

Stretch RX

Inspiration:

We are a team of developers, researchers, and entrepreneurs with a common interest in health and wellness. We were moved by the potential of fully immersive therapies through VR for the relief of chronic physical pain. We decided to begin this journey, by targeting people who suffer from chronic lower back pain as it accounts for over 10% of the population. It is also the most diagnosed chronic physical pain and the most common source of long-term opiate prescription use. Our project pairs physical therapy with visual therapy to form unique treatments for patients. Ultimately, we aim to direct the evolution of novel applications of VR/AR technology in medicine and meditation.

Background:

Throughout human history, visualization through the imaginative power of the brain has been utilized for its ability to modify our experiences or perspectives of reality. Several decades ago there began interest in the clinical research community regarding the phenomenology of the brain as creating for humans a mental “stage”—a representation of the world, rather than the world itself. From this premise, systematic research began to explore the existence and functions of internal mental mechanisms that at root must be responsible for creating and maintaining this representative world.

VR offers clinicians an extremely proxy; a visualization tool that by nature of its immersive quality can offer up a modern, safe, non-invasive approach to chronic pain therapy. “Virtual Embodiment” offers subjects a markedly acute ability to adopt a fake, virtualized surrogate body through a series of actions taken within the calibration phase of the VR experience.

Our Experience:

The experience begins with the subject finding themselves on a patch of grass with a clear, open sky and a mirror, with visualizing ones surrogate self in a virtualized mirror. The subject is made aware of their surrogate hands. Techniques that enhance the efficacy or suggestibility of the embodiment experience have been explored, but a significant degree of immersion is accomplished through the subject’s interaction with their surrogate reflection. Once sufficient time has passed to allow for “calibration” of the subject to the avatar, the subject is instructed to perform actions that affect change in the experience of pain. In this case, the actions will trigger modifications to the morphology of the subject’s torso, the elongation of the patient’s spine gradually increasing with every successive movement.

Recent pilot studies (n=19) have reported pain scores reduced by up to 50% in cases of compartmental regional pain syndrome (CRPS type I and II), peripheral neuropathy injury (PNI), and an array of other chronic and acute cases of pain experience.

In this project we explore the therapeutic viability of embodiment experiences in a VR setting with a virtualized avatar body as applied to chronic lower back pain. We allow the subject to stretch their arms out, triggering an elongation of the lower torso. The goal is to test the effectiveness of this technique, extending research into VR based pain therapies with the hope of reducing drug dependencies and

improve quality of life in chronic pain sufferers.

Abstract:

Over 84% of adults in the US have had low back at some point in their life(Carey et al., 2009). Pain that continues for greater than 12 weeks is considered chronic pain. Millions of individuals live with chronic lower back pain and inappropriately prescribed opioids long term, a class of medications that may provide effective analgesia but can lead to opioid use disorder, opioid-related overdoses and serious adverse events, including death. It is vital to identify opioid-free treatments to assist in the management of chronic pain. This intervention was developed to give patients the illusion of body ownership with a virtual avatar. The patient will then undergo therapeutic maneuvers and virtual torso elongation to create an analgesic effect based on previous research.

Value Proposition:

- Pain reduction through guided physical therapeutic movement
- Pain reduction through elongation and expansion visualization
- Pain reduction through immersive virtual environment
- Pain reduction through sound therapy

Who would implement this for use?

- Medical professionals
- Hospitals
- Research Institutions

Who is the user or beneficiary?

We are targeting patients with chronic lower back pain who are in the 30-50 year old range and have mobility. Isolating a target demographic will allow us to collect comparable data.

Goal:

We intend to run measurable controlled trials. We hypothesize to reduce pain by 25% after one use. Studies of a similar kind, that were less targeted, reduced pain by 20-25% after one use.

What's Next?

We aim to add an array of capabilities we envisioned but were not able to include in our MVP (demo) due to the short-term time-frame of the hackathon. Once our experience is complete, a researcher and M.D. on our team, who presented the idea for the project, aims to use it in clinical trials to treat chronic pain patients in outpatient pain clinics. Pain medicine practices are growing as the opiate epidemic continues to rise. This serves as one way to help alleviate one source of the problem. This mechanism for VR therapy could also be used for preventing patients from going on opioids, by adding this to acute pain regimens.

