Virtual Reality for Rehabilitation

Subjects: Others
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Virtual reality (VR) is a trending, widely accessible, contemporary technology of increasing utility to biomedical and health applications. VR is the technological experience that allows for a full immersion in virtual spaces with which you can interact via specific wearable or using only your hand. A key feature of all VR applications is interaction.

VR ranges from non-immersive to fully immersive, depending on the degree to which the user is isolated from the physical surroundings when interacting with the virtual environment. Non-immersive virtual reality allows for interacting with the environment through mouse or joystick; immersive virtual reality, instead, uses tools that are connected to the human body in order to perform the same motor task.

Despite the growing evidence of the positive effects of VR in rehabilitation of functional and cognitive abilities, some systems still raised concerns regarding their acceptability with complex clinical populations, as, for example, the older people. In particular, during trials with immersive systems, few adverse events have been described by participants, including headache and dizziness. Finally, little is known about the perceived effect of the exposure at multisensory input during a complex activity, such as treadmill walking with VR in patients during post-stroke rehabilitation to improve balance and gait ability.

Keywords: Virtual reality ; Cognitive and Physical Rehabilitation ; Oldest old person

1. Definition

Virtual reality (VR) is a trending, widely accessible, contemporary technology of increasing utility to biomedical and health applications[1]. VR is the technological experience that allows for a full immersion in virtual spaces with which you can interact via specific wearable or using only your hand. A key feature of all VR applications is interaction. Virtual environments (VE) are created and allow for the user to interact with not only the VE, but also with virtual objects within the environment. In some systems, the interaction might be achieved via a pointer operated by a mouse or joystick button. In other systems, a representation of the user's hand (or other body part) might be created within the environment where the virtual hand movement is generated[2].

2. Introduction

VR ranges from non-immersive to fully immersive, depending on the degree to which the user is isolated from the physical surroundings when interacting with the virtual environment. Non-immersive virtual reality allows for interacting with the environment through mouse or joystick; immersive virtual reality, instead, uses tools that are connected to the human body in order to perform the same motor task[3][4]. Non-immersive VR systems have been studied as a therapeutic tool for improving symptoms in neurological disorders and have shown potential to promote cognitive and motor improvements even in advanced stages of different neurological diseases (e.g., stroke, Alzheimer and Parkinson disease (AD, PD), multiple sclerosis (MS), and traumatic brain injury) because of these characteristics[5][6][7][8][9].

3. Application in Rehabilitation

The use of VR technology in rehabilitation derives from research in computational neuroscience involving motor learning mechanisms[10]. VR provides real-time visual feedback for movements, thereby increasing engagement in enjoyable rehabilitation tasks[11].

VR provides alternative rehabilitation programs with new and effective therapeutic tools that can improve the functional abilities in a wide variety of rehabilitation patients in a neurological setting, offering several features, such as goal-oriented tasks and repetition. The use of VR environments for virtual augmented exercise has recently been proposed as having the potential to increase exercise behavior in older adults[12] and it also has the potential to influence cognitive abilities in

this population segment[13]. Therefore, VR represents a real opportunity for the cognitive rehabilitation of neurological patients with different neuropsychological symptoms, especially in attention, memory, problem-solving and executive dysfunction, and in behavioral impairments[7][8][9].

Moreover, VR training has been mostly described for the upper limb[14][15], but also for the lower limb[16], balance and walking[17][18], as well as for perceptual/cognitive skills[19].

To our knowledge, systematic reviews or meta-analyses have been undertaken to review the utility of VR technologies in a single arm of rehabilitation (i.e., motor or cognitive rehabilitation, upper or lower limb rehabilitation), focusing on a specific pathology (stroke, PD, AD, MS)[6][7][9].

Despite the growing evidence of the positive effects of VR in rehabilitation of functional and cognitive abilities, some systems still raised concerns regarding their acceptability with complex clinical populations, as, for example, the older people. In particular, during trials with immersive systems, few adverse events have been described by participants, including headache and dizziness[20]. Finally, little is known about the perceived effect of the exposure at multisensory input during a complex activity, such as treadmill walking with VR in patients during post-stroke rehabilitation to improve balance and gait ability[6][21].

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