Methodology for muscle recovery, through motor imagery techniques applying virtual reality

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Abstract. Recovery of movement is a long and hard process for patients. One of the most common problems that occurs is the so-called "phantom limb", which induces the body to feel strange due to the failure to use the injured limb. This process is due to the lack of use of the leg that in most cases is fractured and the long recovery time, so the use of crutches makes the body in conjunction with the brain understand that normal movement of the body is with the leg suspended and always with the help of crutches. In the present work a technique for the retraining of the brain is presented by means of which the brain is taught through the presentation of images if it corresponds to the right and left side of the arms and legs. This retraining makes it possible for the brain to understand the coordinated movement between the arms and legs. In addition to the use of virtual reality, through the OCULUS GEST II lenses, allowing maximum concentration, the results allow to improve the recovery time of patients, the technique can be used both in rehabilitation centers and in the patient's own home patient.

Keywords: Virtual reality, imagery, muscle recovery, images, senses, relearning.

1. Introduction

In the treatment related to the recovery of mobility, physical therapy is considered the standard for walking again, in this sense all help is important to help train the brain and muscles in the process of gait recovery, Making a review of the literature, we found works related to providing tools related to muscle recovery using the motor imagery technique using images projected on computers and evaluating brain activity through the brain-computer interface, in which concentration levels can be evaluated when is performing these activities, the techniques dedicated to assessing muscle activity to assess whether patients are able to concentrate at the time of rehabilitation exercises, in this way to know if the patient is committed to recovery [1] [2].

In the management of muscle recovery techniques are presented in which the intention is to be able to evaluate the recovery of mobility for which the person is required to recover their mobility by analyzing the gait pattern, there are techniques in which inertial navigators are used to assess gait behavior [3]. Not only the issue of gait is important, the movement of the hands also has a pattern, which is why studies related to the recovery of these movements are presented, also using different techniques such as virtual reality [4] [5].

In the recovery of the mobility's of the different limbs, one of the common characteristics is pain management, for which many patients tend not to perform the exercises or to perform exercises in their minimal expression, always avoiding pain, which is why it is It is important to know to what extent the pains that occur in the recovery of the mobility of the limbs is important to know [6], these pains appear consecutively for which the motor imagery techniques in the different forms of being able to present them, it is very helpful to assess pain and keep the brain busy concentrating movements [7], one of the most common pathologies present in mobility problems is known as phantom limb [8] [9]. One of the most common techniques in the use of brain behavior to check whether people who are concentrated and thus committed to their recovery, demonstrated at the time of performing the exercises, as well as the interpretation of many biomedical signals that are present at the time of performing the exercises [10].

Having made a description of the works referring to muscle recovery through different means, in the present investigation we present a methodology to improve recovery in rehabilitation procedures, through the use of virtual reality using OCULUS GEST II lenses, through which It is used to improve the recovery of mobility through the projection of images that correspond to the upper and lower limbs and their location in the human body, in order to redefine the interaction of these limbs when performing motor rehabilitation exercises.
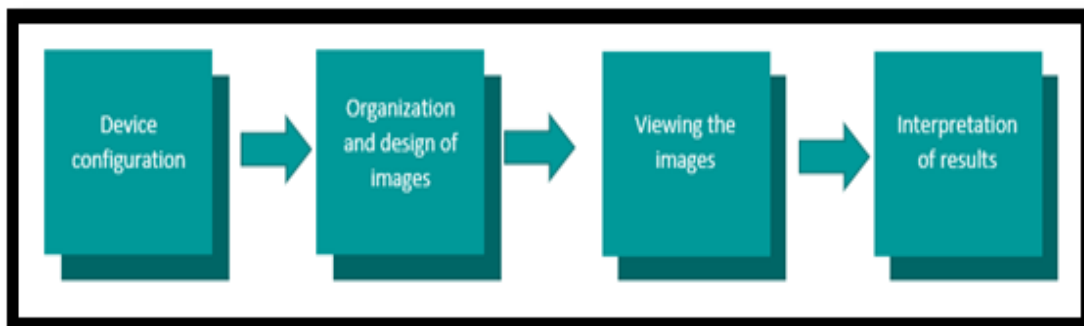
2. Materials and Methods

Figure 1: Block diagram of the proposed methodology

2.1. Device configuration

The methodology presented begins with the configuration of the devices. In our case, the OCULUS GEST II virtual reality glasses, a computer, and the Virtual Desktop application are required as a software tool.

