VIRTUAL REALITY IN HEALTH USAGE

Abstract

Virtual reality (VR) will be used as a research tool in healthcare and for patients. This paper demonstrates how healthcare and medical professionals can use virtual reality technology for surgery and personal development, and also how physically and mentally disabled people can benefit from the innovative virtual reality techniques. The healthcare industry has become a big adopter of VR technology. Early examples would include the monitoring of visualizing complex medical data during surgery and for surgery planning via 3D models and virtual environments such as the Virtual Reality Operating Room environments. Practicality and usability of virtual reality to the PTSD therapy and rehabilitation of people with various disabilities shows that VR can gain experience from patients. In addition, the paper describes how VR is used to distract the patient from the pain such as painful burn treatments for children. Many experimental studies are developed by VR about many subjects such as for cancer-stricken kids, veterans, non-migraine healthy people, non-disabled people, and blinds to empower empathy and motivation. Finally, the use of VR in healthcare has shown that VR is a useful tool for diagnosis, treatment, therapy, education and training.

Keywords: virtual reality, vr, telesurgery, ptsd, disabled, pain treatment, experiential treatment

Introduction

Virtual Reality is a technology by simulating interactive 360-degree imaginary digital environments, replaces the real world for a user with VR headsets. As explained by Curcio et al. (2016) VR is the simulation of an environment accomplished by the creation of immersive experiences. In addition to this, Brey (1999) stated, “Virtual reality systems are defined as being employed head-mounted displays (HMDs), data gloves and data suits to simulate an immersive, interactive computer-generated environment” (p. 5).

Gaming is a most known virtual reality application domain but there are a whole host of uses for virtual reality, some of which will be more familiar than others, such as military, education, simulation, entertainment, marketing, fashion, engineering, sport, media, scientific visualization, construction, and healthcare. Virtual reality produces a set of data which is then used to develop new models, training methods, communication and interaction (VRS, 2017).

There is a significant potential for VR based healthcare applications are being increasingly developed worldwide. Usage of information and communication technologies in healthcare such as telegraphy, telephony, radio, and television have been called and used for distance medicine since the mid-19th century (Wootton, 1999). After internet, e-mail, and video teleconferencing are becoming familiar methods for diagnosis, therapy, education and training, the possible impact of virtual reality (VR) on health care became even higher than the one offered by the new communication technologies (Riva G. , 2003; Riva G. , 2000), hence the healthcare industry has become a big adopter of VR technology.

Ann, Le, & Bailenson (2013) shows that VR experience is perceived as a souvenir by human brain and gains a more effective learning ability which gives more effective behavior change ability than traditional media sources.

Healthcare Usage of VR

According to the former studies, the first healthcare applications of VR started in the early ‘90s to visualize complex medical data, especially during surgery and for surgery planning (Chinnock, 1994). According to Riva (2003), surgery-related VR applications separated into three classes: surgery training, surgery planning, and endoscopy radiosurgery. Virtual reality supplies many new applications which have recently come to assist doctors, allow looking inside the patient. Westwood et al (1999) reported that there are many different educational and visualization VR applications. The first instance of them is Anatomic VisualiZeR which is used in medical school anatomy and high school biology classes and provides a virtual analysis room as a virtual environment in which students can directly interact with computer-generated models and concurrently access supporting curricular materials is a VR based multimedia application (Hoffman & Murray, 1999).

Surgery with VR

Virtual reality would help surgeons to gain all surgical skills through the medium of simulation of all operations and to better investigate each organ of the human body. This is useful not only for students but also for experienced professionals who are performing new or high-risk procedures to avoid the critical outcomes.

Manchester Visualization Center is a VR-based telemedicine system projects development center works for surgical simulations using VRML and JAVA technologies to render the 3D models. The authors can create simulations of ventricular catheterization and how to cannulate it in an emergency access through the
network for trainees in neurosurgery (John & Phillips, 2000). In the virtual environment a student or a surgeon comes into a virtual room, starts operating on a virtual patient and can move the virtual cannula to the entry point on the 3D patient in order to examine the simulation of surgery same as Deep Matrix software (Reitmayr, Carroll, & Reitemeyer, 1999) which is another VR based surgery simulation project. In all of these simulations, trainees can be guided through telemonitoring.

