Journal of
Health Science and Development

ISSN: 2581-7310
J Health Sci Dev 2019

Increasing Sense of Ownership in Stroke Patients using Haptic Enhanced VR System for Fine Movement Impairment

Samirah altukhaim

Physiotherapist in Amiri Hospital Kuwait, PhD student in Reading University,UK

The use of Virtual Reality in rehabilitation of stroke patients is considered one of the vital therapeutic approaches. However, numerous studies have indicated that lack of body awareness can significantly reduce the effectiveness of this approach. According to Padilla et al. (2010), the effectiveness of VR in rehabilitation of stroke patients primarily relies on the sense of the user, or feeling of one's self to be there in the virtual environment, rather than on the real place. Two aspects impact this body awareness; the sense of agency (SoA) and sense of ownership (SoO). Sense of agency is a subjective awareness of initiating, executing, and controlling one's own body movements. Sense of ownership is the sense that one's own body is the source of sensations. The next project will be seeking how to increase the sense of ownership in stroke patients using Haptic enhanced VR system.

In a study, 'Music Upper Limb Therapy—Integrated: An Enriched Collaborative Approach for Stroke Rehabilitation' conducted by Preeti Raghavan and his colleagues, it was found that using group music of about forty-five minutes twice a week for six weeks on stroke patients significantly improved their upper limb sense of ownership and as a result there was improvement in the motor impairment of the upper limb (Raghavan et al., 2016). Another study done by Giorgia Tosi suggests that restoring body representation in the brain can help to recover motor coordination in stroke patients. The rehabilitation process involves the patient observing the reflection of his body with an intact limb while hiding the defective one. The study concluded that the mirror induced some sense of ownership to the impaired hand hence encouraging the patient to manipulate it (Tosi et al., 2018). This study seeks to stimulate similar results using haptic enhanced VR system. If the experiment proves our approach can increase the SoO, we will apply the paradigm to stroke patients with some modifications.

This study will be conducted on 30 healthy right-handed subjects. It will be preceded by a pilot study on three subjects to determine its conditions and efficacy. The experiment will focus on the hand movement flexion and extension (open and close) of the impaired limb either actively by the person movement or passively by the functional electrical stimulation (FES). FES is a mechanism that uses low-energy electrical pulses to artificially generate movements in paralyzed individuals (Rushton, 2003). FES utilizes special equipment that applies small electrical charges to muscles of weak or paralyzed patient's due to damaged spinal cord or brain. The electrical charges stimulate the muscles to make their right movement. Unlike other studies which concentrate on the proximal part, this study will focus on the distal region; hand and fingers. An increase in the SoO will be measured by the likelihood of the patient using it. The study will aim to increase the SoO by integrating the visual information with haptic feedback. It will have two main objectives;

Article Information

Conferenc Proceedings: Global Congress on Physiotherapy, Physical Rehabilitation and Sports Medicine (Paris)

Conferecne date: 18-19 November, 2019

Inovineconferences.com

***Corresponding author:** Samirah altukhaim, Physiotherapist in Amiri Hospital Kuwait, PhD student in Reading University,UK; Email: remonchettri(at)gmail.com

Citation: Altukhaim S (2019) Increasing Sense of Ownership in Stroke Patients using Haptic Enhanced VR System for Fine Movement Impairment. J Health Sci Dev.

- To improve fine motor skills after stroke by using haptic Enhanced VR system.
- To measure the sense of ownership on the affected hand by using a visual detection.

The hypothesis is;

- The brain will integrate proprioception and visual information. This will lead to stronger sense of ownership.

Experimental flow

The participant will sit comfortably on a chair with back support placing both hands on a table. The right hand will be holding a silicon ball; this ball will be inflated and deflated. The left-hand index finger will be on a button of the keyboard so they can press it according to the task. An oculus rift will be worn to immerse the participant in the virtual environment. The experiment will involve two tasks, as described below.

The first task will require the participant to press the button in the left hand as soon as he spots light on the virtual hand. Pressing the button will make the light to disappear. The reaction time will be measured by getting the time between when the light appears and when the button is pressed. The study hypothesizes that the shorter the reaction time, the higher the sense of ownership (Aizu, Oouchida and Izumi, 2018).

The second task will be divided into two phase: In the first phase the participants will be asked to close or open the hand actively. Basically, they will be the ones responsible of opening and closing the hand. A three combination of feedback will be collected.

The second phase the movements will be done passively using functional electrical stimulation (FES machine will influence the movements). Different electrodes will be applied to the extensor digitorum communis, abductor pollicis brevis, and extensor pollicis longus (Makowski et al, 2014). These muscles play a vital role in the opening and closing of the hand.

The entire exercise will involve three combinations of feedback:

- Visual information (either the same or different from the intended movement).
- Haptic information (feeling of the pressure of ball expanding)
- Kinematic changes of the hand.

There will be different conditions; for each condition, we will see if the SoO will increase or decrease and test the best condition on healthy participants The table below summarizes some conditions we anticipate. There are many other conditions to be tested (Table)

The main aim of this task is to feed the mind with different combinations of feedback until we obtain the best match that can give us a higher sense of ownership. Once this match is discovered, we can apply it to stroke patients with some modifications. Even though this experiment is expected to yield positive results, there are certain challenges yet to overcome like how to know what the participant is thinking.

Reference

1. Aizu, Naoki, Yutaka Oouchida, and Shin-ichi Izumi. "Time-dependent decline of body-specific attention to the paretic limb in chronic stroke patients." Neurology 91, no. 8 (2018): e751-e758.
2. Padilla, M.A., Pabon, S., Frisoli, A., Sotgiu, E., Loconsole, C. and Bergamasco, M., 2010, July. Hand and arm ownership illusion through virtual reality physical interaction and vibrotactile stimulations. In International Conference on Human Haptic Sensing and Touch Enabled Computer Applications (pp. 194-199). Springer, Berlin, Heidelberg.
3. Raghavan, Preeti, Daniel Geller, Nina Guerrero, Viswanath Aluru, Joseph P. Eimicke, Jeanne A. Teresi, Gbenga Ogedegbe, Anna Palumbo, and Alan Turry. "Music upper limb therapy-integrated: an enriched collaborative approach for stroke rehabilitation." Frontiers in human neuroscience 10 (2016): 498.
4. Rushton, D. N. "Functional electrical stimulation and rehabilitation-an hypothesis." *Medical engineering & physics*25, no. 1 (2003): 75-78.
5. Tosi, Giorgia, Daniele Romano, and Angelo Maravita. "Mirror box training in hemiplegic stroke patients affects body representation." Frontiers in human neuroscience 11 (2018): 617.

Table: different conditions to test the Sense of ownership.

Motor intention (subject imagination of hand movement either closing or opening the hand)	Haptic feedback (inflating or deflating the ball)	Virtual feedback (from the virtual hand either opening or closing)	Kinematic changes (hand movement)	Sense of ownership
Hand closing	The ball is inflated	Hand closing	Hand closing	High sense of ownership
Hand closing	Ball deflate	Hand closing	Hand closing	Low sense of ownership
Hand closing	Ball deflate	Hand opening	Hand opening	No sense of ownership
Hand opening	Ball deflate	Hand opening	Hand opening	High sense of ownership
Hand opening	Ball inflate	Hand opening	Hand opening	Low sense of ownership
Hand opening	Ball inflate	Hand closing	Hand closing	No sense of ownership