In order to configure and achieve communication between the virtual reality glasses and the computer, the Virtual Desktop application is installed, for this communication the two devices must be connected to the same network, in this way the virtual reality glasses , work as an extension of the computer, managing to repeat the same content that is displayed on the computer and that is projected on the virtual reality glasses.

In figure 2, the configuration of the Virtual Desktop application is presented, connecting with the virtual reality glasses, the application, the configuration is very practical, doing a search for the devices connected to the same network, it is recommended to connect the glasses of virtual reality to the WIFFI network in order to be able to connect with the computer.

This interconnection allows everything that is displayed on the computer to be presented simultaneously and in real time in the virtual reality glasses.
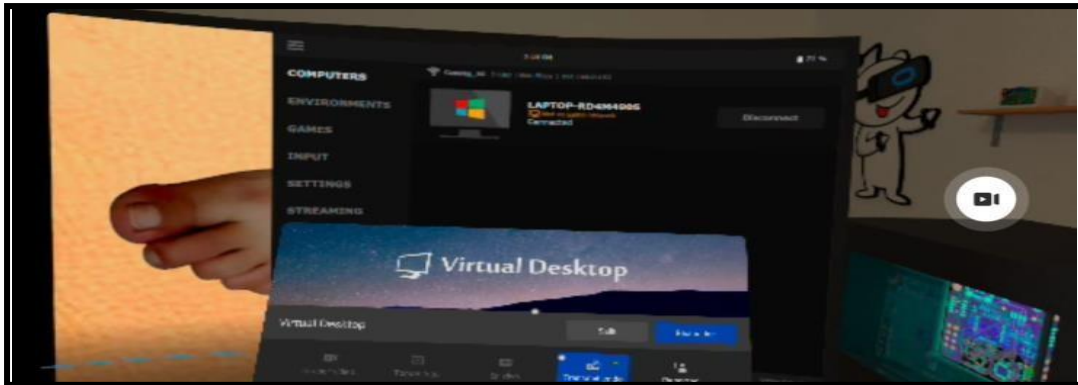

Figure 2: Device configuration

2.2. Organization and design of images

A second step in the development of the methodology is characterized by the organization of the images that will be used, for which different images corresponding to the upper and lower limbs are taken, a record of images of the hands and feet was made, In the registration of the images, it was processed by adding a black background to eliminate all kinds of noise or foreign objects that are not part of the hands and feet.
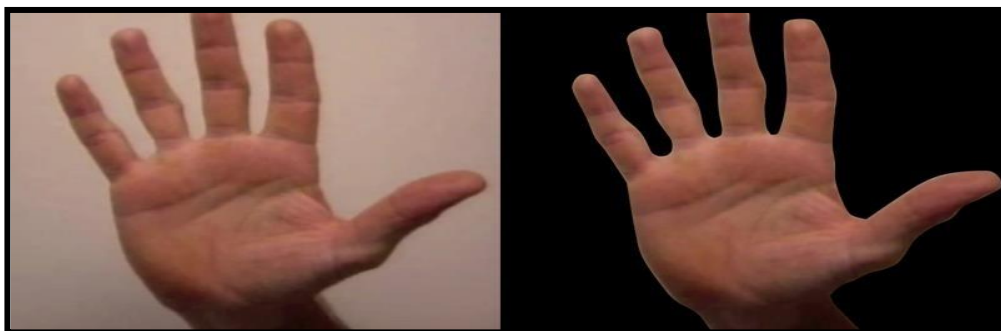

Figure 3: Organization of top member images

Figure 3 shows the acquired image and its corresponding image with a black background, which was part of the group of images that formed the sequence through a video record.

Figure 4 shows images that correspond to the foot, in this case the recording was made with the same foot as the patient, so the recording made has a non-uniform background, the processed image has a black background, similar to that of the hands, forming the base of images to be organized, in order to create the video.

