AGATHE: a tool for personalized rehabilitation of cognitive functions

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1. Introduction

Stroke, traumatic brain injury, multiple sclerosis, Parkinson's disease, Alzheimer's … Every year in France, tens of thousands of people fall victim to one of those neurological pathologies. Acquired brain injury leads to cognitive impairment and heavy loss of autonomy. Rehabilitation interventions are needed to enable people to recover capacity and return to Activities of Daily Living (ADL), such as grocery shopping. Unfortunately, the resources made available in cognitive rehabilitation are insufficient for the growing needs of victims of brain damage. The assets of virtual reality to address this big problem of public health are today scientifically recognized [Rizzo and Kim 2005; Klinger, et al. 2010].

In this context, we designed the AGATHE tool (Adaptable, configurable and upgradable tool for the generation of personalized therapeutic applications in cognitive rehabilitation) (AGATHE project, ANR-09-TECS-002).

2. Exposition

AGATHE is positioned as an industrial research project that was conceived and coordinated by Arts et Métiers ParisTech. Five other partners participated to the design of the tool: Bordeaux EA4136, Kerpape Rehabilitation Center, Armines, Intempora and Dassault Systèmes. 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 Activities of Daily Living (sADL). It also opens a new application field to the technology of the industrial partners.

2.1 Elaboration

AGATHE tool is a software package dedicated to two types of users (patients and therapists) and based on two real-time software 3DVIA Studio from Dassault Systèmes (creation of real-time virtual interactive environments) and RTMaps from Intempora (monitoring and real-time recording of patient activity through sensors). Its core leans on a virtual neighborhood where functional places are positioned (town, studio, post office, and supermarket). Each functional place is conducive to functional tasks or specific sADL (topographic tasks, post mail, or shopping). While interacting during the Virtual Therapeutic Scenario (VTS), the participant's activity is recorded in the real world thanks to sensors as well as in the virtual world thanks to indicators. The analysis of the activity provides a picture of the participant's cognitive and global functioning.

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).

Figure 1. *AGATHE neighborhood and Patient point of view*.

3. Results

Usability tests were carried out among healthy subjects and patients with brain injury. 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.

4. Conclusions

With AGATHE, virtual reality serves cognitive therapies, by offering patients customized rehabilitation sessions, on the basis of sADL, and by allowing therapists to measure patient activity and to follow-up his progress. With AGATHE, patients become actors of their therapy. Since mid 2012, AGATHE is being tested with patients in two rehabilitation centers in France. The first phase of this research project ended successfully in Nov 2012 and we are now looking for investors to bring this tool to the market in Europe and in the U.S.

References

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