#49 PAPER 65 - USING VIDEO GAMES FOR KINECT SYSTEM IN POST-CVA RECOVERY

Oprisan Emilia, Chiriac Ilona
University of Bucharest

Abstract

In the context of technological evolution new virtual neurological rehabilitation systems have developed, which can be used both in the clinical context and in the family environment. Starting from this idea a number of researches that led to the development of SMART video games for systems that use motion capture software (Jintronix, Virtual Rehab) and which aim to achieve a neurological rehabilitation of people with post-CVA sequelae have been developed.

Keywords: virtual rehabilitation systems; video games; neuromotor deficiency; post stroke sequelae; intervention.

1. INTRODUCTION

Neuromotor recovery represents a major importance issue for reactivating psycho-motor abilities, with impact on reestablishing the maximum functioning level of lost capacities, by a person, following brain lesions occurred after a cerebrovascular aneurysm (CVA), as well as for developing compensating mechanisms in an adaptive direction.

The clinical symptoms differ depending on the localization and type of CVA and on the extension of the affected region. It debuts gradually, within minutes/ hours, or gross, within a few seconds. In its initial stage, motor deficiencies occur (sudden loss in balance, disturbance of the limb coordination ability), or even modifications of the state of consciousness (dizziness, confusion, irritability, memory disturbance), sensitivity disturbances (blurry vision). (Bolte Tayler, 2011)

Currently, worldwide, various studies are carried out since a procedural guide does not exist yet but only a series of recommendations on the recovery elements among which the main ones are: physical therapy (it includes kinetotherapy and physiotherapy), logopedy and occupational therapy.

Post-CVA motor sequelae are characterised by paralysis (hemiplegia) or the partial force decrease (hemiparesis), fact which determines the installation of motor incoordination and lack of balance, the recovery on these sections being essential for an individual’s independence. (Zoltan, 2004)

From the psychopedagogical point of view, we are interested in the stimulation of patients in difficulty by using the appropriate methods so that, together with a multidisciplinary team, we can help the patient reintegrate socially and professionally post CVA. A current means of stimulation is the use of video games with a wider and wider spreading in the recovery field, both regarding motor abilities but also other types of abilities: learning, language abilities, etc. The playful framework offers even for adults a strong motivation to reach the objectives of the game, it allows emotional expression but also a bodily awareness.

Specialists from the psychology and pedagogy field see the game as (Popovici, coord., 2009) a means of relation between the EGO (subject) and the world of objects and relationships and a form of organising cognition and knowledge.

Video games are a particular form of games. The industry of video games has known in the last 10 years an extremely fast increase and after the appearance of mmorpgs (massively multiplayer on-line role playing game) these games became mediators between people all over the world. By means of these games, the payer becomes an active actor and takes part to the interactivity. It can virtually test the level of its abilities, it can find out its weaknesses and with exercise it can overpass them. (Tisseron, 2010)

Telerehabilitation involves the use of communication systems and associated technologies with rehabilitation. This concept represents a new research field in progress which can increase the capacity and accessibility of the means of rehabilitation by supplying remote recovery services. (World Report on Disability, 2012). “The telerehabilitation systems were initially designed to supply accessible and efficient recovery systems
to the persons in the areas difficult to reach and for the people disadvantaged from the physical and/or economic point of view” (Latifi, 2008, p. 191). Another designation of remote rehabilitation programs is to complete the range of services supplied by the recovery centres by offering new possibilities with regard to the rehabilitation techniques.

Telerehabilitation allows the performance of physiotherapy exercises both within the treatment centre and at people’s place of residence. This offers the specialist the possibility to monitor the patient in a remote way, to assess its progress and optimize the therapy program. Modern technologies allow the physician to change the duration and the intensity of the prescribed program in a remote way, in real time. (Holden, Dyar, Dayan-Cimadoro, 2007)

This work suggests the introduction of an additional telerehabilitation program in the individual recovery plan. This program is at the intersection between kinetotherpay (with the exercises it suggests) and ludotherapy (with the playfulness of video games) thus making a connection between the two types of therapy.

