VR Therapy: Management of chronic pain using virtual mindfulness training

Abstract
The definition of health according to the World Health Organization is “a state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity.” This definition is aligned with the mission of our interdisciplinary team, the Transforming Pain Research Group, focusing on inventing and reconfiguring multimedia technologies for the estimated 1 in 5 people in North America who experience chronic pain. 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. Previous research has shown that mindfulness meditation helps cultivate emotional well-being, empathy, and compassion. Therefore, in this paper, we will provide an introduction into how Virtual Reality (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.

Author Keywords
Chronic pain, VR Therapy, Empathy, Mindfulness, Meditation, Patient Care

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Introduction
It is estimated that 15-20% of the people in industrialized nations suffer from chronic pain [1]. 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 [2]. 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 [3]. 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 [4]. 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. Recent studies show that a combination of guided imagery and mindfulness meditation may result in a reduction of pain [5]. Psychologists have described mindfulness and empathy as an important component for effective therapy since it involves a moment-to-moment experiential understanding of the patient [6]. Furthermore, one of the key terms in defining empathy is the intention to help patients minimize the impact of pain and suffering they experience [7]. Our research goal is to teach mindfulness meditation to chronic pain patients by taking advantage of technologies such as VR integrated with biofeedback and interactive media. Combining VR with biofeedback systems and meditation can help provide long-term care for chronic pain patients and help regain lost abilities such as walking, flexing, and general motor skills.

Virtual Meditative Walk
Immersion and presence play an important role when combining virtual reality and mindfulness meditation techniques for pain management. One of the projects designed by our research team called the Virtual Meditative Walk (VMW) combines biofeedback with virtual reality (VR) to help accelerate the learning process of meditation. The goal of the system is to allow patients to concentrate on a specific task and divert their attention inward, to their physiological processes. The challenge is to create a virtual environment that provides feedback to the user and allows them to learn and practice mindfulness meditation to help self-manage their pain. The type of interface and functionality that is provided for the user will have to be carefully designed to address these issues and maintain the immersive experience. The following is a list of factors that was considered in order to create an affective immersive virtual environment:

- Comfort level of peripherals and environment while the patient is in a VR environment
- Quality of the sounds and images
- Perceived engagement level experienced by the patient
- Age and familiarity with technology
- Proper feedback response to the patient if using biofeedback
- Level of control provided to the patient during the experience
- Repetitive visual and auditory cues
Our VMW improves the patient’s ability to enter a meditative state by sensing and collecting biofeedback changes in real-time. This data is translated into visual and auditory feedback. For example, Galvanic Skin Response (GSR), which can detect arousal based on skin conductivity, controls the amount of fog visible in the virtual environment; when patients learn how to reduce arousal, which is correlated with stress, the fog dissipates. Figure 1 illustrates the visual change the system produces for the patient. Other sensors measure physiological aspects that are correlated to stress, such as temperature and heart rate variability (HRV).

The VMW empathizes with the patient since it is collecting, understanding and communicating continuously with the patient. Biofeedback in this case is the empathic component in the interactive system, which enables the patient to obtain an immediate response about their physiological states, especially those that seem to be outside of the reach of self-control. As a result, the real-time feedback that the system provides increases the levels of control users can learn to exert over their body.

Using the VMW and learning mindfulness meditation can enable higher cognitive empathy, which can lead to positive well-being amongst patients [7,8]. Additionally, research has shown that groups who practiced meditation over a four-week period had a significant improvement in their empathy ability [9].

**Figure 1:** As the patient enters a meditative state, the fog begins to dissipate and the more of the environmental sounds become audible.

**Conclusion**

In this paper, we briefly discussed how empathy could be embedded in technology, such as VR therapy, which may be used as a non-pharmacological alternative to pain management. By teaching mindfulness meditation to patients in this context, we believe that patient health can be improved over time. The system is designed to understand and communicate with the patient in an empathetic and therapeutic way. Furthermore, this system’s use is not limited to chronic pain patients, health practitioners, nurses, and patients suffering from acute symptoms can benefit from learning mindfulness meditation and to foster empathy.
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References