The techniques like the Telesurgery, allows surgeons to operate on people who are physically separated from themselves (Gorman, et al., 1999). Medical students can use interactive 3D holographic images and collaboratively perform a surgical operation without risking lives or costing a cadaver. (Lee, 2013). The Virtual Reality Operating Room (VR OR) simulator is a fully functional immersive surgical simulator that can generate an interactive VR environment replicates the surgical environment itself (Olasky, et al., 2015).

In surgical training, surgeons always had to gain practical experience through “supervised trial and error” on a real patient which make surgical training completely related on the actual case-work, compromises patients’ safety (Bishoy, 2018). Surgeries can now be watched from 360 degrees and in real time from all around the world with VR apps (Thinkmobiles, 2018).

PTSD with VR

VR is described as an advanced form of human-computer interface that allows the user to interact with and become immersed in a computer-generated environment and to obtain the feeling of “being there” by use of specialized devices as head-mounted displays, tracking systems, earphones, gloves, and sometimes haptic-feedback devices.

Clinical psychologists and rehabilitation specialists use VR to provide a new human-computer interaction paradigm in which users are active participants within a computer-generated 3D virtual world (Giuseppe, et al., 2009; Rizzo, Wiederhold, Riva, & Van Der, 1998). In the virtual environments, the patient has the possibility of learning to manage to recall the specific details of the problematic situation related to his/her disturbance. High level of control of the interaction without the constraints and the gained experience provided to the patient are the important characteristics of virtual environments for this domain (Schultheis & Rizzo, 2001), and with disabled patients’ feedbacks can be translated into alternate and/or multiple senses (Luís, Raya, Baños, & Beltrame, 2015).

VR for Disabled People

Kim Lawther (2016) who is assistive technologist at Scope identifies that VR allows disabled people to not only practice things that can help them with life skills, but it can also give them an opportunity to experience something that they wouldn't normally be able to due to their disability. Virtual reality system developed at Department of Occupational Therapy from the University of Haifa, Israel contained many scenarios which were all designed to teach autistic children how to cross a road safely (21c Staff, 2008). The children dramatically improve their ability and confidence to cross the road safely and also the engage in basic everyday activities after this experience.

Another example is that with an empowering first-person game using Oculus Rift, a student in a wheelchair can take VR orientation class for Aalto University in Finland (Lawther, 2016). According to New York Times article (nytimes.com, 1994) the cost of these technologies was about 30.000 USD while in 90’s, however, it costs a couple of thousands USD dollars nowadays.

The University of Georgia helps disabled students by VR-mentoring platform (georgiabreakthru.org, 2015) which is designed with orientation scenarios in a virtual environment looks like Simcity application. Students are able to learn what and how they can do and use anything on the campus with this platform.

As a founder of the AbleGamers Foundation, Mark Bartlet (2016) announced that the hype is a good thing. Bartlet said that “One of the core philosophies of the AbleGamers charity is that games allow disabled people to do things that they wouldn’t in real life. And that includes able-bodied people … in virtual reality you can climb Everest, be an NFL player … most of us can’t do that.”

VR headset maker Fove served interesting project is pitched as a “universal piano” which children can play using eye movements while wearing the headset called Eye Play the Piano project in Japanese schools for children with disabilities (Dredge, 2015).

Danny Kurtzman, who has muscular dystrophy, says being able to virtually surf in the headset experience surfing like standing up (Hoshav, 2015).

Vincelli (1999) find outs that an important role of VR in clinical psychology study areas. In the psychological literature, empowerment is considered a multi-faceted construct its meaning refers to the alignment between one’s work role and one’s own beliefs, values, and standards reflecting the different dimensions of being psychologically enabled. According to Riva (2003), perceived control, perceived competence, and goal internalization are 3 main dimensions of empowering. The virtual experience is an “empowering environment” that therapy provides for patients. Botella (1999) noted that the patients are not really fear in VR. With such guarantees and under the control, they can freely explore, experiment, feel, live, and experience feelings and/or thoughts such as fear. Anxiety disorders are treated by VR technology at Louisville University, VR technology is used for fear of flight, fear of height, fear of social-speech-socialization, post-traumatic stress disorders, and other types of fears. Patients are not exposed to the dangers, realistic VR simulations are used during sessions to create the environment the patient is exposed to and arrive in a controlled way (Physicians, 2013).