2. PURPOSE OF THE STUDY

We intended to investigate the effects of an additional metrical training by using the VirtualRehab software and the external sensor for motion caption (Kinect) starting from the idea that the patient who suffered a cerebrovascular accident needs the prolongation of the neuromotor recovery supervised by the physician including after the discharge. For this purposes the VirtualRehab telerehabilitation software was used with the help of which it was built a therapy plan based on the use of video games and which aims the improvement of motor abilities.

3. RESEARCH METHODOLOGY

We chose to use the case study as in the research steps the following difficulties were incurred: a decreased number of patients who suffered a CVA and who were capable to keep their orthostatic position for at least 10 minutes and could move with or without assistance and the existence of additional diseases such as hypertension or diabetes which did not allow the performance of exercises as they involved physical effort.

Thus, a number of five patients with ages between 45-75, both genres, who suffered a cerebrovascular accident during the year 2014, were selected from the neurological recovery department of Colentina Clinical Hospital. All the participants benefitted of kinetotherapeutic, physiotherapeutic treatment and the additional program of recovery by means of video games, four days a week for two weeks.

For this study, we intended to investigate if the use of the VirtualRehab system, in parallel with the physical-kinetic-therapeutic recovery program, for two weeks, with daily attendance, can improve the subjects’ motor performances with the increase of the movement motivation brought by the program’s permanent feedback, interactive and playful elements. We suppose that the subjects whom the adjacent recovery program is applied to shall be capable, at the end, to make a series of differences regarding the quality and influence of the program over their recovery.

The instruments used in our study were: the “VirtualRehab” telerehabilitation system (http://www.virtualrehab.info), patient satisfaction survey and kinetotherapist satisfaction survey.

VirtualRehab is a technological system which corresponds to the concept of telerehabilitation designed by specialists in neurological rehabilitation which allows the creation of training programs for the physical rehabilitation of patients with different degrees of physical disabilities and for progress monitoring. By combining the advantages of the virtual environment with the ones of the Kinect device from Microsoft and with cloud technology (Microsoft Azure), VirtualRehab offers the specialists the possibility to create complex treatment programs which should include motivating treatment procedures meant to retrain some extremely important capacities for nourishment, hygiene and clothing.

VirtualRehab contains a series of procedures especially designed in accordance with the principles established by specialists in medical recovery. The system includes 9 different procedures classified depending on the affected bodily function (e.g. Weigh Transfer, Balance, Bilateral Arm Training).

VirtualRehab was clinically validated in a study performed over the year 2010. The study shows how VirtualRehab can help improve patients’ results when combined with traditional therapy. The results of this study were presented at Istanbul within the 8th World Congress of Neurorehabilitation in 2014. For this study the educational license for the use of the VirtualRehab system was obtained;
4. RESULT ANALYSIS

The system records every movement the patient makes during the programmed treatment sessions and saves them. The manner of analysis extracts the data and presents them in an easily interpretable graphic form.

The score is obtained as a weighted average based on the difficulty level of each movement in the program. For instance, the interception of an object while a weight transfer is also performed receives more points than if a weight transfer had not been involved. The more complex the movement, the higher the score.

The telerehabilitation program was built after having studied the recovery methodology by stabilographic feedback suggested by Cinteză (Cinteză, 2003). For this there were selected among the games available in the program the ones which develop: balance, coordination, laterality, flexibility, hand-eye coordination. The exercises involve a training of the entire body, beginning with the upper limbs, then activating the bod and ending with the exercise of the dynamic balance with the implication of the lower limbs.

At the end of the program, each subject obtained an improvement of the motor abilities for movement accuracy between 8% and 31% and for the movement achievement level between 13% and 24%, while the duration of performing the complete program decreased between 7% and 22% compared to the initial moment. A positive evolution was ascertained also with the analysis of each and every exercise. Thus, we mention that the results differ depending on the age, ethology of the cerebrovascular accident and the extension of the sequelae in psychomotor plan.

We briefly present a case study for illustration purposes:
Name: N.G., age: 68, genre: M, diagnostic: left-sided hemiparesis post-CVA ischemic;
At the end of the programme we conclude that the patient’s initial state allowed the execution of the entire program in a proportion of 66% with a movement accuracy of 61% and the performance duration was 52% of the total time given.

In figure 1 we can notice that there is an overall positive evolution; the variables regarding the execution percentage and the accuracy indicating an ascending (medium) cross-bar, while the duration variable determines a descending (medium) cross-bar.