Figure 4: Organization of the lower member images

2.3. Viewing the images

After having obtained the images, it is organized by means of a sequence of them, one after the other, with a time, the images can be organized by ordering those with a black background, images with the original background or incorporating some background color, one of the benefits of the methodology, is to be able to create the sequence of images with different sequences, duration time and speed of the video, as well as the video is presented on the computer, the video can be managed by changing the speed, duration, put in pause among other options of video playback.

One of the advantages of being able to manipulate the video is to be able to provide the patient with different viewing times in order to improve their concentration.

Figure 5: Images that will be organized in sequence to form the video

Figure 5 shows a sample of the created video, where the sequence of images is shown one after the other, you can see a foot, followed by a hand, as well as a hand followed by another hand. , this order will depend on the therapist to check the evolution of the patient.

3. Results

The results that are presented are represented in two ways, the first in the form of a diagram of how the various devices are related, as well as how the information flows, this representation is a graphical form of a basic configuration, in such a way that it can be replicated Depending on the devices that are available, in our case the lenses are of the OCULUS GEST II model, as the main software to be able to share the images, we are using "Virtual Desktop", which is installed both on the computer and on cellular devices and in virtual reality glasses. In figure 6, the connection
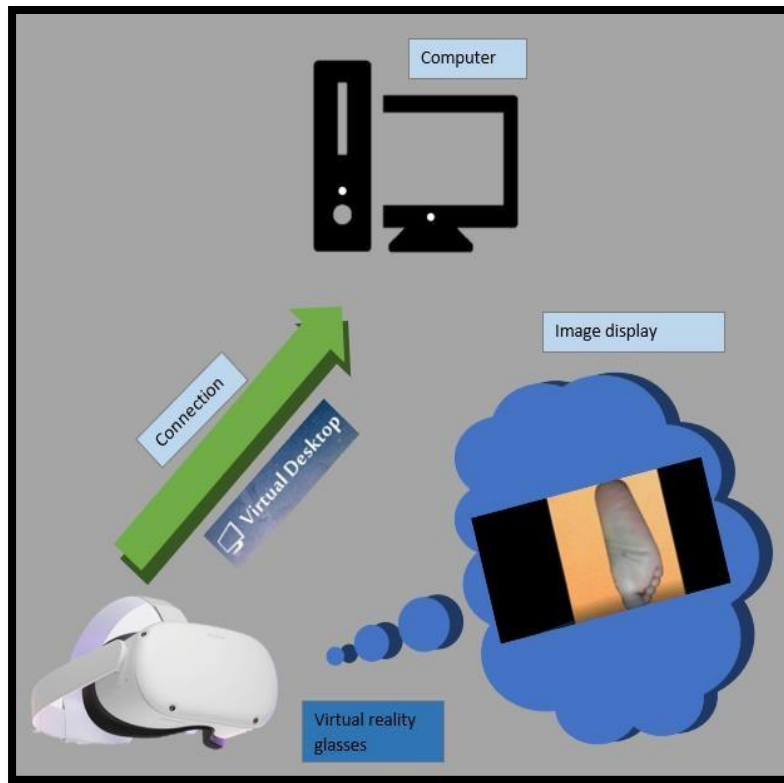
diagram is shown.

Figure 6: Component and connection diagram

Having the configurations made, the following procedure is the projection of the video on the computer and with this it is simultaneously replicated in the connected devices, then the images projected on the virtual reality lenses are presented, this visualization is carried out through the cellular device, what is seen in virtual reality glasses, is replicated in the cellular device, in the following images various situations are presented in the use and application of the proposed methodology.
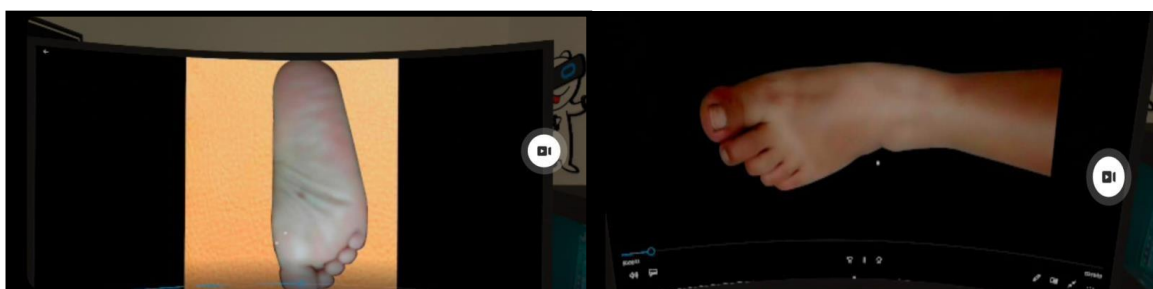

