ABSTRACT

Recently, the use of robots, virtual reality systems and many new technologies has been extensively considered in rehabilitation studies and applications. By the combination of these technologies and new communication systems, a new subfield of rehabilitation known as tele-rehabilitation has been born and is developing widely in the modern world. The presented paper offers a short review of tele-rehabilitation systems with a special focus on upper extremity rehabilitation therapy. Firstly, two main technologies, which are used in these systems, are introduced. These new technologies include rehabilitation robots and virtual reality systems. Afterward, a brief introduction of tele-rehabilitation systems is presented.

Keywords: Physical Therapy, Robotic Rehabilitation, Stroke, Tele-Rehabilitation, Virtual Reality

INTRODUCTION

Tele-rehabilitation, in short, refers to monitoring and guiding of the rehabilitation progress of patients from a distant location. As shown in Figure 1, a tele-rehabilitation system has two main parts: A rehabilitation device and a long distance communication module. Different systems can be used as a rehabilitation device such as high technology rehabilitation robots, virtual reality systems with various sensors or feedback devices and even conventional therapy tools. Depending on the rehabilitation device used in different tele-rehabilitation systems, they are divided into different categories from simple systems to more sophisticated ones. In the simplest arrangement, the patient does his/her workout at home with conventional therapy devices and communicates the results with the therapist through phone lines. In advanced systems, the patient works with an intelligent rehabilitation robot using several motors and sensors which interact physically and graphically with the patient through proper interfaces. The performance results may be communicated online or offline with the therapist for new prescriptions.

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Rehabilitation studies show that to increase the efficiency of a rehabilitation exercise, it should start in early stages, be as intensive as possible and extend over the recovery phase. New technologies such as robots and virtual reality systems are very suitable devices for increasing the intensity of patients’ exercises. These systems can also be controlled from remote locations via tele-communication systems. This feature makes them appropriate for home therapy of patients and, therefore, allows a prolonged rehabilitation process.

The examination of patients was one of the first applications of tele-health systems (Galea, Tumminia, & Garback, 2006; Hill, et al., 2006; Russell, Wootton, & Jull, 2002). By using robots, virtual reality systems, and therapy games as rehabilitation systems and controlling them through web, some clinical tests have been done in this area (Kuttuva, et al., 2006; Piron, et al., 2004; Reinkensmeyer, et al., 2002; Ricker, 2003; Savard, Borstad et al., 2003). Although some investigations have been carried out in this area, this field is still in its early stages, and no large scale clinical trials are available for the time being. However, the increase of people in need of physical rehabilitation along with its costly and long procedure makes the future of tele-rehabilitation very promising.

In this paper, firstly a brief review of new technologies which have made tele-rehabilitation horizons more hopeful is presented. Afterwards, newly introduced opportunities in tele-rehabilitation systems are reviewed.

**NEW TECHNOLOGIES IN REHABILITATION**

**Robotic Rehabilitation**

The use of robots in physical rehabilitation is a relatively new field in the area of medical robots. The first idea about using robotic devices in neuro-rehabilitation was identified by Hogan et al. (1992). Several groups started working on this idea from then on. The first published implementation of these robots in physical therapy was by Erlandson (1995). Currently, because of the developments in haptic hardware and advanced robots and better knowledge of the rehabilitation process this area is expanding at a high rate.

Different studies on robotic rehabilitation show that robots can be useful as an alternative system or an integrative one with classical methods (Colombo, et al., 2005; Kahn, Zygman, et al., 2006; Masiero, et al., 2006; Prange, et al., 2006; Stein, et al., 2004; Volpe, et al., 2000). Robots can be used to provide passive movements for patients with severe paresis. In such exercises, the patient is inactive, and the robot moves his/her limbs. These movements are useful for preventing muscle contracture or spasticity, but their effectiveness in motor recovery is uncertain (Hohan, et al., 2006). Patients with some movement abilities can use robots for supporting their weight of the limb or assistance in completing their movements. For patients in the end of their recovery process
Development and Psychometric Qualities of the SEIPS Survey to Evaluate CPOE/EHR Implementation in ICUs
[www.igi-global.com/chapter/development-psychometric-qualities-seips-survey/73820?camid=4v1a](www.igi-global.com/chapter/development-psychometric-qualities-seips-survey/73820?camid=4v1a)

Study of Zero Velocity Update for Both Low- and High-Speed Human Activities
[www.igi-global.com/article/study-zero-velocity-update-both/53820?camid=4v1a](www.igi-global.com/article/study-zero-velocity-update-both/53820?camid=4v1a)