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HomeCoRe: Bringing Cognitive Rehabilitation at Home

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Abstract

CoRe is a system for cognitive rehabilitation that has been successfully used for several years in hospital settings. Leveraging on the positive survey results from the potential final users (patients and their home caregivers), we developed HomeCoRe. This new version of the system will allow discharged patients to continue the rehabilitation treatment at home.

Keywords:

Home care services; neurological rehabilitation; therapy, computer-assisted therapy

Introduction

CoRe is a program for computer-supported cognitive rehabilitation. Since the development of first CoRe version over ten years ago, we have enhanced the through several iterations. It has been used in different clinical settings for face-to-face rehabilitation sessions between patients and their therapists [1]. A recent clinical study on hospitalized patients affected by Parkinson's disease [2] showed that patients undergoing one month of rehabilitation through CoRe outperformed control patients in the standard battery of neuropsychological tests administered at the clinical cognitive assessment before discharge. However, this advantage was less evident at the six months follow-up after discharge. This observation motivated the development of HomeCoRe, a version of the system that allowed patients to continue rehabilitation at home, after becoming familiar with the program during the hospital stay. We propose that a longer rehabilitation period will maintain the benefits achieved in the first month.

Methods

For the first stage, we interviewed and surveyed patients to investigate their willingness to continue rehabilitation at home. Home caregivers were also study participants, due to their role in both supporting and motivating patients.

The technical stage had the HomeCoRe architecture embedded into two main components, therapist-side and patient-side, and communication channels between them. Consideration was given to addressing the lack of availability of internet connection at home, and particularly for the elderly. The two components communicated through XML files that, from case to case, were either automatically sent using the internet (online mode) or manually shared (offline mode) through flash memories like usb drives, at the control visits.

From the functional point of view, to increase the patient motivation for the rehabilitation treatment, we exploited a unique characteristic of CoRe that was capable of generating "ever new" exercises, due to a stimuli ontology composed by thousands of images, words and sounds, and relationships among them. Moreover, HomeCoRe was able to generate patient-tailored exercises, by adding to the ontology a "private", patient-specific set of stimuli representative of his daily life (pictures from his house, his relatives, sentences related to his job, hobbies, etc.). To monitor a patient's progress, the system calculated an "overall weighted score (OWS)", taking into account the correctness of the answers, the execution time, and the difficulty of the exercises. A temporal abstraction algorithm informed the therapists about the OWS trend. All components were developed in Java.

Results

Out of 21 patient participants, 15 (71.5%) had definite positive responses, 2 (9.5%) had definite negative responses, and 4 (19%), although appreciating HomeCoRe, expressed a refusal to have a further home commitment. Even better results were obtained from caregivers. We were able to interview 16 of them, and 15 (94%) answered positively. The study results encouraged us to start the HomeCoRe project.

Discussion

The therapist's view, migrating from CoRe to HomeCoRe implied to add some functionalities to the therapist's interface. Figure 1 details the top (a) and lower (b) left panel of therapist's interface for creating/selecting patients, managing patients' data and therapeutic plans, and the system dashboard. Figure 2 illustrates the therapist's interface for visualizing the details of the active and expired therapeutic plans for the selected patient.

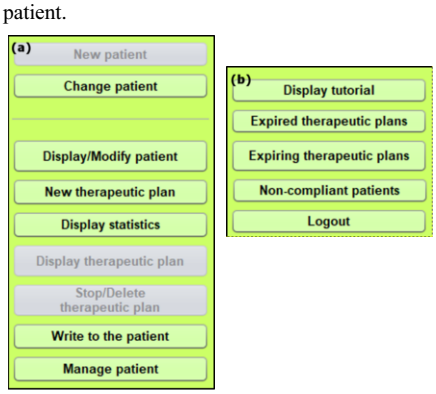

Fig. 1 – Details of the Therapist's Interface with all the System Functionalities

