Working Alliance and Virtual Motor Rehabilitation in Parkinson Patients

Guillermo Palacios-Navarro
Universidad de Zaragoza
Calle Ciudad Escolar S/N
44003, Teruel, SPAIN
guillermo.palacios@unizar.es

Sergio Albiol-Pérez
Universidad de Zaragoza
Calle Ciudad Escolar S/N
44003, Teruel, SPAIN
salbiol@unizar.es

José-Antonio Gil-Gómez
José-Antonio Lozano Quilis,
Hermenegildo Gil-Gómez
Universitat Politècnica de València
C. Vera S/N, 46022, Valencia, SPAIN
{jgil,jlozano,hgil}@upv.es

ABSTRACT
Patients that suffer from Parkinson Disease (PD) have different symptoms such as tremors, stiffness and slowness in the execution of first movements and absence of balance control. This paper introduces the concept of wording alliance within a virtual rehabilitation system for Parkinson Disease (PD) patients. On one hand, the use of serious games increases the rehabilitation process in PD patients against traditional rehabilitation. On the other hand, this virtual environment encourages the links of confidence between therapist and patient, creating a stronger Working Alliance, which is vital in the patient rehabilitation process. This work in progress has been designed to examine both the working alliance during the virtual rehabilitation process, as well as the results obtained by patients as the clinical study goes on.

Categories and Subject Descriptors
H5.1. [**Multimedia Information Systems**]: Artificial, augmented, and virtual realities; H.5.2 [**Information Interfaces and Presentation**]: User Interfaces – *Graphical user interfaces (GUI), Interaction styles, Screen design, User-centered design.* J.3 [**Computer Applications**]: Life and medical Sciences – *Health, Medical information systems.*

General Terms
Design, Experimentation, Human Factors.

Keywords
Human Computer Interaction; Virtual Motor Rehabilitation; Therapeutic Alliance; Parkinson Disease.

1. INTRODUCTION
Parkinson disease (PD) is a chronic neurodegenerative disease. This manifests itself as a series of debilitating motor and non-motor symptoms having a significant impact on activities of daily living. Nowadays, approximately four million people worldwide suffer from PD, with an average of 1 out of 500 people. It is estimated that over 1,150,000 people aged over 65 in Europe are affected by PD [1].

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The main disorders of PD patients are: postural control and more specifically, disorders in the balance, existing in this type of patients a high percentage of risk of falls [2][3], which alter their quality of life. This kind of problems originates a high cost in worldwide health systems and even a high risk of mortality [4].

Besides the problems of postural control, PD patients also present other important deficits associated with their pathology: muscular inflexibility, injuries in visual-spatial tasks, fear to possible falls, loss of confidence, quakes, and mobility reduction to perform all activities in daily life (A-D-L) [5], tremor, bradykinesia, rigidity and postural instability [6]. Consequently, a detriment (physical and cognitive) will be generated [7].

2. RELATED WORK
The concept of Virtual Motor Rehabilitation arises from the need to perform a set of tasks by the clinical specialists in their daily occupation. This kind of novel techniques involves a deep change in the process of the traditional motor rehabilitation in such a way that the therapist-patient affinity (Therapeutic Alliance) is clearly reinforced. The importance of it for a successful therapy has been addressed widely [8][9].

The therapeutic Alliance can be defined as the collaborative bond between therapist and patient [10]. According to Bordin [11], the Therapeutic Alliance (TA) consists of three components: the positive bond which develops between a client and a counselor in the counseling process; agreement about the tasks of counseling treatment as well as agreement about the counseling goals. The TA is established through the interpersonal interactions between the counselor and the client in communication process. Nevertheless, this type of interrelation is not curative, but it fosters the compliance and follow-up of the therapeutic process.

On the other hand, Peschken and Johnson [12] stated that the confidence between therapist and patient enhances the degree of empathy, congruence and compliance. In the light of the foregoing, the Working Alliance is a joint construction between patient and therapist, in such a way that opinions and expectations developed all along the process are vital for a suitable establishment of the working alliance [13].

For these reasons, it is suitable to establish the corresponding links between both the therapist and the patient within the process of virtual motor rehabilitation. It is also convenient, before the establishment of the design and work methodology, to create a type of methodology that fulfills this type of interrelationships.

