AN ONLINE TUTORING SYSTEM FOR HANDICAPPED PEOPLE

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This paper presents a contribution in the assisted handicapped people domain by using computers. The main achievements are related with the improvements in the facilities, integrated in the same multimedia interface, to assist in the communication endeavour.

Keywords human-computer interaction; handicapped people; intelligent tutoring system

1. Introduction

After successfully previous work in two different domains, one devoted to tutorial educational systems [1], and the other developing a specific computer interface to enable more suitable communication for handicapped people [2], we assume a new challenge directed to designing an adaptive tutorial system for handicapped people. The long term objective of this project will be the construction of a system enabling the access to education to all those people that are impaired, for different reasons, and in consequence are incapable to follow the regular Spanish educational system. From a technological point of view, this kind of research is related to one specific knowledge area namely “Intelligent Tutoring Systems” and, initially this research line is directed to the implementation of Artificial Intelligence techniques for developing computer assisted teaching systems, taking into account the adaptation capabilities of any user, and depending of it, taking decisions about the best instructional mechanism for anyone. Bearing all this in main, our intention has been the implementation of a new architecture, which can be summarized in the figure. Thus, taking some previous ideas about adaptive systems based on the web technology [3], now we present a new contribution applied to education for handicapped people.

As can be seen in the Figure 1, there exists three main boxes integrating the complete proposed system: the “User Interface”, the “Hypermedia System”, and the “Tutor System”. All these main parts are explained in detail in this paper, putting special attention to the multimedia designed interface.

Finally, it is noticeable that the present work would be impossible without the strength cooperation with the real context, in our case the Spanish foundation named “Centro de Promoción Personal e Integración Social de Paralíticos Cerebrales Adultos y Minusválidos Físicos Gravemente Afectados (Maset de Frater, Castellón)”. The collaboration with both, the final project users and also with the specialists (e.g. psychologists, etc.) has been absolutely crucial to advance in our investigation.

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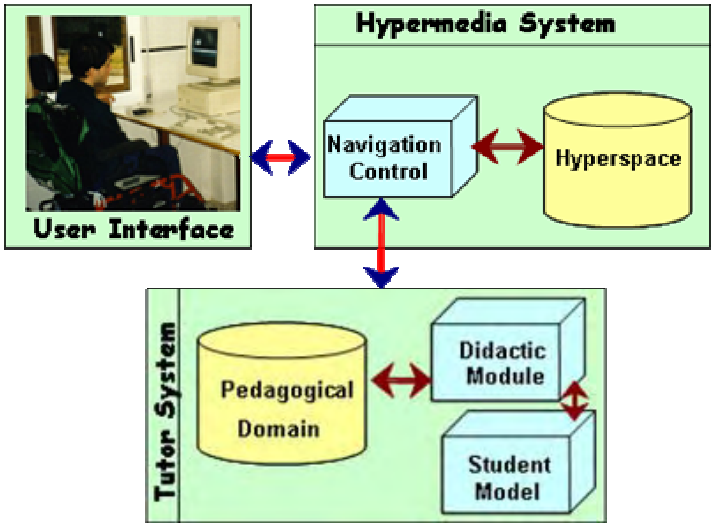

Fig. 1 *Software architecture*. Three main modules are making up the complete proposed system.

2. Previous work

Severely handicapped people are those who lack at least 70% of their physical and/or psychological functionalities (visual, hearing, physical and cognitive/language impairments). A significant part of our population has impairments which reduce their ability to effectively or safely use standard consumer products or communicate with other human beings. These impairments may be acquired at birth or through accident or associated with aging. Severe handicapped people combine some kind of impairments. And one of their main problems is the communication between them and with non handicapped people. However, some individuals assisted and helped by their trainers, can reach normal levels of education.

There have been tools proposed to make easy that interaction. But a lot of them are costly or obsolete systems. Our starting point is a multimedia system based on man-machine interface and object-oriented databases which aims to enhance handicapped people skills related to communicating with other people. Our tool applies the approach known as alternative communication. This approach is based on the hypothesis that the user has his/her own internal language [4], but she/he is not physically able to express it by means of speech, graphs or gestures. With this aim Charles K. Bliss developed a symbolic system to be easily interpreted by anybody [5].

