not introduced to the public until June 6, 1989, at two trade shows by VPL Research and Autodesk, two companies that were involved with NASA projects. Both companies presented devices and head-mounted displays for interacting with virtual worlds.

Jaron Lanier, the founder of VPL Research, originated the term “Virtual Reality” by defining it as “a computer-generated, interactive, three-dimensional environment in which a person is immersed.” Since then, virtual reality has captured the public imagination and in order to explore the possibilities of virtual reality, lots of work has been done in new areas of application such as medicine, chemistry, scientific visualization. VR has begun to shift away from the purely theoretical and towards the practical. Nonetheless, current systems are quite primitive, particularly with respect to their user interfaces. A better understanding of many user issues is needed though advances in interface hardware and software are required. Due to over expectations by public and media exaggeration, the development of virtual reality is slowed to some extent but still, its influence in various fields is immense.^[3]

STAGES OF DEVELOPMENT

Virtual reality applications involve merging of input and output channels for the virtual world simulator. It provides not only such an illusion of the existence of synthetic objects but also the interaction metaphors for interacting with them. The challenges lay in exploiting the perceptual and spatial skills of users. They are:

- Multiple/integrated input and output modalities: User interfaces should be able to use more than just the visual channel for communications.
- Functional fidelity: Taken together, the various sensory cues provided by an interface must be appropriate to the task being performed.
- Responsiveness: 3D user interfaces must be very quick to respond to user actions so that natural and explorative behavior can occur. This introduces important timing constraints on the applications.
- Affordances: Affordances allow the creation of objects that have meaningful properties and provide clues about how to interact with 3D objects and environments.
- Appeal to mental representation: User interfaces must be organized in a way that they are recognizable by users. Real-world metaphors and physical simulation techniques are especially helpful with this respect.

These characteristics pose important challenges both to the hardware side of virtual reality systems, in terms of devices that must be used to communicate to and with users, and to the software side, in terms of techniques that must be developed to efficiently support multimodal interaction in a time-critical setting.

Enabling Technology: Hardware^[3]

Different type of hardware and tracking technologies are being utilized in virtual reality. Head position /orientation tracking, eye, audio, visual, olfactory tracking, Full body motion etc.

Head tracking is the most valuable input for promoting the sense of immersion in a VR system. Eye trackers work by measuring the direction at which the users' eyes are pointed out of the head. There are two kinds of full-body motion to account for: passive motion, and active self-motion. Stereoscopic vision is used. The user should receive visual stimuli of adequate resolution, in full color, with adequate brightness, and high-quality motion representations. Depending upon the chosen systems (2-D and 3-D together) the sounds are delivered to the user by speakers or earphones. Devices used to collect and interpret odors are

usually referred to as artificial or electronic noses and use three basic technologies: gas chromatography, mass spectrometry, and chemical array sensors.

Enabling Technology: Software

There are many difficulties associated with this software because of the user interface tools, such as toolkits, frameworks, user interface management systems, or graphical user interface builders. Current systems employ Toolkits (programming libraries that provide a set of functions for supporting the creation of a virtual reality application), Authoring systems (Complete programs with graphical interfaces for creating worlds without resorting to detailed programming). These usually include some sort of scripting language in which to describe complex actions.

Most of the time, different systems must be combined, and ad-hoc solutions implemented to integrate them into a working application. A typical VR toolkit provides supports for high-speed rendering, low-level interfacing with a variety of input, a few built-in interaction metaphors, graphical database support with converters to/from a variety of formats, and an event model for interactive application programming.

Obstacles when designing VR applications^[4]

There are many issues to be considered while designing Virtual reality applications. As of today, Immersion, Audio feedback, Physical Feedback, Usability: General vs. Specific are some of the major obstacles. Many efforts are being taken by researchers to address these issues. Virtual reality system designers should be the concern with their design being flexible enough to be used in a wide variety of applications.

The frame rate i.e. the times for computation, stereo rendering and reading of the input devices are very crucial for the effective virtual reality systems. Usually, the frame rate should be less than 15 frames per second. In the successive refinement, technique images are frozen, and detail is added in a progressive manner.

APPLICATIONS

Virtual Reality technology has embarked its applications in almost all the domains. Its available since the late 80's. But a drastic development occurred after 20th century, which is called a 'rebirth to virtual reality'

1. Architecture

Architecture field finds virtual reality applications in its all Walk throughs. The area in which virtual reality has tremendous potential is in architectural design already being created are architectural "walk-throughs". It allows the designers and clients to examine homes and office buildings, inside and out, before they are built with virtual reality, designers can interactively test a building before construction begins.

2. Cultural Heritage

Cultural heritage is considered as a major asset in our country. Digital preservation of cultural assets and digital restoration of the original appearance users virtually enter the virtual space.

3. Military

Virtual reality has found its own applications in the field of the military by simulation of reality, the extension of human senses through telepresence, an information enhancer through augmented reality. Military applications of VR are as flight trainers, telepresence, smart weapons etc.

4. Entertainment

Virtual worlds and fantasy spaces are created to entertain people.

