Chapter 6

Difficulty and Scenario Adaptation:
An Approach to Customize Therapeutic Games

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ABSTRACT

Post-stroke therapeutic games are considered to be a promising rehabilitation tool since they can enhance the rehabilitation outcomes by creating a motivating environment. A therapeutic game could provide a personalized rehabilitation session in which the training intensity, duration, and challenges could be adapted to patient's abilities and training needs. This chapter presents a generic adaptation approach that aims to customize the therapeutic game's experience. The objective is to provide the readers with a design steering method that takes into account practical issues related to the adaptation of post-stroke therapeutic games.

INTRODUCTION

Stroke is a medical emergency that can cause permanent neurological and functional damages and disabilities. It can cause, amongst others, hemineglect, the inability to move one or more limbs on the controlateral side of the body and to understand or formulate speech.

Various studies have shown that stroke rehabilitation can improve motor functions, allowing stroke patients to regain their independence and quality of life (Kan et al, 2011). Most rehabilitation strategies are founded on the principles of motor learning and skill acquisition established for the healthy nervous system. These studies suggest that the outcome of neurorehabilitation therapy depends on the quality and amount of the physical activity as well as the patient's active participation or engagement in the therapy session (Cirstea et al, 2001; Dobkin, 2005; Levin, 2010)

Stroke patients who need to capture or practice a certain skill, all have different abilities and

training needs. Therefore, stroke rehabilitation programs should be adapted to patients' abilities in order for them to regain as much motor functions as possible. Therapists train patients by proposing adapted activities and supporting patients' motivation through appropriate feedbacks. In addition, repetition is crucial for the re-learning of patient's motor functions and skills improvement. However, in their daily rehabilitation session, patients often become tired and frustrated due to their weak recovery rate and repeated therapeutic activities (Homberg et al, 2005)

On one hand, therapeutic games afford a rehabilitation environment in which the training intensity, duration, and challenges can be manipulated and enhanced. Integrating gaming features and adapting therapeutic tasks in rehabilitation's virtual environments could enhance patient's motivation (Popescu et al, 2000), which is a key to recovery. An adaptive therapeutic game helps therapists to carry out the rehabilitation session by adjusting the tasks' difficulty to a patient's abilities. It can support a patient's motivation by introducing variability and meaningfulness to the repeated activities.

On the other hand, therapeutic games also have to be faithful to game principles as they should maintain entertainment and engagement factors while serving their primary pedagogical purpose. Thus, the main challenge that can be considered is to adequately meet game features and therapeutic needs.

In this chapter, we deal with a generic adaptation approach for serious games dedecated to upper-limb post-stoke rehabilitation based on pointing or reaching tasks. Our purpose is to provide the readers with a design steering method that seeks to meet both video game and therapeutic requirements. The layout of the chapter can be described as follows:

- We begin in section two with the general background that concerns stroke rehabilitation using a serious game. We discuss the different game design challenges and adaptation issues.
- In section three, we overview difficulty and scenario adaptation techniques in serious games, especially in therapeutic games. This allows for making clear our contribution as well as the objective of this work.
- Section four describes the therapeutic game design process that allows the determination of adaptation parameters, mainly the player's profile.
- In section five, we present the rationale behind the adaptation approach that represents the therapeutic game abstract model.
- Section six gives an outlook about the adaptive system architecture to help get a general idea about the proposed approach.
- In section seven, we explore the scenario adaptation and the difficulty adjustment approach. We also make clear the scenario structure and the decision making process on game difficulty.
- Moving from theory to practice, in section eight, we explain the adaptation process through a case study and a pilot experiment. The latter aims to show the impact of dynamic difficulty adjustment on players' motivation.
- Our closing words are reserved to discuss our initial findings through the pilot experiment's results and initiate our future work. We also expose further adaptivity challenges that the game design process still faces and therefore open up a variety of promising research directions.

TOWARD THERAPEUTIC GAME BASED REHABILITATION SESSION: CHALLENGES AND ADAPTATION ISSUES

In a traditional rehabilitation strategy, rehabilitation programs are organized as a set of exercises

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