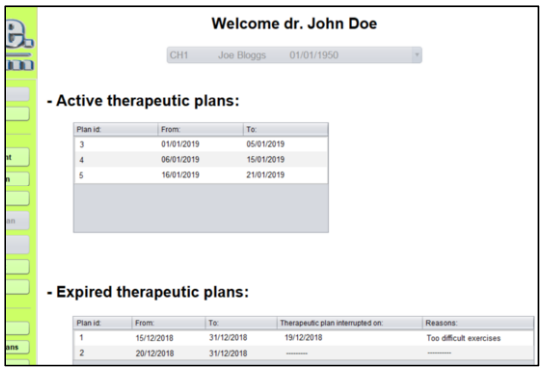

Figure 2 – The Therapist's Interface for Viewing the Active and Expired Therapeutic Patient Plans

The psychologist was able to prepare an entire rehabilitation plan, personalized to a specific patient (see Figure 3). As mentioned, the plan was represented through a XML file that, according to the clinicians' requirements, described (i) the type of exercises for each rehab session, (ii) the duration of the plan in days and daily frequency of execution, (iii) the difficulty level, and (iv) a set of parameters defining some other details, such as the automatic modification of the difficulty level according to the patient's performance, the feedback for the patient, the stimuli exposure time, etc.

The therapist was also able to set a *goal*, i.e. a score that the patient should achieve at the end of the plan execution. The idea was that, if a patient achieved OWS_{disch} at discharge, the goal could be OWS_{final}= OWS_{disch} +y at the end of the plan, with y>=0, decided according to the estimated potentialities of the individual patient. Similarly, goals could be defined for the neuropsychological tests scores (even if they were not continuously measured as the OWS, since they required a face-to-face visit).

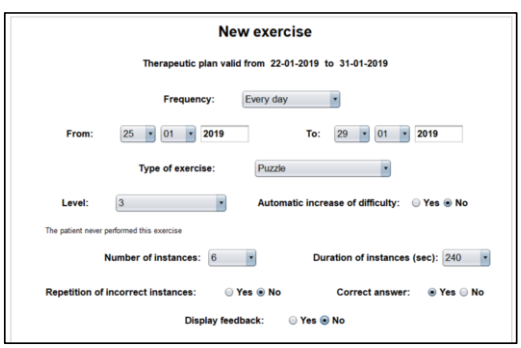

Fig. 3 – The Therapist's Interface for Setting the Requirements for the Exercise Plan

At any time, the therapist could check a patient's progress, and the system showed him the percentage of goals achieved. Accordingly, the therapist could modify the rehabilitation plan or update (upgrading or downgrading) the goals.

On the patient's/caregiver's side, the interface was very simple to use (Figure 4). Patients were able to view the exercises of the day, read the message from their therapist and exit. The caregiver could access his private area with a username and a password. The caregiver had a restricted area, where he could upload the XML file and download the results (offline mode) and see all the messages sent by the therapist.

Figure 4 – Home Page of the Patient/Caregiver

All the exercises were performed through a touchscreen (Figure 5). The interface always showed information about the completion percentage of the tasks.

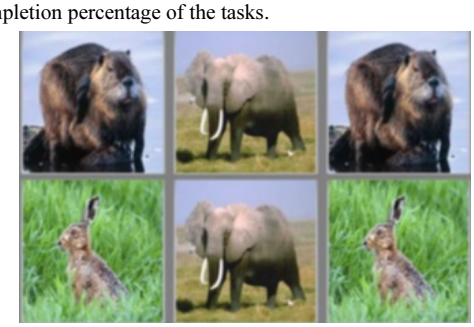

Figure 5 –Memory Exercise Example in the Therapeutic Plan

Conclusion

HomeCoRe is a tool for personalized cognitive rehabilitation that allows patients to continue a rehabilitation plan, which is often abandoned after discharge, due to scarcity of healthcare personnel for homecare. The limitation of the presented work is the lack of a clinical study to show the users' acceptance and efficacy of our proposal. We plan to start a pilot study to refine the system functionalities, in particular communication among patients, caregivers and therapists, and training modalities. Possible next steps include installation of in-hospital workstations to allow patients and caregivers to simulate future home sessions and assessment of the organizational changes that occur with the introduction of technological innovations [3].

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