5. Education

Virtual Reality made an unbeatable achievement by finding applications in the field of education by creating virtual classrooms, virtual library, and the virtual lab. It is a boon for the young aspirants.

6. Virtual Prototyping

Virtual Prototyping technique has been studied and implemented in recent years in engineering design.

APPLICATIONS IN MEDICAL FIELD

The development of virtual reality has enlightened the medical field. Virtual reality helped in increasing adoption of its technologies and techniques to increase productivity, improve team communication, reduce costs, in teaching anatomy, training in diagnostic procedures (such as virtual colonoscopy, or virtual bronchoscopy), teaching open and minimally-invasive surgery procedures, and in rehabilitation.

“Psychotherapy that involves repeated real, visualized, or simulated exposure to or confrontation with a feared situation or object or a traumatic event or memory to achieve habituation and that is used especially in the treatment of posttraumatic stress disorder, anxiety disorder or phobias”.

Thus, Virtual Reality Therapy can be used as a beneficial tool to overcome many complications in the medical field. Some of the applications are mentioned below.

Post-Traumatic Stress Disorder

PTSD is a debilitating disorder, which affects the patient's social life and job performance. It is challenging to treat compared to specific phobias. Virtual Reality Exposure Therapy (VRET) for the Treatment of Posttraumatic Stress Disorder is also found to be effective. The therapy begins by gradually exposing the patient to stimuli that activate these emotions and teaches the patient how to manage the unwanted responses, reduction in fear. Virtual Reality has produced programs designed to treat an array of anxiety disorders, including fear of heights, fear of flying and fear of public speaking.^[5]

An emotional engagement should be made for the reduction in fear to occur; fear-relevant information associated with the patient's memory of the traumatic event must be activated and accessed. After the fear structure is aroused through emotional engagement, new or corrective information is incorporated into the patient's memory structure. These authors suggest that repeated engagement with the feared stimulus in a safe environment is necessary for the fear structures to change, so that long-term habituation to take place. Many results suggested that VR is an effective treatment tool for enhancing exposure therapy for both civilians and disaster workers with PTSD and may be especially useful for those patients who cannot engage in imaginal exposure therapy.^[6,7]

Neuromuscular Treatment

Advantages^[8]

Engaging/motivating, Economy of scale, on line data gathering, Fine time resolution, Impairment/Function, Malingering detection is useful in Neuromuscular treatment.

In post-stroke treatment, virtual reality is helpful in chronic phase by changing daily activities.

Disadvantages

1. Abnormal limb configuration, Applicable to upper functional population, Technical expertise, Clinical acceptance, Cognitive load.
2. Lack of natural interfaces, Lack of child-size equipment, Large equipment cost (for schools), Technical expertise.
3. Expensive equipment, Clinic and clinical acceptance, Technical expertise.^[9]

Combating Phobias

This is achieved by exposing patients to graphics simulations of their greatest fears. This changes the patient on their thought like how they behave, think, and interpret. Therapy is aimed at facilitating emotional processing. Exposure therapy, in which the patient is intentionally confronted with the feared stimuli in a therapeutic manner leading to the processes of habituation and extinction in which the feared stimuli cease to elicit anxiety aid modification of the fear structure, making its meaning less threatening. Any method capable of activating the fear structure and modifying it would be predicted to improve symptoms of anxiety. This can be achieved by some virtual reality programs such as Spider World and Snow World. Thus, Virtual-reality analgesia also has the potential to reduce patient discomfort during other medical procedures.^[7,10]

Social anxiety Treatment

Social anxiety involves the fear of social situations which involves interaction with society. This may include any situations in which the patient struggle to overcome. Thus, the treatment of social anxiety techniques mainly includes exposing the patient to real, imaginary or interoceptive situations. Such method of treatment may be known as Exposure therapy.

Virtual reality in exposure therapy have been used to overcome the disadvantage of current therapy in which the patient can pull out from the situation if they feel uncomfortable which may not be done in normal exposure therapy. In Virtual Reality Exposure Therapy, the patient showed signs of anxiety on exposure indicated by increase in body temperature and Electrodermal Activity which decreased over on repeated exposures.

Psychotherapy

Virtual reality becomes an effective choice for people with psychological disorders to overcome the fear. The invitro exposure therapy makes the patients to face anxious moments and consequences. Virtual environment created by virtual simulators are ideal choice.

Speech disorder

Virtual reality and Exposure Therapy is the most effective and safe method to treat patients who have stutter and social anxiety. By providing an exposure therapy, the participant will be wearing a head mounted display and he/she capable of viewing himself in the environment. A lecture theatre is also presented. This method helps not only for the person with stutter but also from many speech disorders like post stroke.^[11,12]

Hemiplegia Therapy

This is a condition of paralysis on one side of the body caused by brain damage, and it is a part of cerebral palsy. Children with hemiplegia have movements' difficulties especially in their upper limbs, these difficulties occur due to the loss of the communication between the brain and the affected side of the body. The method uses haptic and tactile sensations. The benefits are due to visual and audio sensations come from VR, offers the possibility of enhancing joints motion of upper limbs. This control for therapy concentrates on constraining joints to apply normal recruitment during movements, by working on each joint separately, and assign scenarios.

