Open Hypermedia System for Automatic Control Teaching

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Introduction

Computer technology applied to education has been under development since the early 1960s. Traditional computer aided instruction (CAI) software (Chambers and Sprecher, 1980) was followed by artificial intelligence based on instructional systems (Gable and Page, 1980; Koffman and Blount, 1975) and by hypertext structures (Barret, 1988; Nielsen, 1991; Smith and Weiss, 1988).

Hypertext is not a new concept, but in recent years it has undergone an enormous development. In essence, hypertext is not a sequential writing, but rather a directed graph, where each node contains some amount of text or other information. The nodes are linked by directed connections (McAleese, 1989). Hypertext provides a better model for the mind's ability to re-order the elements of experience by changing the links of association or determination between them (Delany and Landow, 1991).

For teachers, hypertext offers better support and a much more efficient mean of developing, preserving and linking course materials. Hypertext helps to integrate scholarly work-in-progress with teaching. So, we are researching into Hypertext Learning Systems, having implemented a courseware in Control Teaching (Aranda, *et al*, 1991) to be used by the students of the Universidad Nacional de Educación a Distancia (UNED) and a Computer Based Control Laboratory with an environment with a hypertext structure (Aranda, *et al*, 1993). But this development has some problems, as with other first hypertext systems learning. So, the system is closed without the possibilities of modification by the teachers. The auxiliary teachers of UNED (Spanish Distance University) want a system that permits their own teaching method.

Our idea is to build an open hypermedia system, in this case for automatic control teaching, so the teacher feels the hypermedia system is his own and not a rigid tool alien to him. With this idea, the hypermedia system must have the following: a HyperBook with examples and simulations, a set of examples, exercises and problems with their solutions, a module for building courses, a student evaluation by test and problems and a laboratory practices.

Some comments about hypermedia teaching

The historical concept of hypertext supposes a system with only text. With current computer technology (which includes the possibilities of sound, graphics and video) the hypertext concept is changed to hypermedia. We can see hypermedia as a new technology of hypertext with flexibility in information presentation. Hypermedia extends hypertext by integrating our visual and auditory faculties into textual experience, linking graphic images, sound and video to verbal signs. Some authors do not distinguish between hypertext and hypermedia and, in an informal language, both terms are used indistinctly.

The main characteristic of a hypermedia information system is its ability to deal not only with alphanumeric data (as in traditional databases) but with images, both still and moving, graphs, text and voice. It supposes the integration of different media with a hypertext structure. Hypermedia can be defined by the following equation:

$$\text{Hypermedia} = \text{Hypertext} + \text{Multimedia}$$

One of this media introduces the time concept. So, time can be seen as a new data type with new problems, i.e. the synchronisation of sounds and graphics.

When users are moving in a big information space, there is a risk of getting lost in the information web; then we can have problems in finding information. This produces the hypertext navigation problem. There are several solutions to navigation problems. One of easiest to the user is the form of 'visit drive'. However, a navigation system must consider the following questions:

- What are there in this hypertext?
- Where am I now?
- Where can I go?
- How can I go?
- Where was I?

Together with navigation problems come the hypertext structure concept, from the point of view of the user. The information form, objective and presentation help to determine the hypertext structure. If the structure is simple, the navigation is easy. Typical structures are the following:

- Lineal structure (the user moves in one dimension)
- Lineal structure with jump (can jump to other point)
- Tree structure (hierarchical structure of information)
- Network structure (there is no hierarchy)
- Frame structure (the user only sees one node)
- A combination of basic structures.

The system supplies mechanisms to help the navigation. So, the navigation is easier.

There are a number of essential steps in the design, development and operation of hypermedia systems. These include: acquisition, compression, storage, access, and delivery (Bruce, *et al*, 1993). These steps can be divided in two phases (Wentland, *et al*, 1991): creating the content of the nodes (i.e. typing the text and/or scanning the images to be displayed) and building the web of links between those nodes. The other basic task is the design of the man-machine interface. This task is generally carried out after the development of the application.

The learning process must be interactive. A fundamental aspect of the interactivity is the control. Interactive media must permit a weak control of the learning process. When the interactivity is limited, the medium is only an instruction way; and the author is responsible of the learning results. In a hypermedia system the interactivity can be achieved by different forms. A primary interactivity is to push a button or select an option. However, the main thing is not the quantity of actions but the quality of the learning process.

The problem of the learning process control has some implications. For example, who has the responsibility of the results. The main responsibility is coming from the author. As Færch, *et al* (1984) denote, when there is no possibility of immediate estimation, the message has to be complete and clear. In an interactive medium, it can be organised in lineal segments as a learning resource or information spreading resource (Romiszowski, 1992); where the user decides the learning task. Benny Karpatschof (1991) talks of interactive aptitude. So, it is not about making the multimedia very interactive, but supplying it with the appropriate interaction.

