Developing virtual environments with intelligent interface agents to support virtual treatments

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Abstract. *In general, people who have suffered brain damage, have to perform physical therapies in order to recover lost physical movements. These patients rarely follow treatments associated with cognitive stimulation practices. This paper proposes the integration of inter-institutional collaborative groups to construct and use 3D virtual environments to support cognitive rehabilitation of people with different types of brain damage. These environments may contain intelligent interface agents that help the patient perform the proposed tasks. As there are certain groups in the context of the INRIA working in this field, the integration of researchers from Brazil and France could open new perspectives for the development of new technological applications and new ways of using these environments.*

1. Introduction

The technology advances are promoting changes in the activities associated with surgical and therapeutic training or professional updating. Such applications require new approaches towards study, design, construct, and use of computer systems in an efficient way.

Nowadays, medicine and technology are investigating new applications that extend the possibilities for treatment of various disorders and diseases, exploring the new information and communication technologies. Recently, we had some interesting results that are relevant in opening new possibilities to the Virtual Reality (VR) application in treatment of brain damage patients. Alternatively, the VR applications are trying to integrate the new tendencies of Artificial Intelligence to increase the human-computer interaction.

In 2000, the Census showed that the number of people who declared some disabilities is around 24.5 million, approximately 14.5% of the Brazilian population. This percentage is divided into: 8.3% of mentally handicapped, 4.1% of physical disabled, 22.9% of motor disabled, 48.1% of blindness and 16.7% of deafness [Sarraf, 2009]. These high percentages require an expansion of activities for efficient treatment and social reintegration for these people.

Therefore, this project proposes the creation of an inter-institutional group dedicated to the creation of virtual environments that exploit the new technologies of Virtual Reality (VR). It also integrates Intelligent Interface Agents to create sociable tools to support the treatment of patients who have suffered brain damage resulting in cognitive disabilities.

The target of this project is to promote a collaborative network integrating groups from two specific areas: the Computer, by researchers interested in Virtual Reality and Artificial Intelligence; and another group of physicians interested in testing these environments with patients with cognitive disabilities resulting from different brain accidents and diseases. The virtual environments can stimulate the achievement of daily activities associated to executive functions, readapting patients to social living.

In the next sections we will briefly present the basic theories related to the research, some preliminary results that were obtained from previous work, and the possible multidisciplinary inter-institutional groups that have works on related topics, in the context of INRIA (Institut National de Recherche en Informatique et Automatique).

2. The Intelligent Interface Agents

The concept of intelligent agents emerged from the Artificial Intelligence (AI). Agents are the main tool of a futuristic interface, where computers communicate with users exploring similar expressions used in the human communication. The challenge of the complex systems construction is dealt with the systems control. An agent oriented paradigm reinforces the software flexibility and the agents´ social possibilities. The interface agents act as assistants, supporting users to achieve tasks. They can be used to help instruction and education processes, replacing humans in software applications, or assisting users to navigate in complex environments. These animated characters can be employed as a natural way to provide users with additional information.

3. Virtual Reality

Virtual Reality includes advanced technologies of interface, immersing the user in environments that can be actively interacted with and explored. Moreover, the user is able to accomplish navigation and interaction in a three-dimensional synthetic environment generated by computer, using multi-sensory channels. In this case, diverse types of stimuli can be transmitted by specific devices and perceived by one or more user's senses [Burdea,2003].

VR applications are being explored in different areas through the development of pilot projects that aim mainly to discuss and experience the possibilities offered by this technology.

The integration of VR with the intelligent agents was the subject of research made by Bouchard et al. (2006), Araújo et al. (2009) and Yang et al. (2008). These studies used the interface agents to increase the user involvement with the activities in virtual environments and discussed the technology limitations and advantages.

4. Cognitive Rehabilitation through Virtual Environments

The introduction of VR is being considered as a new aid to diminish the difficulties involved in the cognitive rehabilitation (CR) process, making these activities more friendly and fun.

Recently, several experiments and described case studies have been performed, yielding positive results. These researches as presented by Dawson et al. [Dawson,

2008] and Broeren et al.[Breoeren, 2008] encourage the studies for the integration of these fields. Corroborating these results, the experiments developed in recent years by our inter-institutional research group with patients with neuropsychiatric disabilities [Costa, 2004], [Cardoso, 2006], [Piovesana Neto, 2007] are also showing very interesting results. These pilot studies sought to discuss and experiment with the possibilities offered by this technology. In these contexts, VR is allowing therapeutic practitioners to help their patients in a number of innovative ways, offering new approaches to old questions and augmenting the effectiveness of consolidated methodologies. The use of VR technology, with an interface nearer to reality, could reduce the gap between patients and daily life tasks, decreasing fear of errors.

The potential of the interface agents to facilitate human-computer interaction, stimulated the development of an environment where these agents support the activities carried out by patients and may generate a higher level of motivation to perform the tasks. The environment is a house divided into rooms (Figure 1a); each room provides activities for cognitive stimulation. The interface agent is in the kitchen (Figure 1b), where he supports the execution of tasks associated with daily activities.

