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LOW-COST METHODOLOGY FOR THE FOLLOW-UP AND MONITORING OF MUSCLE RECOVERY, BASED ON VIDEO GAME TECHNIQUES, APPLIED TO CHILDREN, IN TIMES OF PANDEMIC CAUSED BY COVID-19

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ABSTRACT

At present, information and communication technologies are achieving notable importance in all actions of people, from education, work and with greater emphasis on health. It is in this area of knowledge that many applications arise based on the use of hardware and software that try to help medical diagnosis, in this work we use the video game console "Nintendo Switch" to interact with the child, so that children They can play the games and at the same time be able to perform the rehabilitation exercises, depending on the muscles to be recovered, in our case it is evaluated to recover the mobility of the "elbow" and the muscles that interact with it, in a normal situation, children have complications in performing rehabilitation exercises in health centers, this refusal to perform the exercises may be due to fear or even more so, the environment itself does not allow them to feel confident. The results allowed us to show that children can perform rehabilitation exercises at home using the Nintendo Switch console, for the

verification of the methodology, it was possible to configure the console with wireless controls so that children can interact with the game "Just Dance" , where children try to perform the same movements that are presented in the video game, with the help of the surface electromyography circuit, the muscle activity linked to the signals can be recorded. We can indicate that the methodology presented allows the use of a device that children feel more comfortable and identified for complex tasks such as the issue of recovery of elbow mobility, it can also be possible to record each movement with its respective muscle activity, for analysis later by the doctor of the specialty of Physical Therapy and rehabilitation.

Keywords: Covid-19, pandemic, exercises, video games, muscle recovery.

Introduction

Information and communication technologies are causing a very important influence on the development of people, in such a way that they can help in daily tasks and in some cases improve their standard of living, this is the case of use in the HEALTH environment , where thanks to technological devices certain medical treatments can be improved, where patients are induced to play games through various video game consoles and in this action of playing certain clinical activities can be evaluated, in the literature we can find works where an attempt is made to measure muscle activity through electro myography devices where a device is used to play based on a bracelet with sensors, where muscle activity is measured and with it the movements that the person performs are evaluated [1].

In the treatment of patients with certain difficulties in motor activity, certain fears arise at the time of performing the rehabilitation exercises, for this reason mechanisms based on Virtual Reality are used, to be able to abstract the patient in an environment other than hospital and that they can perform your rehabilitation exercises [2] [3].

The techniques of video games are also becoming widely used in rehabilitation areas, we can indicate works where various components of video game consoles are used as a movement analysis mechanism to evaluate the degree of improvement of patients [4]. In muscle recovery, the most used analysis method is the evaluation of muscle activity and as these are improving, the most used technique is the measurement of muscle activity based on surface electromyography, where the degree of muscle work is evaluated and As this is behaving in activities, we found works where muscular activity is evaluated in the performance of various exercises in order to measure the work of the muscles [5].

Video games are being used in many of the applications where the patient feels afraid to be able to perform the movements, that is why research works arise where there is emphasis on measuring the strength of the muscles, in order to evaluate the degree of improvement of the As the patient performs rehabilitation exercises, in a normal situation, the patient cannot perform the exercises, but being in a video game environment he manages to perform certain movements, with this it is possible to measure the force exerted in each of the movements he performs, these movements can be analyzed by various components of video game consoles such as the Kinect of the Xbox console [6] [7].

One of the challenges in the rehabilitation of people is to be able to work with children and adolescents, where there is a greater degree of fear of the exercises and in cases in which they do not feel comfortable, therefore the idea is to be able to take them to a comfortable environment where they consider themselves more liberated from pressures and can achieve the exercises [8].

In this sense, and managing to find solutions that have satisfactory results in the improvement of children, the present work presents the use of the Nintendo Switch console as a video game environment mechanism and to be able to take children and adolescents towards a video game environment where they can achieve the exercises and thus recover.

Materials and methods

The methodology presented is based on the use of the Nintendo Switch game console, both for displaying the image on a television, and on the use of the controls as a mechanism to follow the game and the movements to be carried out, the use of the wireless controls is very important because, because its use allows to analyze if the child performed the movement as indicated in the Video Game, making the child think that he is playing instead of doing rehabilitation exercises. Below are the steps to follow to demonstrate the usefulness of the methodology.

