

Chapter 8

AR Using NUI Based Physical Therapy Rehabilitation Framework with Mobile Decision Support System: A Global Solution for Remote Assistance

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ABSTRACT

This article describes how physical therapy rehabilitation promotes functional ability of the disabled people to improve quality of life using Range of Motion exercises. The conventional rehabilitation seems to be effective; however, the efficiency of the treatment sessions is not guaranteed resulting in longer recovery period. Thus, there is a need of self-motivating and engaging training solution to support rehabilitation and enhance continuous assessment of disabled patients. The proposed framework is “AR-NUI-REHAB-MDSS,” augmented reality (AR) using natural user interface (NUI) based physical therapy rehabilitation with personalized exercise rendering and monitoring system for patients and mobile decision support system (MDSS) for therapists leading to a global solution for remote assistance. NUI allows human computer interaction intuitively through human body gestures. AR provides an entertaining environment for treatments with less-assistance. MDSS enables therapist to customize treatment plans at dynamic environments. Upper limb is considered as its functional recovery is significant and more challenging.

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INTRODUCTION

The improvement in quality of life (QOL) for the people with disabilities due to functional impairment in any part of the human body is obtainable through physical therapy rehabilitation. It is a medical field expertise that deals with examination, evaluation, and re-mediate impairments to promote mobility and functional ability (Khalid, Sarwar, Sarwar & Sarwar, 2015). These disabilities can be physical or psychosomatic ailment due to various facts like accidents, congenital or birth disorders or aging concern (Fathima, Shankar, & Thajudeen, 2016). The improvement and restoration of movement and functional ability is achieved through performing regular and repetitive physical therapy exercises. Physical therapy treatment is a kind of Range of Motion (ROM) exercises that can be offered to any people regardless of the age based on the pain, injury or disability with the aid of Physiotherapist. Engaging in training using ROM exercises supports the patient to amend joint functionality concerning ease off swelling, stiffness and pain (Bhatia, Bejarano, & Novo, 2013). The main aim of this rehabilitation therapy is assisting individual personals to restore ability to perform their basic tasks and physical activities independently and accomplish the maximum level of freedom in all level such as physically, emotionally, socially, and spiritually in order to maintain QOL in the society (Murphy, Shea, Cooney, Shiel, & Hodgins, 2006, pp. 14-15). This can be obtained by doing certain prescribed physiotherapy exercises regularly and repeatedly and will be more effective in the early intervention of disability.

Upper limbs (hands) are the most significant part of the human body to perform any physical actions like grasping, holding, and manipulating objects that involves complex coordination of muscle activity engaging every part of a hand from shoulder to fingers (Feys et al., 1998; Alonso et al., 2014). The disabilities of upper limb can happen due to post-stroke, post-traumatic, paralysis, aging, etc. (Fathima et al., 2016). Several studies from various agencies reported that the functionality of one-third of the human body is affected by occupationally impaired upper limb (Ojeda, Moreno, Ramirez, & Rodriguez, 2014). Achieving the functional recovery of hands is rarely possible by few days of treatment in hospitals or by undertaking oral medicines. In most of the cases, there is a need for continuous physiotherapy treatment in order to make them functionally enable; independent and improve QOL, even after their discharge from hospital (Fathima et al., 2016). The lack of impulsive stimulation during functional activities leads to the reduction in probability of retrieving the upper limb fully functional. By nature, non-affected side is exclusively used by the patient to perform upper limb activities (Kwakkel, Kollen, Grond, & Prevo, 2003). Findings from research studies indicate that the paretic arm remains without function when measured after 6 months post stroke, whereas the complete functional recovery is demonstrated only 5% to 20% (Feys et al., 1998). Thus, it is more challenging to rehabilitate upper limbs.

As the upper extremity functional recovery is quite complex, the training of moderate exercises has to be maintained appropriately. The proper rehabilitation training is very crucial to be performed by those who have impaired limbs and it is not easy to restore normal daily function (McNeill, Pokluda, McDonough, & Crosbie, 2004). There are many therapeutic rehabilitation approaches currently available but the notable concern is that though conventional therapy is effective, there is a lack of efficiency in the treatment sessions due to unavailability of facilities and therapists, about 60% of the day the patients were alone, in some cases only about 13% of the day patients are engaged in activity (Bernhardt, Dewey, Thrift, & Donnan, 2004), also enduring some traditional therapies continuously make patients to lose their interest and lag motivation to continue their exercises regularly, leading to longer recovery period. It is been proven that performing two to three hours of arm training a day for six weeks when started within one or two months after stroke improved motor recovery (Lawrence et al., 2001). Thus, it neces-

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