



Review article

Leap motion controller: the most efficient tool for enhancing hand functions

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ABSTRACT

Virtual reality devices, such as the leap motion controller, have been created by the gaming industry for both home and clinical uses. As part of virtual task practice, the leap motion gadget collects and records fine motor abilities of the hand and fingers while controlling a simulated environment that needs coordination. For improved hand function development, it has a more realistic environment design and object tracking. It can also process moving depth using two embedded cameras, providing users with a real-time on-screen hand simulator that is nearly as accurate as genuine hand gestures. The aim of the study is to evaluate the importance of leap motion controller in treatment of various physiotherapeutic disorders. Although the majority of interactive virtual trials have focused on stroke patients, brain development in those with severe and symptomatic brain damage is still normal. Most virtual reality systems are only available to the proximal upper extremities due to the limits of their control mechanisms.

Keywords: Leap motion controller, Hand Function, Rehabilitation.

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INTRODUCTION

The Leap Motion Controller (LMC) is a hand sensor with remotely sensed virtually reality. It is a detector that converts hand gestures into computational models [1]. Leap Motion is an electromagnetic sensor-based system that can be installed on interactive Virtual reality to monitor hand gestures down to millimeters [2]. This interface recognizes all of your fingers and their actions, allowing you to communicate with the digital reality using gestures. It can also manage action depth using two existing cameras, giving users an authentic on-screen motion simulator that is nearly as effective as real repetitive motion. A two dimensional monitor but instead of 3D interactive VR has been used in majority of upper limb treatment research utilizing Virtual reality. Furthermore, Leaping Movement isn't used to monitor notice the way in studies utilizing 3D intelligent Flow, and 2D monitors were used rather than virtual Reality in experiments utilizing New Node. Virtual reality training has become a powerful platform that can accelerate motor recovery by delivering high-intensity, repeated, and undertaking training with computer programmers imitating three-dimensional environments in which individuals play by rotating the body parts [3]. The system has proven to be a reliable and sensitive device. ADLs that require the use of the upper limbs, including such eating, residential hygiene, and grooming, are typically restricted to children and young adults. Grip strength recovery is a lengthy, complex, and challenging procedure to develop

fine motor development in students with neurological disorders of the hand function [4]. The Motion Sensor, which was recently released, can detect the fine motions of both arms and legs. Virtual reality learning is a great invention for enhancing motor rehabilitation by comparing total, intense, and task-oriented practice with computer programmers who simulate multi-scenario interactions in which patients participate by changing their internal organs. Studies have continued to use the Leap Motion system to build complex methods for a wide range of applications, including playing, defense, upper extremity recovery, human touch screen, air reading, and so on [5]. The majority of interactive virtual experiments has focused on stroke survivors; however, brain development in severe and symptomatic brain injuries is still healthy. Because of the limitations of their control mechanisms, most virtual reality systems are only available to the proximal upper extremities. However, in the case of hemiparesis treatment after an injury, the muscle strength of an injured hand is by far the most challenging. To aid in the functional recovery of a paretic hand as well as the proximal upper extremities, an ideal virtual reality system should be able to track hand position and motion, which is not a feature of most present virtual reality systems [6].

Hand Gesture Recognition

Chetna Naidu, Archana Ghotkar et al. conducted a study on Leap Motion controller for hand gesture recognition for static signs of

Indian Sign Language (ISL) ^[7]. The acquiring of an individual object via a leap motion system aids in meeting the demands of productive gesture control in a three-dimensional environment. The sensor addresses issues such as skin tone, lighting changes, and hand position in relation to the device that plagued earlier perception systems. Sensing methods for obtaining feedback from the user are used in hand gesture recognition ^[8]. Perception techniques, glove-based methods, and depth-based techniques are all possibilities. Detectors are used in glove-based techniques to calculate angular position and the orientation of the hand and arm in real time. The data glove is a technical information hardware system that is used to capture joint data in order to extract gestures. This approach has the benefits of requiring fewer input data and operating at a great velocity. Gloves, on the other hand, are expensive, and the weights of the glove and the connections of the measurement device limit free movement of the hands ^[9]. The program's design becomes more complex as a result of this. And they came to the conclusion that the use of more features like finger angles and hand alignment with classification models like Bayes and HMM for complex movements would be potential technical. The Leap Motion controller can be used in conjunction with the Kinect camera to recognize all body movements for various facial expressions ^[7].