The test's first results demonstrated that we have some technical problems associated with the integration of this reactive agent in this environment and its communication with the users. In that case, we need to define new intelligent relationships and include new criteria to control the agent behavior.

(a)   (b)

Figure 1. Façade of the house and the main entrance of the kitchen with the agent image [Piovesana Neto, 2007].

5. Integration possibilities with the INRIA groups

Currently, our team is composed of researchers/teachers from the Department of Informatics and Computer Science of the State University of Rio de Janeiro (UERJ), Program of Systems Engineering of COPPE-Federal University of Rio de Janeiro (UFRJ), the Faculty of Medical Sciences from UERJ, and the Laboratory of Neuropsychology, Cognition and Cognitive Rehabilitation of the UFRJ Hospital. Our previous experience in the development of studies in the cognitive rehabilitation, supported by 3D virtual environments allowed us to continue toward the same direction of interdisciplinary researches.

In the context of the INRIA, we verified that some groups have many points of adhesion to this proposal. The "Alcove Project" (INRIA, 2007) works with the

construction of 3D interfaces because of the possibilities for cooperation offered by them and has obtained significant results in the navigation and interaction in 3D environments. This group also developed studies in the Cognitive Rehabilitation area: the "Reactive ANR TecSan Project", which has been developed in conjunction with the Foundation HOPALE (Medical Institute specialized in rehabilitation). This project also involves other partners in the CEA, as the Idees3com Company.

Another group that stands out at INRIA in the context of our line of interest is the "Bunraku Group" (INRIA, 2007), which examines the possibilities for interaction in 3D virtual environments and also studies the impacts of the inclusion of intelligent agents in virtual environments.

6. Final Comments

This paper outlined the base theoretical aspects of a project that is being developed by researchers from two public universities in Rio de Janeiro and its promising results.

This proposal has two approaches; the first one is associated with the technical questions, studies and the application of intelligent agents in 3D virtual environments. The other assesses the impact of these agents in the interaction of users within these environments.

Some groups that developed studies in the context of INRIA have good prospects of integration with our group. This collaborative association can open new possibilities to enlarge the development and testing of 3D virtual environments in the cognitive rehabilitation field.

References

Araújo, A. S. ; Carvalho, L.A.; Costa, R. M. E. M. (2009). "The influence of intelligent characters on the users' navigation through a three-dimensional Virtual Environment". *Presence,* (submitted for publication).

Bouchard, S., Dumoulin, S., Chartrand-Labonté, G., Robillard, G., Renaud, P., (2006). Perceived realism has a significant impact on presence, *Cybertherapy Conference*, Quebec.

Broeren, J., Bellner, A-L., Fogelberg, M., Göransson,O., Goude,D., Johansson, B., Larsson, P., Pettersson, K., Rydmark, R*., (2008),* "Exploration of computer games in rehabilitation for brain damage", *Seventh International Conference on Disability, Virtual Reality and Associated Technologies*, Maia, in: http://www.icdvrat.reading.ac.uk/2008/index.htm#abstracts-section-i, visited on 2009-March.

Burdea, G. C., Coiffet, P., (2003), *Virtual Reality Technology*, J. Wiley & Sons Inc.

Cardoso, L., Costa, R. M., Piovesana, A., Costa, M., Penna, L. (2006), "Using Virtual Environments for Stroke Rehabilitation", *IEEE- 5th International Workshop on Virtual Rehabilitation*, New York, p. 1-5.

Costa R.M., Carvalho, L. A. (2004). "The Acceptance of Virtual Reality Devices for Cognitive Rehabilitation: a report of positive results with schizophrenia", *Computer Methods and Programs in Biomedicine*, Elsevier Science, 73(3), p.173-182.

Dawson, A., Buxbaum, L., Rizzo, A., (2008), "The Virtual Reality Lateralized Attention Test: Sensitivity and validity of a new clinical tool for assessing hemispatial neglect", *Virtual Rehabilitation 2008*, Vancouver, in: http://www.virtual-rehab.org/2008/advanced_program.html, visited on 2009-March.

INRIA, (2007) "Scientific Activity Reports", INRIA.

Piovesana Neto, A. (2007), "O desenvolvimento de ambientes virtuais para a Reabilitação Cognitiva", *Workshop de Iniciação Científica do IX Symposium on Virtual Reality-SVR2007*, Petrópolis, (in Portuguese).

Sarraf, V. P. (2009) "A inclusão dos deficientes visuais nos museus", in: http://museuacessivel.incubadora.fapesp.br/portal/publicacoes/artigos/inclusao%20dos%20d eficientes%20visuais%20nos%20museus.doc, visited on 2009-March.

Yang, H., Pan, Z., Zhang, M., Ju, C., (2008). "Modeling emotional action for social characters", *The Knowledge Engineering Review*, Cambridge University Press, 23(4), 321-337.