We initially developed a first multimedia prototype under the ComBLISS project (Communication Bliss System) which was born with the aim of building the Bliss Symbols Communicator. This is a computer aided system which operates interactively by the speech synthesis, graphics symbols on the screen and textual representations of symbols. The whole system provides a continuum feedback mechanism between the user and his/her symbol subset in order to learn and/or improve his/her information broadcast way. The system may be a useful and functional tool to help several handicapped people using minimal motion capabilities of the user. The prototype requires as minimal operative characteristics a personal computer with standard configuration and cheap special input devices, and a windows operative environment/system. In this way, multimedia systems have many facilities to add adaptive technology to a computer [6]. The end users are not computer professionals. They use Bliss symbols system as a theoretic-cognitive support. Therefore, the system must allow operating and maintaining it at low cost with little complexity.

We are applying the abstract symbols system developed by Charles K. Bliss. The main characteristics is that the model proposed allows to build three-valued multimedia words (objects), composed by text,

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image, and sound. All of them are related to a single idea or object in the real world, an action or an emotional status. In this way the objects have two main categories: structural, which represent the attributes, relationships and components; and behavioural, related to context parameters and operative elements. In addition, the conceptual architecture of our multimedia system is composed by three levels, according of three layers of Bliss communicator. The bottom layer is composed by the conceptual schemata of databases with Bliss symbols and user context profile. The middle layer is a set of conceptual objects to model the real world. The upper layer contains multimedia presentations of conceptual objects as representation objects. The same object may be represented by the system respectively to different usage environments.

The ComBLISS project was organised into two main work lines. The first was the construction of the conceptual model, with the formal foundations explained below, and defining the language syntax of basic concepts. The second one was the development of a prototype in two phases. The first phase is necessary to obtain a basic an immediate operative tool which sets a feedback between the user and the abstract model. Applying some rapid prototyping techniques [7] [8] [9]. This prototype is based on a client server approach because it is easier to keep on line more than one user, with minimal extra resources. The second phase consists on developing a more complex prototype adding other multimedia and cognitive functions. In fact, this paper is related on this stage, and now we are trying to add the intelligent tutoring characteristics aforementioned in Section 1.

3. Problem description

The main goal of this research is focused on developing a suitable tool capable to offer a complementary way to traditional session instruction (see Figure 2, a), based on an intelligent tutoring system (e.g. assuming as knowledge base an alternative communication learning: Bliss, SPC, etc.) both in a classroom or outside. Thus it will open new learning opportunities to those users with special necessities. In summary, it will be able of making easier the instruction of a novel user in connection with an alternative communication method.

This goal promotes two significant challenges at a functional level:

- Implement an Intelligent Tutoring System (ITS), which must be adaptable to any user profile, with sensory motor deficiencies and/or cognitive ones through a specific designed user interface. Earing in mind that we have several years experience because a previous research (i.e. ComBLISS system).
- Build this STI taking into account a specific knowledge base. In our case, the standard method of non verbal communication learning.

In summary, with the aim to solve this problem, a new architecture has been now proposed, that can be seen in Figure 1, showing its basic structure.

This new architecture tries to put together the ITS and Hypermedia Systems advantages, based on web technologies. As observed in Figure 1, the two main components are the Tutor System (TS) and the Hypermedia System (HS). The TS takes advantage from the high flexibility and interaction degree of an interface based on a HS. And this HS component is benefited from the high adaptation degree between the user and the TS module, promoting an optimal performance of the complete system.

The HS can be divided into three functional modules: the user interface, the hyperspace and the navigation control:

- The User Interface module, is the common place where the system final user and its constructor converging. It should be designed with the aim to get the adaptation of any user specific profile that will be “no standard”. In our case, this module will be especially difficult, because each user can require different physical media to interact with the system, from binary actuators until virtual keyboards, depending on the sensory motor capabilities suitable for this kind of interaction. As it has been aforementioned, all the previous experience gained with our previous project will be very helpfully (i.e. ComBLISS).

