AGATHE: a tool for personalized rehabilitation of cognitive functions

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***Abstract*—Virtual Reality has recognized assets to address some cognitive rehabilitation issues. The purpose of this poster is to present an overview of the design of AGATHE, a tool for personalized rehabilitation of cognitive functions based on simulated Basic and Instrumental Activities of Daily Living (sBADL and sIADL).**

Keywords— Brain injury, Cognitive rehabilitation, Virtual Reality, Simulated Basic and Instrumental Activities of Daily Living (sBADL and sIADL), Virtual Therapeutic Scenario (VTS)

I. INTRODUCTION

Cognitive impairments are a major factor of loss of autonomy and dependence. Each year in France, more than 25,000 people, mostly young adults between 15 and 25 years, suffer from cognitive impairment resulting from Traumatic Brain Injury (TBI), especially after a road accident [1]. At the same time, more than 130,000 people suffer a disabling stroke [2]. These brain lesions induce alteration of several cognitive functions, limitations in activity and participation, and finally reduction of quality of life [3]. Rehabilitation interventions are needed to enable these people to recover capacity and return to instrumental Activities of Daily Living (iADL), such as grocery shopping. Unfortunately, traditional paper and pencil approaches are below the expected efficacy and ecological interventions are often difficult to carry out.

The assets of virtual reality to address this big problem of public health are today scientifically recognized [4, 5]. In this context, we designed the AGATHE[1] tool (Adaptable, configurable and upgradable tool for the generation of personalized therapeutic applications in cognitive rehabilitation [6]. Six partners with complementary multidisciplinary skills worked together to design and produce the AGATHE tool. The Research Team included partners from Arts et Métiers ParisTech (project leader) and from Mines ParisTech, both specialists in virtual reality and its challenges. The Health Team included the Bordeaux EA 4136 team and the Kerpape rehabilitation center, featuring specialists like rehabilitation clinicians, occupational therapists and neuropsychologists. The Industrial Team included two software publishers Dassault Systèmes and Intempora.

The poster will present an overview of fundamental design issues.

II. FUNDAMENTAL DESIGN ISSUES

AGATHE objective is to provide therapists with an innovative means of dealing with cognitive rehabilitation and to offer patients customized rehabilitation sessions, on the basis of various simulated Basic and Instrumental Activities of Daily Living (sBADL and sIADL).

We adopted a co-design approach which involved the whole partners of the AGATHE project. Thanks to the observation of cognitive rehabilitation sessions and to brain storming meetings, we collected and synthesized the needs and practices of therapists working in rehabilitation (physicians, neuropsychologists, occupational therapists).

AGATHE is a software tool dedicated to two types of users (patients and therapists) (Figure 1). Its core consists of a virtual neighborhood where functional places are positioned (town, studio, post office, and supermarket) (Figure 2). Each functional place is conducive to functional tasks or specific sBADL and sIADL (topographic tasks, post mail, shopping ...). While interacting during the Virtual Therapeutic Scenario (VTS), the participant's activity is recorded in the real world thanks to sensors (e.g. camera) as well as in the virtual world thanks to indicators that can be either generic and therefore common to all tasks, such as

[1] AGATHE : outil Adaptable, paramétrable et évolutif pour la Génération d'Applications THErapeutiques personnalisées de rééducation cognitive

session length or duration, or specific to the task, such as the time in a crossroads for a task topographic or reaction times during the dialogue with the post man. The analysis of the activity provides a picture of the participant's cognitive and global functioning.

Various functionalities were implemented in order to adapt the VTS to participant's capacities. For example, various levels of instructions are available (step by step, guided, semi-guided or global); a plan of the town may be used by the participant to understand how to reach a place in topographic tasks. Graphical

Graphical User Interfaces (GUI) have been developed around AGATHE core. Therapist GUIs are used for setting the tasks, managing the instructions and the aids, supervising or replaying patient's activity. Patient GUI provides tools potentially useful to carry out the task and linked to specific information (pause, plan of the neighborhood, instruction, help, date and time).

Different interaction interfaces were included in the AGATHE tool. Thus, users can interact (navigation, selection) in the virtual environment using the keyboard and the mouse, a joystick or a Microsoft Kinect. Software architecture of AGATHE tool provides the ability to integrate other interaction interfaces in the future.

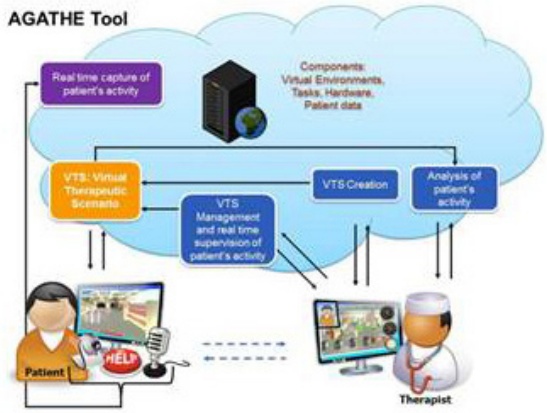

Figure 1. AGATHE tool

Figure 2. AGATHE neighborhood and patient point of view

III. CURRENT WORK AND PERSPECTIVE

Usability tests were carried out among healthy subjects and patients with brain injury during two protocols protocols (P1: Therapists and P2: Patients). We collected the feedback of 15 therapists (physicians, occupational therapists, neuropsychologists, speech therapists) and 13 patients after stroke that contributed to the iterative process of tests and development. Therapists succeeded in customizing the experience to match patient functioning and needs, and to gradually stimulate cognitive functions. Patients willingly invested themselves in the attractive and rewarding rehabilitation tasks.

A clinical trial is currently set up in order to validate the efficacy of the personalized interventions among patients after stroke. Next steps will consist in consolidating the current prototype and increasing its functionalities, as well as assessing the efficacy of AGATHE-based rehabilitation among various populations of patients.

During Laval Virtual, AGATHE project received the SIGGRAPH – Emerging Technologies award, and is invited to participate to SIGGRAPH 2013.

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