
TagTrainer: end-user adaptable technology for physical rehabilitation

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Abstract

TagTrainer is an end-user adaptable technology for physical rehabilitation. Patients can perform training exercises that require the manipulation of physical objects on three interactive surfaces. Therapists can adapt, extend and create exercises to fit the needs of individual patients. The system addresses a range of important issues in physical rehabilitation, such as treatment personalization, increasing treatment efficiency, and increasing patient motivation.

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Author Keywords

Rehabilitation technology; end-user development; physical interaction; tangible interfaces.

ACM Classification Keywords

H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous; J.3 Life and medical sciences: health.

Introduction

The incidence of age-related diseases such as stroke is on a rise [2]. This increase puts pressure on the healthcare system, especially on care providers such as rehabilitation therapists. At the same time, there is a trend towards providing better and more personalized care. We believe that well-designed technology can aid therapists to provide increasing quality of care to a growing number of patients.

This belief has been the onset for a four-year research project (WikiTherapist) on rehabilitation technology that can be adapted, by therapists, to the needs of individual patients. During the course of WikiTherapist, we designed and developed TagTrainer in close collaboration with clinical and technological partners.



Figure 1: TagTrainer setup with three interactive surfaces.



Figure 2: Two RFID tags have been attached to a cup. The tags allow TagTrainer to track the cup's position and rotation.

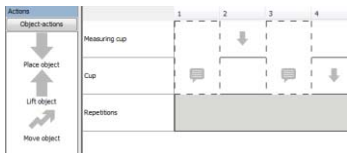


Figure 3: Close-up of the timeline based visual programming interface for therapy exercises.

TagTrainer

TagTrainer [1] is an end-user adaptable technology for physical rehabilitation training. The system consists of three interactive tabletop surfaces that are connected to a laptop. Two of the interactive surfaces are integrated in a movable table, the third surface is mounted above the table on a flexible arm (see Figure 1). Compared to the initial design with just one interactive surface [1], the current version provides therapists with greater flexibility in designing exercises, expanding the target user group towards patients that train coarse motoric skills (e.g., reaching). The laptop runs software that guides patients in the execution of training programs (TagTrainer Patient Interface), as well as software that allows therapists to modify, extend and create new training exercises (TagTrainer Exercise Creator).

Exercises

Exercises are constructed by sequencing manipulations (moving, rotating, placing, picking up, etc.) of objects of daily life (e.g., cups, cutlery) on the interactive surfaces. Objects are tagged with color-coded radio-frequency identification (RFID) tags (see Figure 2), such that the surfaces can detect their position, and changes thereof. In an example exercise, a cup would be equipped with two tags: one on its bottom, and one on the end opposite to the grip. The patient is instructed to lift the cup from the left-bottom surface and touch the elevated surface with it. Finally, the cup is placed on the right bottom surface, and the exercise is repeated in reverse order.

Patients performing an exercise get visual feedback on the surfaces, as well as visual and auditory feedback on the laptop.

Extension & adaptation

Therapists can easily extend and adapt exercises, without requiring any programming knowledge. The TagTrainer Exercise Creator offers a visual programming interface that allows therapists to position 'action blocks' (i.e. manipulations of objects) on a timeline (see Figure 3). Adaptations can reach from simple parameter setting (e.g., target locations for the object) to altering the exercise structure entirely. New objects can be integrated in exercises by simply attaching color-coded RFID tags to them. This allows therapists to create personalized exercises within minutes, providing them with the opportunity to increase the patients' motivation to perform exercises, and increasing the quality of care.

Contribution

We believe that TagTrainer is a valuable contribution to the PervasiveHealth community. It provides an item for discussion on topics such as patient tailored care, the way in which technology can facilitate tailoring, and the way in which end-user adaptable technologies such as TagTrainer should be deployed in a clinical context.

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