Effects Based on Serious Gaming for Rehabilitation

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Abstract - *Stroke has been a very common problem for middle and old aged people causing disability and a range of impairments. Rehabilitation of patients is done with the help of serious gaming as it has been a promising tool. Using computational intelligence techniques the home based rehabilitation has been safe and effective. This paper discusses about the effects of rehabilitation on the patients through serious gaming. It mainly focuses on the monitoring of the player's actions through games including the wrong actions which degrade the rehabilitation process. The system employs the fuzzy-based monitoring of the patient's actions and provides a real-time feedback to the therapists. Text to speech and simple animation are used as more helpful techniques which envisage the patient. Adaptation challenges are maintained in the games which make the rehabilitation safe and effective. Bayesian method is used to tune up those three parameters when the patients start to perform. A log is maintained for the interaction between the therapists and clinicians to advise the patients in a more effective manner. This approach has resulted in the serious game domain.*

Key Words: Fuzzy based method, Adaptation, Rehabilitation, Virtual therapy, Games.

1. INTRODUCTION

STROKE has been one of the most common diseases in the old age people. It can be treated through proper treatment under the supervision of doctors and then the rest of the rehabilitation is carried out by the therapists. Usually there are two phases, 1) during the initial phase, the patient is hospitalized and is taken care of in the hospital and 2) another phase is based on the exercise of the patient for a long time, after getting out of the hospital. But for the rehabilitation phase, the patients need to go to specialized centers for daily sessions to the therapist. Given the increasing number of stroke patients and the increased cost of rehabilitation, the outpatients are being progressively shrinking. Some of the patients, who can afford such prolonged session, drop it in the middle due to its high prices. This stops the improvisation of their health and it returns to the previous stage. This is where the need of home rehabilitation comes into the picture.

The rehabilitation at home can be done in many ways. Traditionally rehabilitation at home had limited resources which led to an ineffective approach. So to make this approach a better approach, the exercise will be supervised by the clinicians and the therapists. Just like tracking of the patients motions to evaluate the performance of the patients using the log. Until recently, this was only possible, restoring to motion capture technology because of its cost, complexity, and maintainability, are more suited to hospital rather than patients' houses [1].

Devices used like Nintendo Wimote Controller, Microsoft Kinect, Balance Board, and the Sony Move is widely used for video games. At the same time, these devices allow the acquisition of motion data that can meet the requirements of rehabilitation protocols [2], [3]. These games have somehow increased the interest in video games as to support the rehabilitation. Through these games the capability of patients can be measured, and then the difficulty level can be maintained so that the patient should not get fatigued or frustrated.

There is some commercial and non-commercial devices available in the market like Fit-Bit, games, but these all devices did not support the entire rehabilitation process. There has been a lot of researches made between this rehabilitation process and games, but somehow this process and games did not fit into support properly, so some of the games are used at commercial level only (i.e. video games). The process of rehabilitation is divided into following steps. 1) A continuous monitoring of patients actions and capturing them with correctness is very important otherwise it can lead to maladaptation that might cause joint pain. 2) A proper feedback must be given to the patient like when to visit the therapist, results of the

therapy, occurrence of the maladaptation, motivating the patient and so forth. This also is very important when the rehabilitation is taken at home as there is no real therapist to guide. So the level of game also must be adjusted according to the patient status. 3) The configuration time taken to setup the difficulty level for the patient according to the residual abilities. 4) To manage the difficulty level and the game played by the patient, to make the patient satisfied with the game or else the patient will get frustrated or bored. 5) Lastly, everything should be summarized and stored in the log for proper action to be taken further and to know the improvisation of the patient.

2. MOTIVATION

This research has been made to motivate the patients and also to have engaging sessions for them. The feedback can be real-time and even the low-cost rehabilitation would be affordable for the patients. These goals are not so easy to achieve as there are many games in the market but only few games supports the rehabilitation. The intelligent games had come out with more interesting 3D games supported by the high-end 3D devices.

3. RELATED WORK

In the past few years, the research has proposed many new rehabilitation processes and technique at the hospital as well as home. All the researchers agreed with rehabilitation application (i.e., games) should be adapted to the actual status and capability of the patient. The difficulty level of the game should be maintained. Moreover, there are lots of games available in the market, but not all of them support rehabilitation only few of them are suitable for it. So the related work on rehabilitation of patients is done in a very proper way and to handle it efficiently.

Michele Pirovano, Renato Mainetti, Gabriel Baud-Bovy, Pier Luca Lanzi and N. Alberto Borghese, Proposed "Intelligent Game Engine for Rehabilitation (IGER)" [1], this is basically based on the IGER module which is divided into two parts one is the game engine and another is the virtual therapist. The functionalities of these games are: input data, animation, and collision detection, rendering and game logic. A configuration is set purely on the basis of a patient's status. In this the game should be allotted, how to customize the game and how to monitor the player's action also the difficulty level of the game to be maintained. This can explain with the game (i.e., Fruit Catcher) using weight shifting exercise for 5 minutes. With

this the difficulty is associated with the range of lateral movements; this can be mapped on the basis of the value of range, accuracy and speed. Then the monitoring panel sets the restrictions on the monitor during the exercise. The last panel enables or disables the difficulty level of the game according to the therapist. The difficulty level in the Fruit Catcher game is that the position of fruits appearing and their frequency is decided. The fuzzy-based monitoring main task is to capture the patient movements and to correct them. This mainly focuses on the trunk, head, and leg postures. They endeavor played roughly strength of the body and basically how to detect the preversions behavior. The wrong postures are detected and unsystematically they are discerning look over a warning level; those are the five fuzzy sets- {silent, log, warning, error and shutdown} and based on this alarm sets the feedback is given for the home based rehabilitation. There are 11 games support rehabilitation through high-end 3D devices and this made the supervision of rehabilitation better than before.