As far as Virtual Motor Rehabilitation is concerned, several sources [14][15] state that patient interest in performing repetitive tasks involved in traditional treatments is an important drawback

in the way of rehabilitation. Indeed, rehabilitation is by its nature repetitive, and repetition tends to "decouple" the mind, and reduce patient's motivation [16]. Another characteristic deals with the predominance of simple mechanical devices with little or no computerized sensing. Traditional rehabilitation is done one-to-one, meaning one therapist working with one patient. In fact, traditional approaches include exercises often considered repetitive and boring for patients [17]. To overcome this, virtual rehabilitation and serious games can augment physical and cognitive rehabilitation oriented to a significant therapeutic benefit. Virtual rehabilitation can be defined as computer-based technology providing a multisensorial environment with which the user can interact [18].

Technological advances have been gradually incorporated aimed at improvement people quality of living. The application of virtual reality technology for the rehabilitation of cognitive and motor deficits has been growing in the last decade and stroke patients have been one of the main target populations for these new rehabilitation methods [19]. These virtual reality based-methods can offer the patients to be part of immersive experiences that are engaging and rewarding for them.

Some examples can be found in Betker et al. [20], Ma and Bechkoum [21] allowing patients to interact with virtual objects in real-time through multiple modalities and to practice specific motor skills. Conconi et al. [22] introduced a platform for rapid development of serious games, with a special focus on therapeutic support games for behavioral and addictive disorders. Burke et al. [19] developed several games designed for upper limb stroke rehabilitation, which use low-cost webcams as input technology to capture video data of user's movements.

The advantages associated with the use of Virtual Rehabilitation are numerous. The same hardware can be used for various types of patients (children with attention deficits, post-stroke patients, etc.), as well as for various types of exercises done on those patients. Thus a major advantage in all forms of Virtual Rehabilitation is economy of scale [16]. Another great advantage is interactivity and motivation [23][24] By providing visual and auditory rewards, such as displaying gratifying messages in real time ("Great", "Very Good", etc.) or visual stimuli [25], patients are motivated to exercise. Immediate feedback on patient performance and results [26] seems also to be a remarkable help in the rehabilitation process of patients. Games also require cognitive and motor activity so they can engage a person's attention [15], and most games offer increasingly difficult levels that give the player the sense of challenge in his progress and in such a way that is also adapted to his skills. Another important aspect is that games distract the patient's attention and can be used to aid in the management of pain [15] [19].

It has been showed that games contribute to increase motivation in rehabilitation sessions, which is the major problem in therapy sessions, caused by the repetitive nature of exercises. Literature is plenty of "serious games" for rehabilitation purposes. This concept has been defined by Michael and Chen [27] as "games that do not have entertainment, enjoyment or fun as their primary purpose". Serious games are not only the application of games and games technology, they are entertaining, enjoyable and fun, but their main purpose is other that was conceived by the game designer when designing the game or that the user defined when played the game.

Information Technologies (IT) used in the framework of health sciences allow to establish a narrower relation between the patient and the specialist, as well as to increase the communication between both [28]. Within the area of patients' rehabilitation, we find a series of associations and forums involved in facilitating relevant information about rehabilitation processes, where experiences are shared, diagnoses generation done by physicians, questions related to symptoms in specific conditions, answers raised by patients with PD during the rehabilitation process, inherent information in last stages in PD, affective connections among patients having this type of ailments, relatives and physical therapists, forums comprised of medical experts who solve any situation and analyze rehabilitation sessions. Furthermore, we can find communities of scientists, rehabilitators, clinical staff and patients committed to collaboration with those experiences of special relevancy related to this type of ailments.

Our proposal deals with the evaluation of the working alliance within a virtual rehabilitation system (PARK-Rehab System) based on serious games. We think this association will improve the effectiveness of rehabilitation in PD patients.

3. METHODS

3.1 Participants

We have chosen 4 PD patients belonging to the Teruel PD Patients' Association. In this experiment, only one group of patients has been considered: the virtual group, which will use our virtual system. The inclusion criteria are: subjects needs to obtain a score in the Mini Mental State Examination greater than 23 (>23), in order to ensure the correct participation; patients should be between 50 and 75. The exclusion criteria are: clinical instability, patients with a history of falls and patient refusal. All the patients have movement slowdown and thinking slowdown. Two of them have rigidity, one has tremor, and one has hearing impairment.