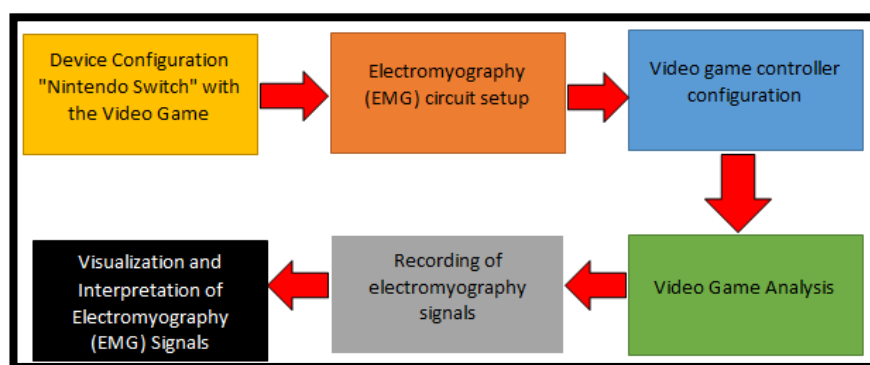


Figure 1. Block diagram of the proposed Methodology

Device Configuration “Nintendo Switch” with the Video Game: The configuration of the console is important, because it is the starting point of the methodology, it is configured with the television, with which the child manages to understand that he will only play with his video game, the configuration of the video game is made up of the choice of the game "Just Dance", this game was chosen because the child needs to follow the movements that are presented on the screen, the game presents many songs each with different movements and it will depend on the movements that are required to be evaluated.

Electromyography (EMG) circuit setup: The electromyography circuit allows us to record muscle activity, in the methodology it is very important because it will be the mechanism by which we can evaluate the muscle we want to evaluate.

Video game controller configuration: The control of the Video Game is based on being able to configure the controls of the console, the controls have a fundamental characteristic, which is a motion sensor where the movement made by the player can be registered, in the case of the video game, through the control the game can evaluate if the player performs the movement in a similar way to the video presented on the screen, in our methodology the command allows to evaluate if the child performed the desired movement.

Video game analysis: Having configured the game and the controls, the methodology proposes that the child perform the movements and according to the result that the game allows us to evaluate if the child performed the movements as indicated by the game, in addition, the video game allows a replica of the movements, with which we can repeat the movements performed at the time of playing, in our case it would be at the time of performing the rehabilitation exercises.

Recording of electromyography signals: the recording of electromyography signals is done through the circuit, this circuit is placed on the child's arm where the muscle we want to evaluate is located, in order to record the work of the muscle.

Visualization and interpretation of electromyography (EMG) signals: The final part of the methodology is characterized by evaluating the recording of electromyography signals taken from the muscle to be studied, this evaluation is carried out with the help of the Labview software, where we make an application to be able to record and visualize the signals electromyography.

Results

The results presented below are based on the steps of the methodology, where movements were recorded with the devices of the Nintendo Switch and the electromyography circuit..

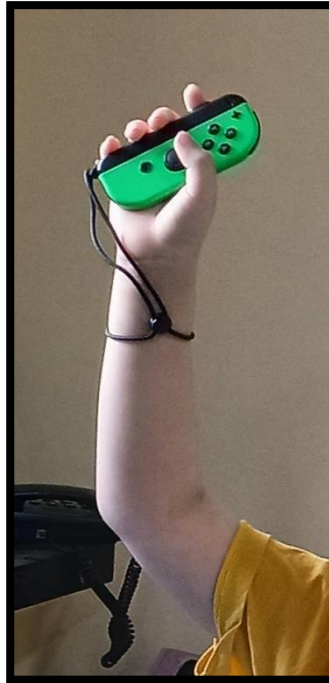


Figure 2. Nintendo Switch Controller Settings

In figure 2, you can see the configuration of the console controls, in the hand to be studied in the child. With which it is possible to identify the arm to be analyzed.



Figure 3. Play the game as well as the rehabilitation exercises

In figure 3, you can see the performance of the game and therefore the rehabilitation exercises, at this time it is achieved that the child can replicate the movements that the game presents on the television as closely as possible, the movement control unit is represented by the control of the console, thanks to the command you can capture the movements and compare if the child performed the movements in a similar way, at the end of the game it presents a result if the movements were performed in a similar way.