Figure 7: Component and connection diagram

In figure 7, the video sequence is presented as a representation of what is being presented in the virtual reality glasses, with the images with a background other than black. Due to the functionality of the lenses, background music can be added to improve the experience when performing motor imagery practice.
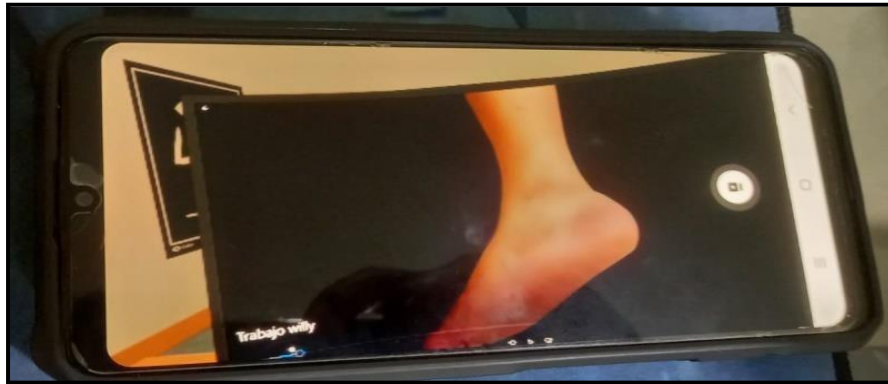
Figure 8: Visualization of the sequence of images displayed on the cellular device

In figure 8, the visualization of the sequence of images in the cellular device is presented, where an exact replica of what is visualized in the virtual reality glasses is a characteristic.

One of the main characteristics of the methodology is to be able to have a better interaction with the patient, so if the patient needs to advance or delay the sequence of images, these changes can be made using the controls of the virtual reality glasses, these Controllers can be used by making the function of an integrated keyboard and mouse. In figure 9, the representation of the mode of use of a patient is presented, in which he is interacting with the video through virtual reality glasses.

Figure 9: Interaction of the patient with the sequence of images through virtual reality glasses

One of the additional characteristics that virtual reality lenses present us is the ability to provide different backgrounds and appearance in the presentation of the sequence of images, in figure 10, a film background is presented, giving the patient the feeling that he is in a movie theater and the film being presented is the sequence of images, as well as this background and appearance we can have a background of tranquility on the beach, forest, among others, the choice of these backgrounds will depend on the tastes and preferences of the user, these funds are chosen through the controls in the use of the properties and functionalities of the virtual reality glasses.

Figure 10: Additional functionalities of virtual reality glasses

4. Conclusions

The conclusions that we reached at the end of the investigation, from the point of view of knowing and using the technological tools that are coming onto the market and leading them towards a use in the practice of health care, we can indicate that in the application of the methodology described This can be used and implemented without problems, which will depend on the devices available, from basic configurations to the use of more advanced devices, in the use of these devices you must know the compatibility of the computing tools to be used.

In the development and organization of the images, it is necessary to have a record of the images, in most cases, many solutions consider making a batch of their own images, which helps a lot because the number of images can be increased and scenes that can be used, this put into practice, can be used and applied in physical therapy centers, before performing their respective exercise exercises, as well as at home, when they are free, one of the Advantages that it has, is the power to be used at home, with this we are not limited in the use and to be able to do the necessary repetitions in order to accelerate the improvement process and be able to walk normally in the case of the lower limbs and a normal movement of the hands, in the case of the upper limbs.

One of the benefits that is presented in the methodology is the ability to create different types of videos, with different groups of images, with various backgrounds, depending on the age of the patient and the ability to concentrate, so viewing can also be optimized. of the video through the manual reproduction of the video on the computer, controlling the speed which the video is monitored at all times, this is achieved thanks to the connectivity between the computer and the virtual reality glasses.

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