3.2 Instrumentation

The PARK-Rehab system was designed and developed using UNITY Software and it uses low cost devices such as Tablet PCs. Unity is a development engine of 3D and interactive content that allows publishing/exporting to different platforms, included mobile platforms (iOS, Android). We have chosen this tool taking into account the following reasons: it is free for non-commercial use, it allows the importation of 3D models from the majority of existing platforms and it is relatively simple to use. Three programming languages are available: JavaScript, C# and Boo. We have use C#. The created scripts are added to the 3D models imported to the scene in order to indicate the object behavior as well as its interaction with other objects. To make virtual rehabilitation more feasible for patients, Tablet PCs have been selected, as most of our patients have such devices at home and are familiar with them.

At the moment, two well-known games have been implemented inside the system: 'Simon' game and the 'Dominoes' game. They both are used by PD Patients in their traditional rehabilitation. Figure 1 shows a PD Patient playing the dominoes game. See Table I for a short description of both games

3.3 Training Programme

The study was carried out in the Teruel Parkinson Patients Association.

Figure 1. A PD patient playing the dominoes game.

The PD patients will perform a total of 20 30-minutes-sessions using PARK-Rehab, twice a week in a pre-fixed timetable.

3.4 Metric Analysis

Data gathered from each interaction session is stored in separated files and can be individually processed. The data samples are analyzed to derive a series of metrics which are proposed to indicate the severity of various PD symptoms. Initially, we have considered the following metrics:

The Performance Rate (PR) or (% correct clicks) provides an indication of the impact of PD motor symptoms on the completion of fine motor tasks. This is calculated by comparing the number of correct clicks to the number of incorrect clicks. A correct click is defined as a button press performed while the cursor intersects with the desired target. An incorrect click is defined as any other unnecessary button press.

The Level of Difficulty (LD) provides the maximum level obtained by the patient in every session. It is supposed to be increasing as the number of session increase.

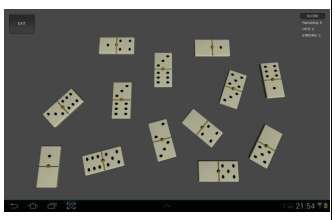
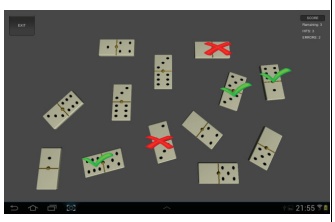
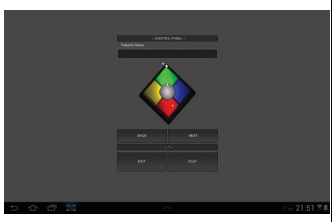
The Completion Time (CT) (milliseconds) describes the total time taken to complete tasks which are not time limited.

For the measurement of the working alliance between the patients and their therapists, the short form of the Working Alliance Inventory (WAI) [29] will be used. The patient/therapist short forms of the WAI comprise 12 items, each four measuring the goal, task and bond aspects of the working alliance. The WAI items were rated separately and independently by the patients and their respective primary therapists on a 7-point Likert scale ranging from 1 = 'not at all' to 7 = 'a lot'. Prior to the completion of the questionnaires, both the patients and therapists will be informed that their ratings would be treated as confidential. The questionnaire regarding their working alliance will be performed at the end of session 2 and again at the end of session number 20 by both therapists and patients.

4. DISCUSSION AND CONCLUSIONS

The purpose of this work in progress deals with the examination of development and interaction of the working alliance during the process of virtual rehabilitation in PD patients. Furthermore, a series of metrics are stored for every patient, in order to show their evolution along time.

Table 1. Implemented games in Park-Rehab System

DOMINOES GAME	
Virtual Game	Visual Aspect
A series of dominoes pieces are shown to the patient. A score showing the hits, errors and remaining pieces to complete the task	
The patient select the the dominoes pieces whose sum is equal or greater than six.	
SIMON GAME	
A Contol panel showed in the initial screen allows the therapist to enter the patient's data.	
The patient has to remember the presented sequence by pushing the right buttons. The level of difficulty is more and more challenged	

At the moment we are immersed in the virtual rehabilitation process, and first inputs coming from both therapists and PD patients are promising, showing a great deal of commitment in the virtual rehabilitation process. Future work deals with the establishment of two groups of patients: a control group and a virtual group, respectively. In this way, we will be able to show the benefits of virtual rehabilitation in conjunction with the working alliance in the process of PD patients' rehabilitation.

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