Subject N.G. recorded the shortest program finishing time, 38% of the programmed duration and the best results of the accuracy, 80%, in the last session. And the best results of the program execution percentage, 90%, were recorded in the sixth session.

As a comparison, in figure 2 we can notice the differences in percentages between the first and the last session of the program. Thus, we can conclude that Mr N.G. recorded a progress during the program, as follows:
The duration necessary to perform the program decreased by 14%, from 52% in the first session to 38% in the final session;
The execution percentage increased by 24%, from 66% in the first session to 90% in the final session;
The accuracy increased by 19%, from 61 in the first session to 80% in the final one.
After having applied the satisfaction survey, the quantitative analysis indicated that for the questions in the first part of the survey the highest percentage was obtained for the answer “very good”, 52%, and the lowest percentage corresponds to the answer “unsatisfactory”, 0%.

The utility of the proposed recovery program was appreciated as being a good one in a percentage of 60%, it corresponded very well to the needs of 80% of the patients, and 60% of them believe they evolved well.

The answer very good, in a proportion of 20%, for item 1 and in a proportion of 80% for item 2, items which take into consideration the utility and applicability of the program in the neuromotor recovery post-CVA support the idea that VirtualRehab can be successfully used in the customized recovery program.

Regarding the weight level, item 2, opinions generally differ between good and very good and as for the appreciation of the games, VirtualRehab, integrated in the recovery program 20% of the patients answered good, 60% very good and 20% excellent, these items concern the adaptability and attraction of the VirtualRehab software. The answers show that interactive games are appreciated by the patients in recovery.

Item five in this section asks the patients to self-assess their evolution at the end of the intended program: as such, 20% are satisfied, 60% believe they had a good evolution and 20% evaluated very good.

The quantitative analysis indicated that for the questions in the second part of the survey the highest percentage was obtained for the answer “DA”, 76 %, and the lowest percentage corresponds to the answer “NU”, 24%, these results indicating a positive attitude towards the VirtualRehab telerehabilitation software.

The first two items intend the fact that the used software allows the performance of recovery programs outside recovery centres at any time. As such, when the subjects were asked if the use of the program in a familiar environment could contribute to a better evolution 60% answered “No”, 100% of the subjects believed that the possibility to choose the moment to perform the exercises could influence the results in a positive way. Thus, we notice that the patients are reticent regarding the continuation of the program outside the recovery section but nevertheless wish to have control over the interval when the exercises necessary for their recovery should be performed.

Items three, four and five are meant to highlight the subjects’ opinion on the telerehabilitation software. Hence, 80% would be more willing to use the software and would recommend it to other persons if they were also more forthcoming to try similar software.

5. CONCLUSIONS AND DEBATES

The recovery process in CVA is a complex one, extended on the time axis and needs the collaboration of specialists in various fields. The neuromotor recovery program must be customized according to the patients’ specific manifestations and it includes various sub-programs meant to train each component of the neuromotor system.

The theoretical analysis on neuromotor recovery of the persons after a cerebrovascular accident and of the kinotherapists’ opinions contributed to the shaping of the recovery program based on the stimulation by movement using the VirtualRehab telerehabilitation system.

Thus, we have the confirmation of the hypotheses where we started from finding, by means of the case studies, the positive influences which the integration in the physio-kinetic-therapeutic recovery process of the video games offered by VirtualRehab, as an element of connection between occupational therapy and kinetotherapy has over the functional rehabilitation with persons post CVA.

It was proved that the use of movement sensors for the immersion in the video game can represent a basis for the improvement of the psycho-motor habits provided that the principles of applying physical exercise in kinetotherapy are followed.
The second hypothesis was also confirmed, the quantitative analysis of the answers to the survey completing the research work by highlighting the positive opinions of the subjects concerning the utility and adaptability of the VirtualRehab system and with regard to the quality of the recovery program by video games which as we suggested.

The limits of the research correspond to the case study limitations and, as such, the data obtained and presented cannot be generalized for all the persons who have a CVA.

Hence, the presented work is only a starting base for future research on Romanian population regarding the influence of using technological means for telerehabilitation in neuromotor recovery.

6. REFERENCES


On-line Sources:


Official site of VirtualRehab http://www.virtualrehab.info/