HABITAT: a Web Supported Treatment for Acquired Brain Injured

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Abstract

The rehabilitation of a patient with Acquired Brain Injury begins during the acute treatment phase. It is important to focus on maximizing the patient's capabilities at home and in the community. Positive reinforcement helps recovery by improving self-esteem and promoting independence. In this context, user interface design is very important for several reasons. First of all the more intuitive the user interface the easier it is to use. The better the user interface is the easier it is to train people to use it, reducing training costs. The better your user interface is the more your users will like to use it, increasing their satisfaction with their work. In this paper a web-based system, namely HABITAT, for the treatment of Acquired Brain Injured is presented, which has been design by means of model-based user interface design techniques to maximize the effectiveness of the treatment activities.

1. Introduction

Persons with disabilities constitute a collective that requires continuous and customized attention, because their conditions or abilities are damaged regarding specific standards. They must be treated from two different points of view: medical and social. The disability can emerge unexpectedly due to a sudden lesion or be suffered throughout the life because of congenital problems. Persons with Acquired Brain Injury (ABI) are born without any damage but have experienced in a moment of their life an accident or illness that has provoked them a brain lesion [5].

This paper describes the main characteristics of HABITAT and how it is customized according to the specific needs of the persons affected with ABI. With this objective it is structured as follows. In section 2, ABI is described in a social and research context. HABITAT is presented in section 3, describing its architecture; the design decisions make to customize its design according to the needs of persons affected by ABI; and, how Model Driven Development has been exploited. Finally, the conclusions round up this paper.

2. Social and Research Context for ABI

One of the main needs of this collective is the access to a proper rehabilitation process. Most of the times, their treatment is carried out in a rehabilitation center where the disabled, supervised by the specialists, perform a number of activities usually employing a board game or learning cards [2]. However, this alternative exhibits several problems, specially, in terms of the time available for the rehabilitation process, because it is highly dependent on the number of specialists working in the center.

In addition, it has been confirmed [1] that the use of computers in the rehabilitation process helps to encourage and stimulate the cognitive behavior allowing the disabled to reinstate damaged functions and eliminate disabilities. However, up to date there are no specific systems for persons with ABI. They are using other systems such as *Gradior* [3], for persons suffering Alzheimer, or children's games, that is, systems oriented to persons with different needs and characteristics. The non-existence of software specific to their needs means that they can find difficulties to develop all their potential as fast as they could.

It has been also detected that the use of these systems provokes negative reactions in these persons, especially when they have to use children’s games. It must be considered that usually they are adults when they acquire this disability and they have a clear perception about what their age is and, therefore, what activities, information, images, etc, are more appropriate for their age.

3. HABITAT: HCI techniques for ABI TreAtmenT

As was stated above, HABITAT has been designed as a virtual space where persons suffering from ABI can put into practice their rehabilitation process. Its main aim is to facilitate an e-learning system customized according to their specific needs, abilities and disabilities. It is basically structured into two different sub-systems according to two kinds of users: disabled persons and specialists. The first subsystem provides the disabled users with a view of the system that allows them to perform their rehabilitation tasks. As can be observed in Figure 1, the disabled users can access HABITAT from their home and the rehabilitation center, relieving in this way the problem of the reduced timetables, the waiting lists, etc. The second subsystem makes available to the specialists a set of utilities for defining and designing the rehabilitation activities, as well as monitoring the rehabilitation training performed by the disabled users.

In this paper we want to focus the attention on the subsystem that the disabled use. In its development, a study has been conducted with persons with ABI in collaboration with the *Association of Acquired Brain Injury of Castilla-La Mancha* (ADACE), in order to determine which factors are relevant to provide the required accessibility features and to improve the overall usability of HABITAT for the target audience.

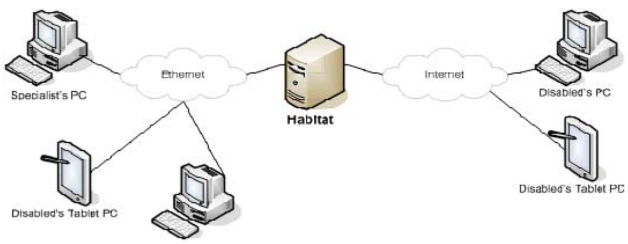

Figure 2. Distribution architecture

Therefore, it seems obvious that each disability and its related grades had to be considered to develop the ABI-affected user subsystem. During its design the proper exploitation of HCI techniques became mandatory in order to meet the high accessibility and usability requirements of the system according to the diversity of target users, as presented in the next section.

3.1. Designing for the Diversity of People with ABI

Nowadays, most learning environments are web-based. By using the Web as the vehicle for communication, several important problems usually found in learning are reduced or overcome: (1) the scheduling and space problems disappear, since the users can learn at anytime and anywhere; (2) it is possible to provide a channel for a fluent communication between students and teachers; (3) a monitoring and tutoring engine can be present in the system to help both the students and the teachers.

To deal with these goals a model-based methodology for the design of UIs [6] has been used. Although, the model-based approach has been used for the last 15 years, it has not been adapted for its use in the development of learning environments. That is precisely, one of goals of HABITAT project.

3.2. The Model-Based Approach to UI Design

Model-Based User Interface Development Environments (MB-UIDE) [6] provide a mechanism to design the UI by means of a number of declarative models. These models describe the different facets of an application partitioning the system in a collection of cooperating models. Then, these declarative models are translated into some code directly executable on a specific platform or into some kind of intermediate language (usually an XML-based language), which can be later interpreted by a renderer.