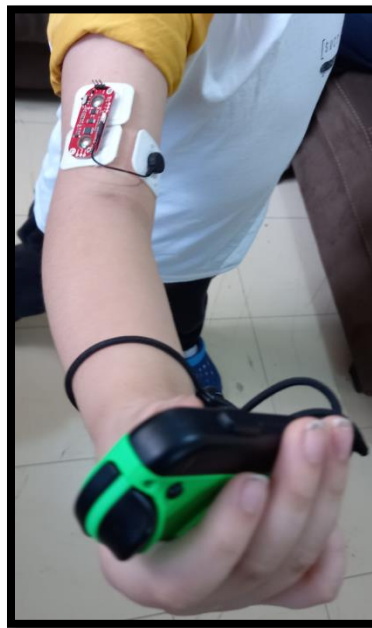


Figure 4. Conditioning the electromyography circuit

In figure 4, you can see the configuration of the console controls, as well as the location of the electromyography circuit, where you can indicate if you need to evaluate a particular arm, you have to place both the console control and the electromyography circuit. To use the electromyography circuit, disposable clasp electrodes are used, it is recommended to change the electrodes to evaluate each muscle.



Figure 5. Performing movements with the electromyography circuit

In figure 5, you can see how the electromyography circuit should be configured with the control and the console, it is the correct way to take advantage of all the sensors that are working at the moment that the child is performing the exercises, added to the fact that the child is at home, therefore we can indicate that the child is at home, is playing and in turn is performing rehabilitation exercises, without the need to subject him to traumatic rehabilitation exercises in a center of health.



Figure 6. Setup to analyze multiple muscles

In figure 6, an alternative can be observed to be able to record the electromyography signals from several muscles, in this case three

muscles are evaluated simultaneously as well as the recording of the movement of the arm through the control of the console.



Figure 7. Movement record

In figure 7, the registration of the movement in an adolescent is presented, the arm is in the proper movement for the registration, with the 3 electromyography circuits as well as the control of the console, the identical movement can be appreciated with the video game presented on screen.

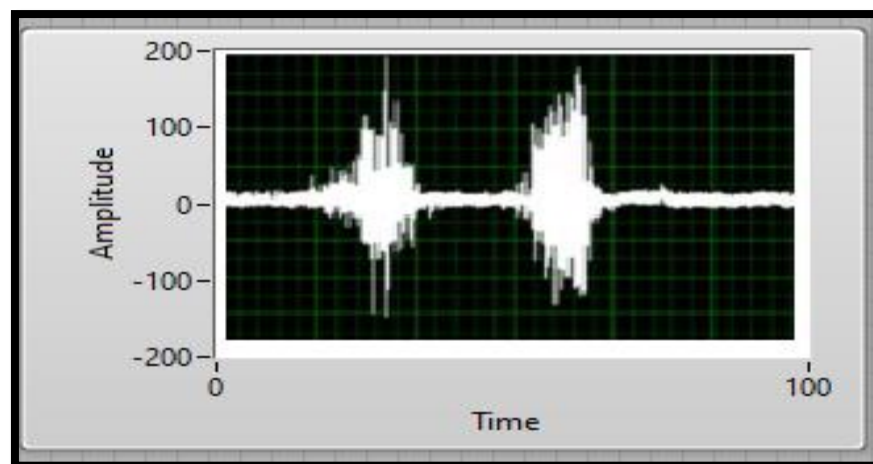


Figure 8. Recording the signal of the activity of a muscle

In figure 8, the electromyography signal is presented, which corresponds to the activity of a muscle, in order to be analyzed simultaneously as the child is performing the activities, the signal can be stored for later visualization and analysis.

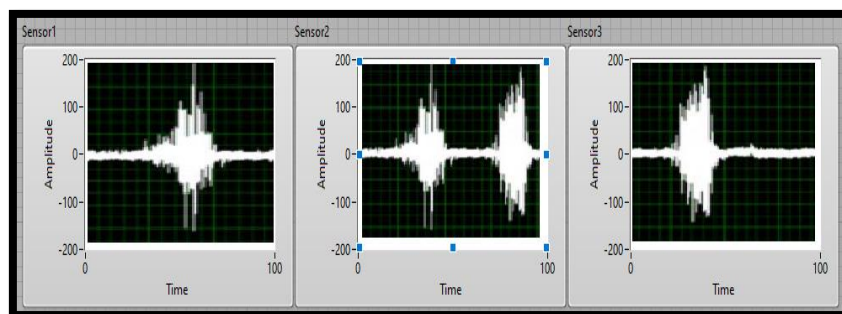


Figure 9. Recording the muscle activity of three muscles simultaneously

In figure 9, 3 electromyography signals are presented, recorded simultaneously in the same child's arm, the recording of more signals can be increased by adding more circuits, these signals can be stored for later visualization and analysis.

