Non-Realtime Social Presence in *LumaPath* as a Virtual Reality Therapy: Better Adherence for Chronic Pain Treatment?

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ABSTRACT

In this poster, we present a pilot study on the efficacy of adherence by adding social components into *LumaPath*, an Immersive Virtual Environment (IVE) built for motivating chronic pain patients to perform range of motion (RoM) exercises, especially aging patients who live with Rheumatoid Arthritis (RA) and Osteoarthritis (OA). Based on results from this pilot study as well as from prior work, we propose that adding a certain level of social presence for patients in an IVE such as *LumaPath* may positively influence their adherence to using assistive tools for treating arthritis and chronic pain.

CCS CONCEPTS

• **Human-centered computing → Virtual reality**; **Collaborative and social computing theory, concepts and paradigms**.

KEYWORDS

Virtual Reality, Chronic Pain, Social Presence, Arthritis, Adherence

1 INTRODUCTION

Moderate exercise has been shown to be an effective way of maintaining joint mobility and reducing chronic pain, and is an important way that can help patients with RA and OA ("patients") to a. maintain good health, improved quality of life (QoL), and b. decelerate the rate of further joint damage. Additionally, the adherence of chronic pain patients to adhere to the advised amount of physical activity is generally low, including that of patients with OA and

RA. We therefore conceived and built an IVE named *LumaPath*[**?**] using Head Mounted Displays (HTC Vive), aiming at motivating aging people with arthritis to more actively exercise so as to alleviate their pain. Exercises built in this IVE were tested in a pilot study and were shown to have positive effects on encouraging physical activity.

Like most IVEs, the approach used in creating *LumaPath* featured a single-person perspective: one patient at a time. In results from an initial study, 50% of patients mentioned that they would appreciate being able to conduct some sort of social interaction in this IVE.[**?**] We thus became interested in discovering whether adding certain levels of social presence in *LumaPath* would lead to better adherence.

We designed this study to measure the willingness of patients to use *LumaPath* based on their self-generated reports, and we hypothesized their increased level of motivation for using a version in which they could gain some sense of social presence.

2 STUDY DESIGN

Our study was designed to test a "non-realtime social" approach by assigning a sequence of inter-related tasks (sequential tasks) of similar complexity inside the virtual world of *LumaPath*.

In this study, we prepared a dominoes task with the same starting and ending points for each round (to align with the original principle of increasing RoM and motivating exercise for RA and OA patients, the dominoes in *LumaPath* were intentionally made large in size, and could be placed as if floating in the air): each patient needed to accomplish two halves of dominoes tasks that each was a part of a different round of game, i.e., every player played the second half of an unfinished game (task **_X**), and then began and played the first half of a new round of game (task **X_**). Meanwhile, it was to each user's will if they wanted to flip the dominoes queue that they finished building in their first rounds. It was worth noting that a controlled group where each patient completes a single complete version of the game (task **XX**) used in this study would be arranged to measure this relative increase of the willingness to exercise.

This design activity required non-realtime teamwork to accomplish a grand mission (a complete dominos queue). As the tasks were made to be causally related, and each patient could pick up from where the previous patient left off, as well as pass unfinished work onwards, these tasks established a sense of social connection

and presence between different subjects that entered *LumaPath*, especially over time.

3 TEST AND RESULT

3.1 Testing the Design

We tested this design with one user (m, 25) from outside the research team. The participant was asked to first conduct an exercise in *LumaPath* as two half sessions as proposed (experiment session), and then to conduct a single round of complete session (controlled session). Particularly, during the experiment session, this participant was told that he was picking up the game left off by someone else in _**X**, and what he did in **X**_ would be continued by another person.

3.2 Feedback and Result

The self-report from the participant in this pilot study showed a higher level of willingness to exercise in *LumaPath* again for the experiment session (co-operate with other players on the designed inter-related tasks) than to conduct a standalone task (controlled session).

It was reported, however, that a more straightforward way of "being with someone" else is demanded. The participant argued that the part of finishing a leftover game (task _**X**) gave him an unpleasant sense of having to clean up other people's work. Moreover, the fact that he knew someone else had been in the game and had passed it on to him but he could not actually interact with that person actually increased the participant's loneliness.

Nevertheless, this pilot study hinted the potential of social presence upon increasing adherence to using Virtual Reality as an assistive tool for routine physical therapy.

4 DISCUSSION AND FUTURE WORK

4.1 Discussion

The result of this pilot study suggests that social presence increases adherence of aging people with arthritis to use *LumaPath* as a means of reducing chronic pain. The reason we have chosen an "non-realtime" approach in this study is because this design would eliminate the requirement of having at least two patients available for participation at the same time, thus making this convention more applicable to flexible clinical and at-home settings. Apparently, feedback from the participant in this study has indicated cues for a more welcoming design for introducing social presence into such Virtual Reality setting for routine therapeutic usage. With the aforementioned constrained settings, it is plausible that adding a virtual character (avatar) that can interact with a person who is inside *LumaPath* would increase their willingness to re-visit the same IVE to conduct therapheutic exercises.

4.2 Future Work

Following the discussion, it is hypothesized that patients with chronic pain might be more willing to use and stick with *LumaPath* if they are able to virtually connect with a human-like character (i.e. mascot) inside this IVE (work surrounding this hypothesis is currently in progress). Additionally, the model used in this study may still

imply application of non-realtime social presence in different settings, such as IVEs for reducing anxiety and social isolation for diverse types of clinical patients. Additionally, further explorations on social presence in alternative patterns (e.g., "multi-person" approach) shall be explored in the future.

5 ACKNOWLEDGMENTS

REFERENCES

[1] Frederico de Machuca. 2018. *Game Design: Motivating Physical Movement in Aging Adults Using VR.* Master's thesis. School of Interactive Arts and Technology. http://summit.sfu.ca/item/17919.