Literature behind the Intervention:

Several papers were instrumental in the development of the intervention. Rosink et al. demonstrated that a projector-based VR experience could be used to help understand body perception in those with chronic lower back pain (Roosink et al., 2015). We then incorporated elongation based on inspiration from a paper from Dr. Mel Slater, which demonstrated a sense of presence with a limb three times its original size (Kilteni, Normand, Sanchez-Vives, & Slater, 2012). Dr. Maria V. Sanchez-Vives recently published a brilliant pilot study using virtual embodiment and modifications of both size and opacification of upper extremity to treat chronic pain (Matamala-Gomez, Gonzalez, Slater, & Sanchez-Vives, 2018). Virtual embodiment is the process of causing the illusion of body ownership to a virtual avatar using visuomotor synchrony and a virtual mirror. Recently a randomized trial published in the journal Neurology demonstrating mild analgesia using virtual embodiment for neuropathic pain from a spinal injury (Pozeg et al., 2017). We also incorporated a back exercise based on several papers demonstrated benefit with VR based physical therapy (Thomas, France, Applegate, Leitkam, & Walkowski, 2016) (Trost et al., 2015).

Team:

Brandon Birkhead MD - Principal Investigator: I am the Co-Chair of the [Virtual Medicine Conference](#) at Cedars-Sinai Medical Center and currently running a large randomized clinical trial for chronic pain. I have designed two VR programs one for dental anxiety and one for breast cancer education. I have also designed several clinical studies: randomized VR pain study using the cold pressor test, randomized breast cancer education, and created guidelines for immersive therapeutic clinical trials along with a cohort of international therapeutic VR experts, called the VR-CORE (Virtual Reality – Clinical Outcomes Research Experts).

Deborah Navarro M.S. - Visionary & Strategist: I am a Product Manager and Hyperloop technology leader. I have a background in biological sciences, technology commercialization and engineering and I am enjoying exploring AR/VR. I aim to augment the relationship between tech, sustainability, and artificial intelligence by building products that are mindful of their position in the world and implement them in a way that allows them to connect people.

Anna Muñoz-Farré - Biomedical Engineer

Michelle Juárez - Systems Engineer, Applied Research: I'm a Systems Engineer in the aerospace industry, focusing on applied research and development, modeling and simulation, system design, and radar analysis. I have a background in research in algorithm development and medical image analysis of fMRI brain data, and am currently collaborating on a side project for the development of a novel, holographic heads-up display for vehicles. I am passionate about physics/astronomy/data analytics/biotech/disruptive technologies, and am eager to explore innovating my career in AR/VR/XR development.

Nader Shokair - Research Scientist

Erika Gangware - Unity Developer and 3D Designer

References

- Carey, T. S., Freburger, J. K., Holmes, G. M., Castel, L., Darter, J., Agans, R., ... Jackman, A. (2009). A long way to go: practice patterns and evidence in chronic low back pain care. *Spine*, 34(7), 718–724. <https://doi.org/10.1097/BRS.0b013e31819792b0>
- Kiltner, K., Normand, J.-M., Sanchez-Vives, M. V., & Slater, M. (2012). Extending Body Space in Immersive Virtual Reality: A Very Long Arm Illusion. *PLoS ONE*, 7(7), e40867. <https://doi.org/10.1371/journal.pone.0040867>
- Matamala-Gomez, M., Gonzalez, A. M. D., Slater, M., & Sanchez-Vives, M. V. (2018). Decreasing pain ratings in chronic arm pain through changing a virtual body: different strategies for different pain types. *The Journal of Pain : Official Journal of the American Pain Society*, 0(0). <https://doi.org/10.1016/j.jpain.2018.12.001>
- Pozeg, P., Palluel, E., Ronchi, R., Solcà, M., Al-Khodairy, A.-W., Jordan, X., ... Blanke, O. (2017). Virtual reality improves embodiment and neuropathic pain caused by spinal cord injury. *Neurology*, 89(18), 1894–1903. <https://doi.org/10.1212/WNL.0000000000004585>
- Roosink, M., McFadyen, B. J., Hébert, L. J., Jackson, P. L., Bouyer, L. J., & Mercier, C. (2015). Assessing the Perception of Trunk Movements in Military Personnel with Chronic Non-Specific Low Back Pain Using a Virtual Mirror. *PLOS ONE*, 10(3), e0120251. <https://doi.org/10.1371/journal.pone.0120251>
- Thomas, J. S., France, C. R., Applegate, M. E., Leitkam, S. T., & Walkowski, S. (2016). Feasibility and Safety of a Virtual Reality Dodgeball Intervention for Chronic Low Back Pain: A Randomized Clinical Trial. *The Journal of Pain*, 17(12), 1302–1317. <https://doi.org/10.1016/j.jpain.2016.08.011>
- Trost, Z., Zielke, M., Guck, A., Nowlin, L., Zakhidov, D., France, C. R., & Keefe, F. (2015). The promise and challenge of virtual gaming technologies for chronic pain: the case of graded exposure for low back pain. *Pain Management*, 5(3), 197–206. <https://doi.org/10.2217/pmt.15.6>