For ABI rehabilitation, the model-based approach can provide a design method that inherently covers the goals mentioned in the previous section. It allows the separation between the specification of the rehabilitation activities (described in the domain model) from the way they are presented to the users of HABITAT (represented in the presentation model), fostering the reuse of the activities from one system to another and allowing the personalization of how those activities are presented to the users depending on their specific disabilities and the platform more appropriate for each user. By designing HABITAT following our model-based approach we are improving the adaptation of the application to our ABI-affected users, and thus, we are improving the overall usability of the application.

Figure 2 depicts the development process used in HABITAT development. The process starts with the creation of the rehabilitation activities repository by the development team based on the templates provided by the medical team. Next, the development team creates the models aforementioned for the activities and the general tasks (login, activities browsing, etc) the users will perform in the system. By transforming some models into others we get a prototype generated by using our model-based design tool IDEALXML [4]. This prototype has been refined for the different target platforms and ABI levels considered. Finally, when users interact with our application they get a UI that meets their needs and tastes.

3.3. Designing a Usable and Accessible HABITAT

A common side-effect of partitioning a system into a collection of cooperating models is the need to maintain consistency between the related objects. For instance, we do not want to achieve consistency by making the learning activities and theirs presentations tightly coupled, because it reduces their reusability. By separating the presentation aspects of the UI from the underlying learning activities, both of them can be reused independently.

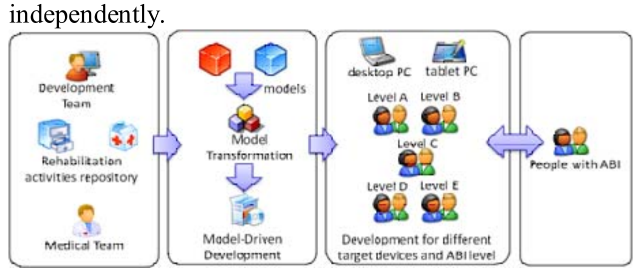

Figure 2. Development process for HABITAT

In a learning activity, both a textual and a graphical presentation of the contents can depict information from the same domain model or application data objects so that different ways to represent the same information can be used. These different alternatives do not know about each other, thereby letting us reuse only the one we need depending on the final user and his/her ABI level.

Figure 3. Default view for matching activity

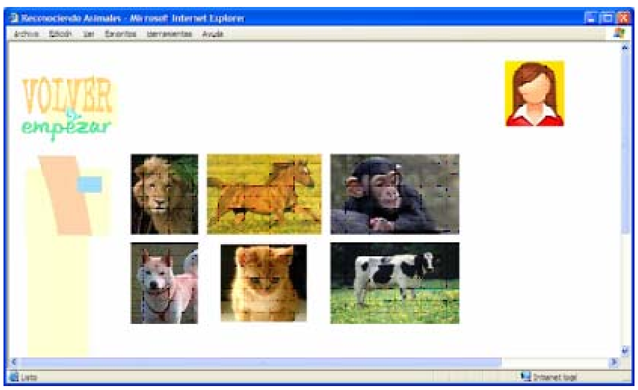

Figure 4. Alternative view for matching activity

To illustrate this concept figure 3 shows the view by default of an activity to match animal images with the sound they make. Since persons with a level A ABI can not read, all the text elements must be removed for the concrete presentation for this level of ABI (see figure 4). The text has been replaced with a different interaction technique. Now the instructions instead of being written are read by the voice of one of the members of the medical team when the person image is selected. Although a drawing has been used in figure 4, in the actual system a photograph of one of the members of the medical team is used.

Developing usable artifacts for users with ABI disabilities involves understanding the fundamental nature of the interaction that these users can do. Typical interaction with an interface consists of the user perceiving an output from the product, deciding a course of action and implementing the response. These steps can be explicitly identified as perception, cognition and motor actions [3] and relate directly to the user's sensory, cognitive and motor capabilities respectively.

4. Conclusions and further work

Persons with ABI are born without any damage but have experienced in a moment of their life an accident or illness that has provoked them a brain lesion. Therefore, all of us are potential victims of ABI. Unfortunately, this disability is not enough well-known, and governments are starting to become aware of the importance of this problem.

HABITAT is aimed at helping in the rehabilitation of people with ABI, and it provides a specific tool to treat this disability. The system supports not only the patient, but also the medical team in its daily work to monitor the patients' activities and improvements. The system has been designed by means of a model-based approach so it can be customized to the diversity of levels of severity of ABI and to the different platforms used to run the application. In this sense, during the development of HABITAT usability and accessibility guidelines have been used to make easier to the patients the interaction with the application.

Acknowledgment

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5. References

[1] C. Christiansen, B. Abreu, K. Ottenbacher, K. Huffman, B. Masel and R. Culpepper, "Task performance in virtual environments used for cognitive rehabilitation after traumatic brain injury", *Archives of Physical Medicine and Rehabilitation*, 79(8): 888-892, 1998.

[2] P. González, F. Montero, V. López Jaquero, A. Fernández, J. Montañés, T. Sánchez. "A Virtual Learning Environment for Short Age Children". IEEE ICALT 2001, 283-285. August 6-8, 2001.

[3] S. Keates, P.J. Clarkson and P. Robinson. "A design approach for accessibility". *Human-Computer Interaction*. Lawrence Erlbaum Associates, 2, 878-882, 1999.

[4] F. Martín, M. Á. Orihuela, T. Buanco, *Programa GRADIOR: programa de evaluación y rehabilitación cognitiva por ordenador*, Edintras, 2000.

[5] F. Montero, V. López-Jaquero, "IdealXML: An Interaction Design Tool and a Task-Based Approach to User Interface Design", CADUI 2006, 6-8, June, 2006.

[6] J. M. Muñoz, J. Tirapu, "Rehabilitación neuropsicológica", Madrid, 2001.

[7] A.R. Puerta, *"A Model-Based Interface* Development Environment," IEEE Software, 14 (4), pp. 40-47, 1997.