Leap motion controller for upper limbs physical rehabilitation in post-stroke patients: a usability evaluation

Zineb Hadjadj[1,*], Mostefa Masmoudi[2], Abdelkrim Meziane[1] and Nadia Zenati[2]

[1]Research Center on Scientific and Technical Information, CERIST, Algiers, Algeria
[2]Center for Development of Advanced Technologies, CDTA, Algiers, Algeria
[*]Corresponding author: hadjadj_zineb@yahoo.fr, zhadjadj@cerist.dz

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***Abstract*—Stroke in Algeria is one of the most important causes of severe physical disability. Since the disease strongly influences the quality of life of patients, optimal solutions for the treatment of post-stroke patients are needed. The use of new technologies in the field of rehabilitation aims to reduce the impact of functional problems. Recent studies have shown that technologies such as virtual reality and video games can provide a way that can motivate and help patients recover their motor skills. In this paper, our objective is to evaluate the usability of the Leap Motion Controller virtual reality system (LMC), which is a sensor that captures the movement of the patient's hands and fingers without the need to place sensors or devices on the body, with serious games specifically designed for upper limbs rehabilitation in post-stroke patients. We measured the usability of the LMC system used with serious games as well as the level of satisfaction among healthy participants and post-stroke patients from Bounaama Djilali Hospital (CHU Douera) in Algeria. The results show favorable data, for the first time, the LMC is a usable tool, measured by the System Usability Scale (SUS). In addition, participants demonstrated good motivation, enjoyment and the majority of them said that they would like to use the proposed system in future treatment. Nevertheless, further studies are needed to confirm these preliminary findings.**

***Index Terms*—Stroke, Motor activity of the upper limbs, Rehabilitation, Serious games, Virtual reality, Leap Motion Controller (LMC)**

I. Introduction

According to a recent statistic published by the Algerian Society of Neurology and Clinical Neurophysiology (ASNCN), stroke is one of the major health problems affecting 60 000 people in Algeria each year, it claims a life every 9 minutes. Of these 60 000 stroke victims, 20 000 die from its consequences [1].

A stroke, also referred to as a cerebral vascular accident (CVA) or a brain attack, is a lesion in brain tissue due to a sudden interruption of the blood supply to part of the brain. Two mechanisms can be at the origin of this interruption: cerebral infarction or ischemic stroke in 80% of cases and cerebral haemorrhage or haemorrhagic stroke in 20% of cases [2]. The cerebral infarction is caused by an abrupt blockage of an artery. Cerebral haemorrhage is caused by bleeding into brain tissue when a blood vessel bursts.

After a stroke, many motor, sensory and cognitive disorders may occur depending on the nature of the stroke (ischemic or hemorrhagic), the location and the size of the brain injury. These disorders have a direct impact on the activities of daily living of patients.

In order to restore their motor, sensory or cognitive abilities as much as possible, patients must follow a long and costly recovery process, called rehabilitation. Patients go to the hospital, often