

Application of metaverse technology to exercise rehabilitation: present and future

Yong-Seok Jee  <https://orcid.org/0000-0001-6797-0843>

Due to the development of technological innovation in various fields, human life is improving. Modern society has recently entered an era of technological revolution, and metaverse technology is playing a pivotal role. Metaverse is a compound word of 'meta,' a prefix meaning 'going over,' and 'universe.' Although the metaverse does not yet exist in its entirety, metaverse-like features can be found on various platforms that use the virtual world concept.

In our society, the death rate of the elderly and the disabled is decreasing, and life expectancy is increasing due to the development of medical technology. Due to this, there will be more people living with various disabilities or inconveniences in the future, and a time may come when young people will be burdened as caregivers. To prepare for this future, rehabilitation exercises and rehabilitation medicine using the metaverse must be developed. 'Care robots' that are recently being developed are good examples.

Exercise rehabilitation refers to restoring physical, mental, and social health through human movement to help the elderly and the physically challenged live independent lives. Exercise rehabilitation includes the concept of holistic health service that helps patients perform daily life activities and also serves as a prevention and recovery program for physical, mental, and social health. Currently, and in the future, the supply of exercise rehabilitation programs for the disabled, the elderly, and patients is insufficient compared to demand. To address this issue, virtual exercise rehabilitation programs have recently been developed for weak and injured populations.

The metaverse is an interactive simulation that allows users to have experiences similar to reality in a virtual space created through computer hardware and software. Metaverse users can use sensory

organs such as sight, hearing, and touch to realize movement in the virtual world. Metaverse technology for exercise rehabilitation is attracting the interest of the public as the number of users grows. Furthermore, the effectiveness, efficiency, and convenience of exercise rehabilitation using the metaverse have also been reported through various studies. That is, the metaverse exercise rehabilitation program has been used to treat Parkinson's disease (Griffin et al., 2011), traumatic brain injury (Ustinova and Perkins, 2013), arthritis (Iversen et al., 2014), Alzheimer disease (White and Mousavi, 2016), strokes (Laver et al., 2017), spinal injuries (Saadon-Grosman and Arzy, 2017), and multiple sclerosis (Hsieh et al., 2020). In addition, exercise rehabilitation programs using the metaverse are being utilized and studied in fields related to various diseases.

Metaverse technology has been reported to increase patient satisfaction due to its usefulness and positive user interaction. However, there are also reports that 'presence,' which is important in metaverse technology, does not significantly affect satisfaction. In other words, an environment that can increase the sense of presence in the metaverse environment must be built. As mentioned above, it is clear that metaverse technology is an essential factor in exercise rehabilitation. However, technological advances will be required, such as increased presence, more efficient software development, and various treatment contents.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

This is an Open Access article distributed under the terms of the Creative Commons Attribution Non-Commercial License (<https://creativecommons.org/licenses/by-nc/4.0/>) which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

REFERENCES

- Griffin HJ, Greenlaw R, Limousin P, Bhatia K, Quinn NP, Jahanshahi M. The effect of real and virtual visual cues on walking in Parkinson's disease. *J Neurol* 2011;258:991-1000.
- Hsieh KL, Mirelman A, Shema-Shiratzky S, Galperin I, Regev K, Shen S, Schmitz-Hübsch T, Karni A, Paul F, Devos H, Sosnoff JJ, Hausdorff JM. A multi-modal virtual reality treadmill intervention for enhancing mobility and cognitive function in people with multiple sclerosis: protocol for a randomized controlled trial. *Contemp Clin Trials* 2020;97:106122.
- Iversen MD, Connors ME, Menapace MR, Samson AJ, Tessitore E. Technology applications to improve health outcomes and self-management in patients with arthritis. *Intern J Clin Rheumatol* 2014;9:487.
- Laver KE, Lange B, George S, Deutsch JE, Saposnik G, Crotty M. Virtual reality for stroke rehabilitation. *Cochrane Database Syst Rev* 2017;(11):CD008349.
- Saadon-Grosman N, Arzy S. Virtual reality may relieve pain in patients with spinal cord injury. *Neurology* 2017;89:e227-e230.
- Ustinova K, Perkins, K. Virtual reality game-based therapy for restoring postural and coordination abnormalities in patients with TBI. *J Neurol Sci* 2013;333:e565-e566.
- White PJ, Moussavi Z. Neurocognitive treatment for a patient with Alzheimer's disease using a virtual reality navigational environment. *J Exp Neurosci* 2016;10:129-135.

Research Institute of Sports and Industry Science, Hanseo University,
46 Hanseo 1-ro, Haemimyeon, Seosan 31962, Korea
Email: jeeys@hanseo.ac.kr