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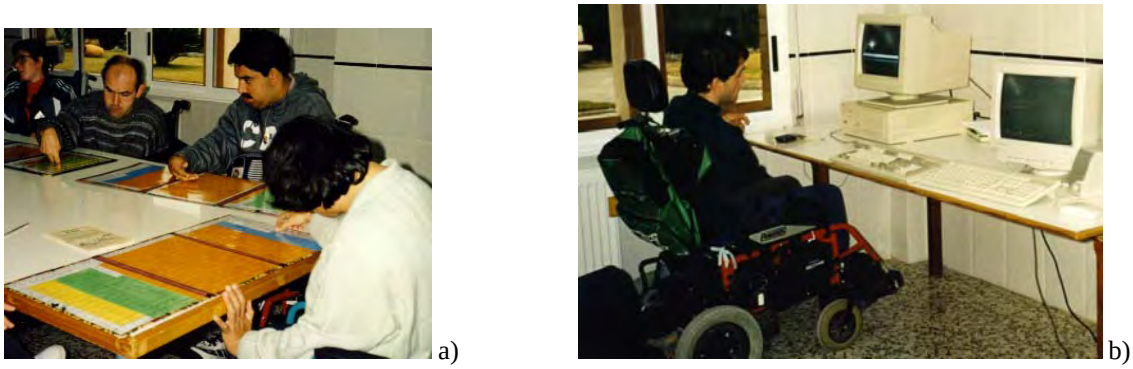
- The Hyperspace, compiled in a data base, contains all the suitable information to show to any user. It is organised in hyper documents, which are sets including nodes and links shaping a knowledge conceptual unit.
- The Navigation Control module, connect the HS with the TS, adapting the hyperspace accessibility to the Tutor decisions and, at the meantime, reporting to the Tutor about the activities developed by the user meanwhile is navigating.

On the other hand, the TS, maintains all the intelligent system activity. With this aim, a continuous tracking operation over user interaction is realized. The idea is the establishment of a set of well defined test in order to control the knowledge acquired by any user at any time. With this information a decision can be tacked for the user access to the hypermedia, establishing the more suitable information in a continuous way.

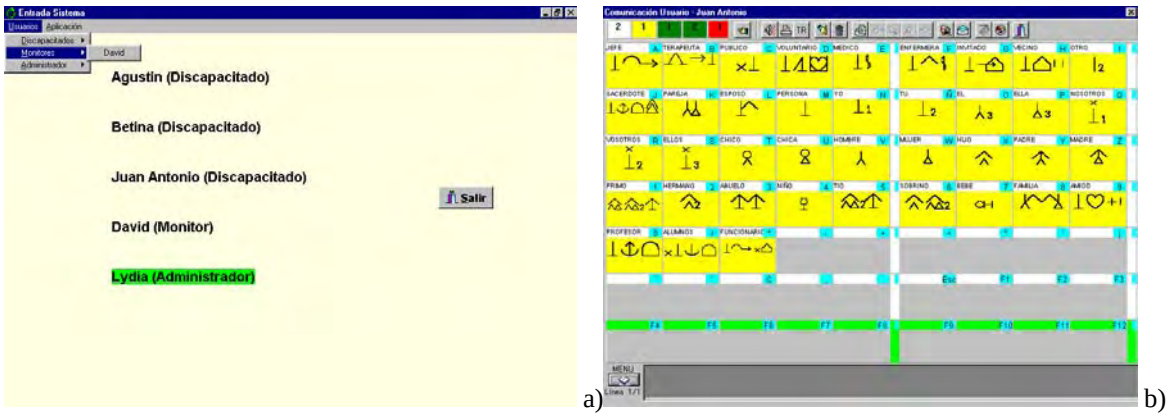
We can distinguish three main modules within the TS as follows:

- The Pedagogical Domain, which represents the specific contents to learn by a student. A non verbal communication method, in our case.
- The Didactic Module, which is responsible to get a good adaptation between the system and the student.
- The Student Model, which compile information about the student profiles, domain knowledge, didactic material used, and a learning historic of any student.



a) b)

Fig. 2 The system Bliss in action. a) A training session with the conventional Bliss method is shown and b) Our prototype COMBLISS, implemented in a PC, is used.



a) b)

Fig. 3 The ComBLISS interface. a) The starting out screen b) An example of screen showing different Bliss symbols.

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Finally, with the aim to clarify the kind of multimedia interface that we implemented, an example can be seen in Figure 3, about our previous system ComBLISS, which represents our starting point for the current work in progress.

4. Discussion

We have establish a cooperation agreement with the Spanish institution "Centro de Promoción Personal e Integración Social de Paralíticos Cerebrales Adultos y Minusvalidos Físicos Gravemente Afectados, Maset de Frater", with the aim to investigate in a real scenario. At that moment, there are eight people in this centre who interact at communicating level with the environment using Bliss system. These people form our test group. Each of the eight test group members has different set of disabilities and capabilities. Therefore, they need different user profiles and different input devices. But output device is a common CTR screen. We have designed our test in two stages: a preliminary stage to elucidate all dynamic parameters of user profiles and to revise the prototype; and a monitored stage when members use the prototype in training sessions and personal communications out of teaching hours.

Prototype results are slower because it is not possible to show effectively more than 40 Bliss symbols per screen shot. On the other hand, it is easier to highlight Bliss symbol categories in screen by means of different colours in order to group categories by colours in different window areas.

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