Conclusions

The conclusions reached at the end of the research is characterized by the use of video game consoles for health purposes, mainly in the process of recovering mobility in the arm, for which a methodology was designed that focuses on use of the "Nintendo Switch" console used as a mechanism to provide the game video, the game used is known by the name of "Just Dance", the game was chosen because it allows us to perform movements similar to those presented on the screen, as well The console allows evaluating the similarity of the movements thanks to the sensor that is incorporated in the console control, to improve the exercise recording, the use of the recording of electromyography signals was resorted to, thanks to circuits for their recording, in The practice was able to register a muscle and subsequently 3 muscles simultaneously, with which it is possible to scale to be able to analyze a greater number of muscles, in the same exercise.

It is recommended to use the game "Just Dance" because there is a diversity of dances with many movements, which can help to perform a variety of exercises, so that children are engaged in playing but are also doing exercises, it can be done recoveries of movement of the upper limbs (arms), lower limbs (legs) and other parts of the body, such as the head and neck, thorax among others, the game is in its version 2021, being able to choose previous versions.

We conclude by stating that each console has its own characteristics to play the game remotely or wirelessly, that is why we can find motion sensors such as the Nintendo Switch, we also find video cameras to record movements and its subsequent analysis, in order to use other consoles, it is recommended to analyze the control mechanism for

games and thus be able to analyze the functionality and the application that we can carry out in order to take advantage of video game consoles.

References

- [1] Wilver Auccahuasi, Gloria Rojas, Aly Auccahuasi, Edward Flores, Percy Castro, Fernando Sernaque, Ingrid Ginocchio, and Nabilt Moggiano. 2019. Analysis of a mechanism to evaluate upper limb muscle activity based on surface electromyography using the MYO-EMG device. In Proceedings of the 5th International Conference on Communication and Information Processing (ICCIP '19). Association for Computing Machinery, New York, NY, USA, 144–148. DOI:<https://doi.org/10.1145/3369985.3370016>
- [2] Wilver Auccahuasi, Monica Diaz, Juana Sandivar, Edward Flores, Fernando Sernaque, Manuel Bejar, Ingrid Ginocchio, and Nabilt Moggiano. 2019. Design of a mechanism based on virtual reality to improve the ability of graduated motor imagery, using the brain computer interface. In Proceedings of the 5th International Conference on Communication and Information Processing (ICCIP '19). Association for Computing Machinery, New York, NY, USA, 119–123. DOI:<https://doi.org/10.1145/3369985.3370015>
- [3] 2017. Proceedings of the 2017 ACM Conference on Computer Supported Cooperative Work and Social Computing. Association for Computing Machinery, New York, NY, USA.
- [4] Sayenko, D. G., Masani, K., Milosevic, M., Robinson, M. F., Vette, A. H., McConville, K. M. V., & Popovic, M. R. (2011). Video game-based neuromuscular electrical stimulation system for calf muscle training: A case study. *Medical Engineering and Physics*, 33(2), 249–255. <https://doi.org/10.1016/j.medengphy.2010.10.010>
- [5] Soltani, P., Figueiredo, P., Fernandes, R. J., & Vilas-Boas, J. P. (2017). Muscle activation behavior in a swimming exergame: Differences by experience and gaming velocity. *Physiology and Behavior*, 181, 23–28. <https://doi.org/10.1016/j.physbeh.2017.09.001>
- [6] Bostanci, H., Emir, A., Tarakci, D., & Tarakci, E. (2020). Video game-based therapy for the non-dominant hand improves manual skills and grip strength. *Hand Surgery and Rehabilitation*, 39(4), 265–269. <https://doi.org/10.1016/j.hansur.2020.02.011>
- [7] Parry, I., Carbullido, C., Kawada, J., Bagley, A., Sen, S., Greenhalgh, D., & Palmieri, T. (2014). Keeping up with video game technology: Objective analysis of Xbox Kinect™ and PlayStation 3 Move™ for use in burn rehabilitation. *Burns*, 40(5), 852–859. <https://doi.org/10.1016/j.burns.2013.11.005>
- [8] Human, A., Corten, L., Jelsma, J., & Morrow, B. (2017, June 1). Inspiratory muscle training for children and adolescents with

neuromuscular diseases: A systematic review. *Neuromuscular Disorders*. Elsevier Ltd. <https://doi.org/10.1016/j.nmd.2017.03.009>