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LOW-COST SYSTEM, IN THE EVALUATION AND RECOVERY OF MUSCULAR ACTIVITY, BASED ON VIDEO GAME SYSTEMS

Wilver AUCCAHUASI[*], Universidad Privada del Norte, Lima, Perú

Fernando SERNAQUE, Universidad César Vallejo, Lima, Perú

Luis ROMERO, Instituto Peruano de Investigación en Ingeniería Avanzada, Lima, Perú

Kitty RURBANO, Instituto Peruano de Investigación en Ingeniería Avanzada, Lima, Perú

Grisi BERNARDO, Universidad César Vallejo, Lima, Perú

Madelaine BERNARDO, Universidad César Vallejo, Lima, Perú

Juanita CUEVA, Instituto Peruano de Investigación en Ingeniería Avanzada, Lima, Perú

Edward FLORES, Universidad Nacional Federico Villarreal, Lima, Perú

ABSTRACT

The recovery of mobility is one of the most important aspects in the process of walking again, and it is evidenced that the recovery of muscular activity is one of the main factors, therefore in every recovery process it is tried to recover the maximum degree the muscles, one of the methods to perform these tasks, are the rehabilitation exercise activities. In these activities, certain recovery exercises are carried out that make it possible to regain muscle mass, in most cases these exercises are usually presented in hospital environments that allow a minimum time to perform these exercises. The present work presents a practical solution to be able to exercise at home with emphasis on being able to have an ideal environment and that eliminates all kinds of fear towards performing exercises, the methodology consists of being able to develop the exercises based on video games, which the patient try to carry out the activities of the game, this eliminates any idea of therapy exercise. The methodology also presents an electromyography signal acquisition unit that aims to record muscle activity, with

which we can demonstrate that the muscle is working first and secondly, measure muscle activity, which would demonstrate that the muscle is in the process of recovery. The results are presented based on a patient with mobility problems resulting from a knee operation, where the severity of his condition is evidenced, for which the exercises carried out through the use of video games help in recovery by eliminating all kinds of fear and achieving exercises that a therapy exercise session fails to develop.

Introduction

In the recovery of mobility, the muscles fulfill a fundamental task, which is why most of the loads that are generated at the time of walking, are the muscles in charge of providing support and thus absorbing most of the loads generated in the movement, for this reason its registration, measurement, analysis and interpretation, it is essential for this reason many works related to these tasks are carried out, we can indicate that there are many wearable devices in charge of recording many muscles, the use of these devices It helps a lot in the registration, due to the ease of use and the different applications that must be carried out [1], we can consider among the devices available for the registration of signals, many hardware solutions, we can find in the market one of They are the well-known hardware of the NVIDIA family, where both the recording, the processing and the analysis can be performed on the same device of electromyography signals [2]. A line of work related to recovery exercises is based on the measurement of brain activity where an attempt is made to evaluate how the brain interprets recovery exercises based on brain signals that can be evaluated by devices based on the Brain Computer Interface. [3]. Another of the techniques that is being used more frequently is Virtual Reality, for this reason related works are presented where an attempt is made to evaluate the recovery of mobility, aided by the use of virtual reality techniques added to the measurement of the brain signals evaluated by BCI devices [4]. When working with equipment that will record signals from people, it is important to consider certain safety criteria that ensure the safety of patients, this safety is characterized by the management of electromagnetic compatibility that must be implemented in the recording devices and analysis of the medical equipment to be used [5].