Many veterans, returning from military service have to cope with Post Traumatic Stress Disorder (PTSD). Rizzo (2006) et al., figured out that at least 1
out of 6 Iraq War veterans are exhibiting symptoms of depression, anxiety, and PTSD. STRIVE project and Virtual Exposure treatment systems that use virtual reality to help veterans to overcome their PTSD symptoms by exposing them to virtual situations that resemble or represent the trauma (Buckwalter, Rizzo, John, Newman, Williams, & Parsons, 2012; Haar, 2005). Early experiments have been led from 1998 on Vietnam veterans and more have followed with Virtual Iraq.

**Pain Treatment with VR**

It has been shown that video games suppress pain perception in pediatric patients and during routinely painful burn treatments (Das, Grimmer, Sparnon, Mcrae, & Thomas, 2005; Gold, Kim, Kant, Joseph, & Rizzo, 2006). VR is used to distract the patient from the pain. According to Dr. Sam Sharar (2015) who is an anesthesiologist at the University of Washington, “If a patient’s attention can be consumed in an immersive virtual world, they experience less pain”. The Virtual Meditative Walk (Gromala, Tong, Choo, Karamnejad, & Shaw, 2015), incorporates a unique virtual environment with biofeedback and meditation in the form of a walking meditation, is a VR system designed for chronic pain patients. SnowWorld was developed by DeepStream VR is one of the VR games for pain relief and rehabilitation which has been used for burn victims with children undergoing painful medical procedures (Williams, 2015).

**Experiential Treatment with VR**

With a 360-degree camera, interactive live-streaming and a specially built screening room, Expedia virtually takes trips for cancer-stricken kids at St. Jude's Children's Research Hospital to the jungle to play with monkeys, to the ocean to swim with fish, or to the desert to dig for fossils without any risk of infectious disease (Beltrone, 2016). Honor Everywhere is a Virtual Reality project for veterans who are not able to physically travel to see their memorials. With recorded 360-degree and 3D videos, veterans are able to experience different sights from their bedside, wheelchair or assisted living center (honoreverywhere.com, 2015).

Experience is the main study term for Virtual Reality technology and human behaviors. To understand the disabled or patient people there are many experiential studies is developed by VR. To easily and effectively experience the world (life) from another person’s point of view, virtual environment technology is enabled to use for individuals (Ahn, Le, & Bailenson, 2013). At the Virtual Human Interaction Lab, founded by Stanford University, VR technology simulates how a disabled person's life can be (for a healthy person to experience color blindness) for healthy people (Ann, Le, & Bailenson, 2013).

Another study is to examine with VR environments that how people can adapt to a situation where more than normal limbs are created eg. 3 arms or 4 legs (Hoshav, 2015). Thus, for those who have experienced limb loss, very serious progress can be made.

Viscira digital agency developed VR project created with 3D sound and video offers the opportunity to experience how people live in a world surrounded by voices, as well as a documentary film about a visually impaired man holding a voice diary. The film also won the British Independent Film award for best documentary. Thus, VR technology has begun to create an empathy bridge by experiencing the disabled world while experiencing the disabled world without experiencing the obstacles (notesonblindness.co.uk/, 2016).

The practice of empathy with VR increases to remove prejudices for different cultures. 360 degree Youtube video about Syrian refugees is one of the VR empathy projects which supplies important opportunities to experience how life in Syria is, and what expatriation is. It also shows to other peoples from the world with VR (YouVisit, 2017).

**Experiential Personal Development with VR**

While being a patient is defined as a temporary obstacle, the research conducted by Torbay Hospital is an important opportunity for institutional and individual development. The relationship of doctors and their patients in the emergency department at Torbay Hospital were recorded 360 degree video footage. That these VR videos were shown to doctors through the patient's eyes. Doctors have seen and experienced their attitudes and body language that they have never noticed before, and an improvement work has been initiated in this regard (itv.com, 2015).

**Conclusion**

The use of VR in current applications has shown a lot of promise as a potential alternative and can be well-considered useful tool for diagnosis, treatment, therapy, education and training. One of the biggest advantages of virtual reality is safety environment. Patients are generally accepting of the technology and the evidence that people react in virtual environments as if they were in real world.

Possible future potential applications of VR healthcare projects will be developed by multi-disciplinary conception of the world teams of engineers, designers and therapists are only limited by the imaginations of talented individuals working to treat specific clinical problems.

Still some questions are still waiting for answers; When VR health services will be used without the aid of a clinician? How will VR health projects interact with other services such as tele-health?


YouVisit. (2017, 01 09). Four Walls Teaser 360. Retrieved 01 07, 2018, from youtube.com: https://www.youtube.com/watch?v=X1Ky0mpaXx4