Stroke Patient Rehabilitation

Khademi, M Dodakian, L Hondori, HM et al. conducted a research on Free-hand interaction with leap motion controller for stroke rehabilitation ^[10]. For stroke patients with arm and hand weakness, hand tracking data from the Leap Motion controller is used to practise finger individuation. In this work, they combined cutting-edge frequency technology with a Motion Sensor. They've tweaked the Fruit Ninja game to take advantage of the Leap sensor's hand gesture recognition info ^[11]. They performed a pilot study with 14 stroke patients to see whether this device could be used for upper-extremity recovery. The findings showed that scores from the Fruit Ninja game had strong associations with traditional clinical outcome measures like the Fugl-Meyer Arm evaluation. They also suggested a kinematic model of the hand to improve the system's accuracy and responsiveness. In a study of subacute stroke patients, Zun-rong Wang, Ping Wang, and colleagues used Leap Motion training is use to improve motor functional rehabilitation of upper limbs and neural reorganization ^[12].

Muhammed Nurogun, Ramazan Kurul et. al in year 2019, patients needed time to acclimate to the VR system, and at least one session was required to get used to the equipment and user interface. The 10-minute session times were challenging during the games that involved shoulder movement, and some of the patients' movement quality deteriorated after 10 minutes ^[13]. According to the findings, Leap Motion-based virtual reality training can aid patients with a damaged upper limb who have had a stroke with cortical restructuring

and motor function rehabilitation. It successful and practical adjuvant treatment program for stroke patients seeking to improve their functional recovery ^[14].

Parkinson's disease rehabilitation

Edwin Daniel Ona, Carlos Balaguer et al. did a feasibility study on efficacy of Serious Games for Leap Motion on Upper Limb Functionality in Parkinson's Disease ^[15]. The use of LMC-related video games in the treatment of Parkinson's disease has been well received based on consumer feedback ^[11]. The relationship between the declining trend and an improved health validates video game results as a predictor of change. Despite the fact that the number of patients is insufficient to provide clinical evidence to the obtained outcomes, the utility of using these games for a dual purpose, as an assessment tool and a complementary therapeutic instrument, is compelling, and it is backed up by user experience ^[8].

For children and adolescents with physical disability

Ela Tarakci, Nilay Arman et al. conducted a randomized controlled trial in year 2020 on upper extremity rehabilitation using a Leap Motion Controller in children and adolescents with physical impairments ^[14]. The aim of this study was to compare the effectiveness of an 8-week LMCBT program as an upper limb rehabilitation facility to a standard rehabilitation programmer ^[16]. They discovered that LMC-based games improved relative and absolute functional outcomes in three different diseases after therapy. As a consequence of these findings, LMCBT is quantitatively successful in enhancing upper extremity functions in JIA and CP patients. The changes are related to the preparation, which is similar to traditional training in that LMC games are rigorous, extremely repetitive, and task-specific.

Cervical myelopathy

M Abdulhadi Alagha, Mahmoud A Alagha et al. conducted a research on using the Gesture Recognition Controller to establish a baseline computation of the number of hand flexion-extension cycles and to analyse the degree of motion in young healthy adults. (LMC) ^[16], as well as to describe gender and dominance hand variations. The aim of this study is to use the LMC to establish normative values that can be used as a diagnostic benchmark in the clinic. The total number of hand flexion-extension cycles and the amplitude of motion decreased as the individual fatigued in the longer 3-minute test. This study backs up the idea of using the LMC in the G-R test by providing objective manual dexterity measurements, which are important in the diagnosis of cervical myelopathy ^[17].

CONCLUSION

We have went through 20 articles based on the use of leap motion controller. Leap motion controller is found to be very effective virtual reality device for improving hand gesture and motor movement. It is very efficient equipment of treating for patient suffering from stroke, Parkinson, cervical myelopathy. While managing a virtual environment that needs hand-arm coordination as part of virtual task

practice, the Leap Motion controller captures and tracks fine motions of the hand and fingers.

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