Materials and methods

The proposed methodology consists of 3 fundamental processes, organized in a logical way, describing the use of the technologies used and how they are interrelated, to present a favorable result in the recovery of the patient, the first stage consists of configuring the video game, followed by the configuration of the device for capturing the electromyography signals and ends with the recording and analysis of the electromyography signal. The proposed methodology is presented below.
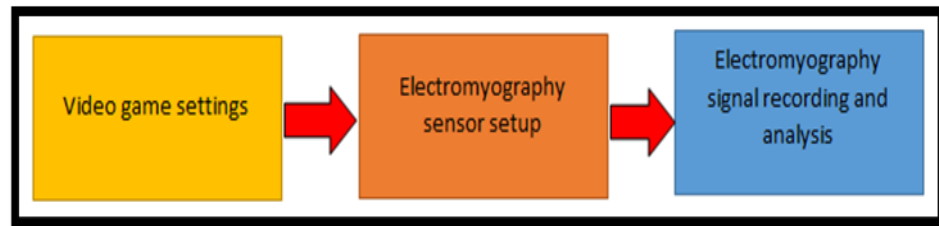
Figure 1. Block diagram of the proposed Methodology

In Figure 1, the methodology is presented, which consists of the use of the new widely used video games, which will be used to exercise with which to eliminate all kinds of fear in situations of rehabilitation exercises.

Video game settings: the use of video games consists of the patient eliminating all kinds of fear or fear in normal exercise situations. With the use of video games, it is intended that the patient is concentrated in the game instead of exercising, making the patient play and therefore perform his exercises, the chosen game is JUST DANCE, this game was taken, because the patient has to dance, within the dance steps, the patient performs certain exercises configured as dance steps, the choice of dance will depend on the type of exercises you want the person to perform.

Electromyography sensor setup: for the recording of electromyography signals, an electronic circuit was used that records the signals produced by the muscles, the circuit is located in the part of the leg muscle to be evaluated, the registered signal is sent to an application, with which you can visualize the signal that the muscle is producing and how muscle recovery is evolving.

Electromyography signal recording and analysis: the signal recording and analysis stage is based on a computer application, which records the signal that is captured by the circuit, this signal is reproduced by the application, where the recording time of the signal and the amplitude of the signal, with these two data it is possible to analyze the evolution of muscle activity, as well as if the muscle is recovering its volume, the greater the value of the amplitude of the signal, it is determined that there is a greater amount of muscle mass.

Results

The results presented below are organized in a logical manner, demonstrating the application of the proposed methodology:

Figure 2. X-ray image of the patient to be evaluated

Image 2 presents the X-ray image of the patient, which will be the object of
study, the image presents a knee reconstruction operation with its respective
device that will hold to ensure a correct recovery of the bone tissue.

The patient presents a fracture at the knee, the recovery time is
approximately 20 weeks, time in which the patient cannot move with his
own means, causing a deterioration and decrease of the muscle present in
the patient's legs, such as can be described in figure 3.

**Figure 3. Image of the muscles of the patient's leg, which is affected by
the knee operation**

Figure 4. Image of the use of the methodology based on the Just dance game

Figure 4 shows the interaction between the patient and the JUST DANCE game, you can also notice the location of the electromyography circuit located on the right leg of the patient at the height of the right knee, the muscle evaluated will be where the circuit is located

Figure 5. Image of the application where the electromyography signal is recorded and evaluated

In figure 5, the electromyography signal is presented, where the signal can be seen in its amplitude and in the duration time, this application connects with the circuit, capturing and recording the signal. Having the captured signal we can analyze it and interpret its results.

Conclusions

The recovery of muscular activity is a very important task for the patient, providing mechanisms that allow their speedy recovery is very helpful, the methodology presented is based on being able to perform rehabilitation

exercises, but with an approach based on video games, where The patient is immersed in the game and is simultaneously performing the exercises, the results show that by being immersed in the game, patients forget that they are in a therapy session, causing them to perform exercises that in a therapy session they it would be difficult to carry out, due to the fear that they might get hurt or due to pressure from health personnel.

The methodology not only eliminates the fear of conventional exercises but also allows an interaction with the game which is used by the muscle for its recovery, aided by the electromyography signal recording and analysis circuit, the patient's evolution can be analyzed to organize the next exercise sessions and the degree of difficulty, leading to a better degree of development in rehabilitation activities.

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