Virtual Reality as Analgesia:  
An Alternative Approach for Managing Chronic Pain

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ABSTRACT

This paper introduces a multidisciplinary and interactive approach to self-management of chronic pain using Virtual Reality (VR). This approach is meant to reduce the reliance on heavy use of medication and provide a non-pharmacological method for pain management. In addition, the paper discusses additional technologies that deal with issues surrounding immersion, presence, and interface design that directly impact the quality of treatment patients can obtain through VR therapy. A set of guidelines are also included that signify the importance of using biofeedback and interactive sound design to help improve rehabilitation and meditation practices for pain reduction.

Keywords: Biofeedback, Chronic Pain, Immersion, Interactivity, Pain Management, Presence, Sound Design, Virtual Reality (VR)

1. INTRODUCTION

Virtual Reality is no longer a new concept. The original theory of the “The Ultimate Display” (Sutherland, 1965) proposed by Ivan Sutherland in the late 1960’s introduced key ideas about a virtual world that is immersive and allows for sensory input and output is now a reality and are the basis for many of the VR research projects that are occurring on a global level. Virtual environments, which are the backbone of a VR system allow for users to navigate and interact with a three-dimensional, computer-generated environment in real-time. And such virtual environments have visually become ultra-realistic mainly due to advances in graphics card technologies, increase in computer power, and high-resolution display systems. The use of VR technologies has allowed researchers to think of new human-computer interfaces and has opened the doors to new types of applications that exploit the possibilities of using presence

DOI: 10.4018/ijcicg.2014070105
simulation, which can have therapeutic and rehabilitative benefits. However, such benefits are challenging to achieve because the research into its safety, effectiveness, and easy-of-use are still in its nascent stage. Patients that are exposed to VR systems for assessment and rehabilitation may have certain disabilities, which may result in side effects. The complexities of such side effects are affected by age, ethnicity, experience, gender, physical fitness, and most importantly by the characteristics of the display and the type of visual and auditory information that is controlled and modified in real-time (Lewis and Griffin, 1997). Therefore, VR turnkey systems must be appropriated and modified in order to be effective when used in the context of pain management.

1.1. Chronic Pain

When we touch something that is hot, the brain triggers an immediate reflexive action causing us to withdraw our hand from the object. The type of pain experienced may be considered a good pain, which protects our body from further injury. However, not all pain is good for us. Chronic pain lasts much longer and may not be related to any injury. It is a pain that is not visible and its effects are not only sensory but also emotional. Furthermore, it is impossible to measure chronic pain objectively rather, the only way a medical professional can understand its effect is by listening to the patient’s description (Cervero, 2012). It is estimated that 15-20% of the people in industrialized nations suffer from chronic pain (Macfarlane et al., 2001). Moreover, this disease puts stress on other systems, resulting in fallout issues or sequelae, such as insomnia, anxiety, depression and significant declines in mobility and social interaction (“Study: Chronic pain”, 2010). Because there is no cure, the approach for treating chronic pain tends to be a long-term process involving continual and varied forms of medical treatments, based on a biopsychosocial model (Gatchel et al., 2007). Body (physiology), mind (psychology) and lifestyle (sociology) are attributes that need to be attended to over time in order to help reduce the effects of chronic pain.

In the visual arts, depictions of contorted bodies, tears, twisting, bleeding, injury, and crucifixion have dominated as a visualization theme for over two millennia (Spence, 1986). Surprisingly, there are few art works produced by sufferers themselves and more importantly art that focuses on the actual sensation experienced (Sacks, 1970). Recent studies show that a combination of guided imagery and mindfulness meditation may result in a reduction of pain (Fernando and Turk, 1989). A study conducted by St. Thomas’ Hospital INPUT Pain Clinic in London showed that chronic pain patients who participated in art by collaborating with an artist demonstrated the need to feel understood by non-sufferers and more importantly, allowed them to gain control over the process of experiencing pain (Scarry, 1985).

Our interdisciplinary team, the Transforming Pain Research Group, focuses on inventing and reconfiguring multimedia technologies for the estimated 1 in 5 people in North America who experience chronic pain (Schopflocher and Jovey, 2010). Because the disease is incurable, the primary approach is that of “managing” chronic pain, which includes both short-term and long-term forms of “neuroplasticity” enabled by practices such as mindfulness meditation (Williams, 2007). Therefore, in this paper, we will discuss how VR therapy for chronic pain management can be made possible by combining mindfulness practices, VR simulation, and real-time adaptive controls using biofeedback and visual and auditory stimulation.

2. IMMERSION AND PRESENCE

Effective immersion can be made possible if careful consideration is given to the controls of many of factors involved both internal and external to the virtual reality. From a technological standpoint, immersion may be determined by the extent to which visual displays are extensive, inclusive, surrounding, and vivid (Blesser and
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