Michele Pirovano, Renato Mainetti, Gabriel Baud-Bovy, Pier Luca Lanzi and N. Alberto Borghese, Proposed "Self-adaptive games for rehabilitation at home" [4], which explains about the Games developed for the rehabilitation and a hierarchical platform for rehabilitation at home, which was taken under the Rewire project [5], this platform had helped a lot through its low-cost oriented platform. This platform consists of three components: a patient station (PS), a networking station (NS) and a hospital station (HS), The PS has four modules which are – a hospital communication module, a lifestyle module, a community module and IGER module. Here they have mentioned about one of the self-adaptive games, i.e., Fruit Catcher. In this paper they have mainly focused on the continuous adaptation of the game and monitoring of the patients' actions so that new games can be generated based on this study.

Gustavo Saposnik, Robert Teasell, Muhammad Mamdani, Judith Hall, William Mcllroy, Donna Cheung, Kevin E. Thrope, Leonardo G. Cohen and Mark Bayley, proposed "effectiveness of virtual reality using Wii gaming technology in stroke rehabilitation-A pilot randomized clinical trial and proof of principle" [6]. This paper discusses about the rehabilitation of stroke patient through Wii Gaming. This is a type of pilot, randomized, single-blinded trial has taken place for 2 months, and they compare the feasibility and safety. Through this treatment the results were 8 out of 10 in the recreational therapy for arm and 9 out of 10 for participants in VRWii. Accordingly,

the VRWii gaming technology has been a safe, feasible, supervised and the fast development rehabilitation.

Jong Hwa Lee, Sang Beom Kim, Kyeong Woo Lee and Ji Yeong Lee have proposed "The Effect of Prolonged Inpatient Rehabilitation Therapy in Subacute Stroke Patients" [7], have made a research through a case study on 52 patients who were under treatment for three months and after that 30 patients were continued for the inpatient treatment and the rest of the 22 patients were discharged and received home-based care. The results were found out to be the better in the case of the treatment group rather than controlled group patients. The report of those 22 patients was not most effective. They used different methods to measure the functionalities measures just like to modify motor assessment scale (MMAS), the timed up and go (TUG), the 10-meter walking, Berg balance scale (BBS) and the Korean-modified Barthel index (K-MBI).

Dajana Dimovska, Patrick Jarnfelt and Shebbe Selving have proposed "Towards Procedural Level Generation for Rehabilitation" [8], has developed a game for rehabilitation named as Ski-Slalom on Wii balance board for patients with injured leg. As it has been challenging to develop a game with the help of Wii balance board, as the games played on this board are usually not applicable for the rehabilitation. So to introduced procedural content generation (PCG) this challenge can be solved.

J. W. Burke, M. DJ. McNeil, D. K. Charles, J. H. Crosbie and S. M. McDonough has proposed "Serious games for upper limb rehabilitation following stroke" [9], this paper mentioned about the why entertainment can be a much effective way for the rehabilitation of instances and to engage the patient. Here in this paper the games are to develop in consideration for the technology the virtual environment can be safe, customized and engaging for the patient. As a patient gets stroke 66%of the upper limb is affected due to it. As a result, the rehabilitation of upper limb can be done through serious gaming rehabilitation. The games were 80% effective, according to the feedback. 57% found that the input devices were very engaging and 90% of them found it easy to use. This concludes that the games gave an efficient feedback and more game design can be implemented further.

Peter Langhorne and Pamela Duncan have proposed "Does the Organization of Postacute Stroke Care Really Matter?" [10], in western countries the postacute rehabilitation had led to the funding of these services are limited patient access care; there is a short review to evaluate the effectiveness of these services. The obliged faultless 9 trials, 6 from the stroke rehabilitation unit and 3 from the general ward, in which for every 100 patients receiving organized inpatient multidisciplinary rehabilitation, an extra 5 returned home in an independent state [11].

3. CONCLUSIONS

High-end 3D games have supported the autonomous rehabilitation at home with the support of IGER functionalities. The rehabilitation has got more dynamic, safe and effective. It controls the computational intelligence methods, providing the monitoring of gameplay and the player action and also to maintain the difficulty level of the games, so that the result is effective. Moreover, the devices which are used are low-cost tracking devices. It builds a platform which is based on IGER very low-cost and its deployment is possible. The IGER has always been a fruitful and a much better platform for rehabilitation and not only at this level, but also in serious gaming domain it is exploited very well.

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