Virtual Reality can be used in the therapy by the integration of possible sensory stimulus such as visual, audio, and tactile. Virtual Reality offers the possibility of enhancing joints motion of upper limbs, which can improve upper limb's functions in children with hemiplegia.^[13]

Breath Regulation

Patient's lung capacity is significantly reduced in patients having lung cancer and breathing disorders. This requires an emergency treatment due to severe shortness of breath. For these patients with breathing disorders Virtual Reality (VR) through simulation has the potential of assisting in breath regulation. The conceptual framework of a smart phone- based VRT is presented that monitors breathing movements and encourage the patients to regulate their breath and increase the oxygen percentage in their blood via an interactive platform.

The framework includes 3-D computer animations of the human body, surfing through various tissue layers and cells, and eventually landing on the lung organ and cells. By performing certain breathing movements/interactions in virtual world, the cancer patient is urged to diminish their own cancerous lung cells. The therapy is promising approach for the patients to empower their immune system and eventually fight off the disease by encouraging them to breath virtually visiting their lung organs or cells.^[14]

Pain therapy^[15-17]

Pain may be acute or chronic. A pain can be due to trauma, operation or due to some disorders which may cause activation of nociceptors through tissue injury. Sympathoneural and neuroendocrine activation, combined with uncontrolled pain, can ultimately lead to various detrimental responses. Chronic pain conditions are caused by neuronal plasticity in the central nervous system (CNS), even though the underlying pathogenesis has not been fully understood. VR may be used in alleviating pain. Pain has a strong psychological component. Pain signals are being sent to brain cortex based on the psychological thought. To enhance pain management, physical and psychosocial treatments must occur simultaneously. Psychology and state of mind plays major role in managing pain. The intensity of the pain and the tolerance level varies from one patient to other. Since brain cannot handle too many signals, introducing a distraction to the patient reduce the pain. VR technology has been firstly proposed as a tool for pain modulation by Hoffman et al in 1998. By introducing the patients to the virtual world, the attention towards the pain is diverted. Even most powerful analgesics cannot control the pain. Though opioids are the choice of treatment, hypnosis and virtual therapy (immersive VR technology) are potential alternatives in managing pain, thereby taking medicines like opioids can be reduced. This makes the patient to experience a dramatic drop in the feeling of pain.

Surgery and training

Acquiring necessary technical skills have become increasingly limited due to the higher costs, ethical concerns, and decreasing resident work hours. VR simulations help the trainees to interact with all anatomical structures. It helps in understanding all logical steps. Basic skills and knowledge can be gained without senior supervision and patient participation. VR simulators are employed in surgical operations. The Combination of physical body models and actual surgical tools with VR simulators promotes the interaction between realistic tools, virtual bodily fluids and virtual physical materials accuracy and efficacy of VR training still need to be improved.^[18,19]

Challenges

Virtual Reality has crossed many challenges. It remains both in the enabling technologies and in the systems engineering and human factors disciplines. The most crucial tasks range in both technological and systemic level like getting latency down to acceptable levels, rendering massive models, finding the best fit application, modeling the existing and non-

existing the worlds and measuring the illusions. The software is the core part affecting the treatment outcomes. Medical therapies vary according to patient's specific symptoms. The simultaneous use of panoramic photos, videos and models controlled by the therapist may be helpful, since the number and category of models as well as the interaction methods with virtual objects can be adapted according to therapeutic progress. Since each patient's symptom is different, each VR platform has diverse working conditions and therapy procedures largely depend on individual therapist's decisions. An appropriate evaluation system for VR therapy alone, or for VR therapy combined with other therapeutic methods are urgently needed.

Addressing these challenges is the need of hour for the success of adoption and continuance of virtual reality.^[20]

CONCLUSION

The development of the virtual reality has opened a new door to the researchers. Considerable achievements have been obtained in the last few years, and we can finally say that virtual reality is here. VR is widely used nowadays to treat many disorders as discussed. Virtual prototyping, simulation and training, telepresence and teleoperation, and augmented reality. The concept begin begin from film, gaming, entertainment but now in this recent era it has marked its footprint in surgery, patient care, medical training, management of incurable disorders by reducing medicines, relaxing patients with chronic disorders, feeling them at home. VR technology can be used as self-treatment to some extent. VR devices can be used in private practices and even private homes.

Virtual reality has thus finally begun to shift away from the purely theoretical and towards the practical. The marketing situation of VR is very fluid by this improved understanding not only is required to know how sensory cues can be delivered or simulated but when and how they should be used.

As a conclusion, though many misconceptions prevail, virtual reality is still used in medical field for better patient care. Though virtual reality is not real, may have negative reactions, the lacuna can be fulfilled by changing standard solutions, setting it up to more realistic applications. VR therapy combined with other therapeutic methods is urgently needed. Further research is encouraged in this field and more is expected to develop a better patient

care environment. The technology continues to Advance; we can expect even more remarkable applications in the years to come.

Conflict of Interest

No conflict of Interest is associated with this work.

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