General description of the open hypermedia system for automatic control teaching

With this hypermedia system, we wish to state some theoretical concepts. It gathers the previous comments and the results of other work (Dormido, *et al*, 1990; Aranda, *et al*, 1991; Aranda, *et al*, 1993).

So, the Open Hypermedia System for Automatic Control Teaching includes:

- A HyperBook with all course topics and references for other studies, examples, simulations, exercises and problems with their solutions;

- A module for building courses – the tools of this module are functions incorporated to Hyperbook and run it from a button or menu bar when this module is selected;

- Student evaluation by test and problems, with a test's automatic generator and a student data base. In the evaluation by problems, the student can compare his/her solutions to the problems with proposed solutions;

- The laboratory practices permit students to do the practices at home by simulation, and when they go to the laboratory, they have a better knowledge of the real process and the instrumentation.

Furthermore, the 'Help system' has a navigation help, a glossary of terms, a student notebook and a session history.

Figure 1 is a representation of the structure of this system.

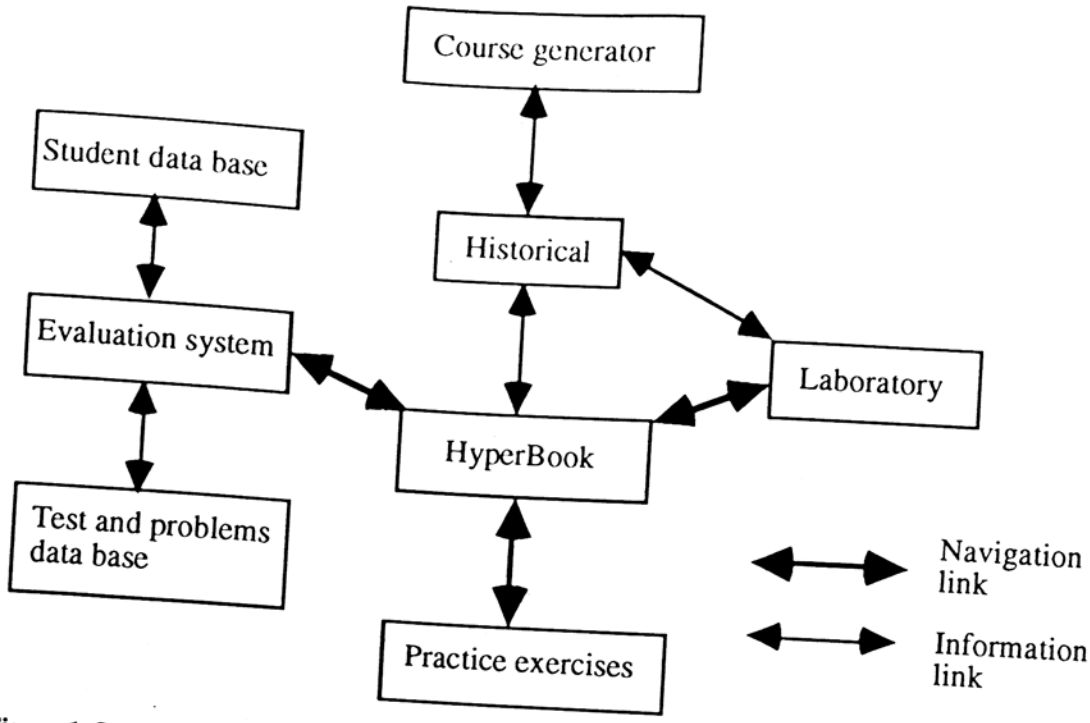

Figure 1. Structure of the Open Hypermedia System for Automatic Control Teaching.

The HyperBook has much information based on images, videos, simulations, etc., with a friendly interface to students. The simulations are open, so the student can modify some parameters of simulations and see different answers. Figure 2 is the simulation for a first order system, the simulation is made in Matlab, but the results are presented with the same interface.

The functions of the 'course generator' improve the interaction between the hypermedia system and the professors. Each professor can build courses according to the necessities of his particular students. So the professor feels the hypermedia system is his own and not as a rigid tool alien to him.

The laboratory has three main parts (Aranda, *et al*, 1993): a simulation laboratory for control, a simulation of practical sessions and an interface for connection with real systems. Furthermore, it has a hyper handbook of laboratory instrumentation, control kit and software; helps and explanations with video and audio and scripts for practical sessions.

The implementation is very modular, with sounds, videos, animation, texts, etc. in different files. This permits better transportability. For example, the student can carry home the electronic book in one disk only, i.e. without the sounds and movies files,

The implementation has been made using the following Programs in Macintosh: Hyperacid, MacroMind and Authorware. In 'Windows' machines the programs are Toolbook, MacroMind and Authorware.

Conclusions

The goal of this work is give an open hypermedia system to auxiliary teachers of UNED, so they feel the system to be their own and not a rigid tool alien to them. So, we are building the Open Hypermedia System for Automatic Control Teaching with: a hyperbook with all course topics and a set of examples, exercises and problems with their solutions, a module for building courses, a student evaluation and laboratory practices.

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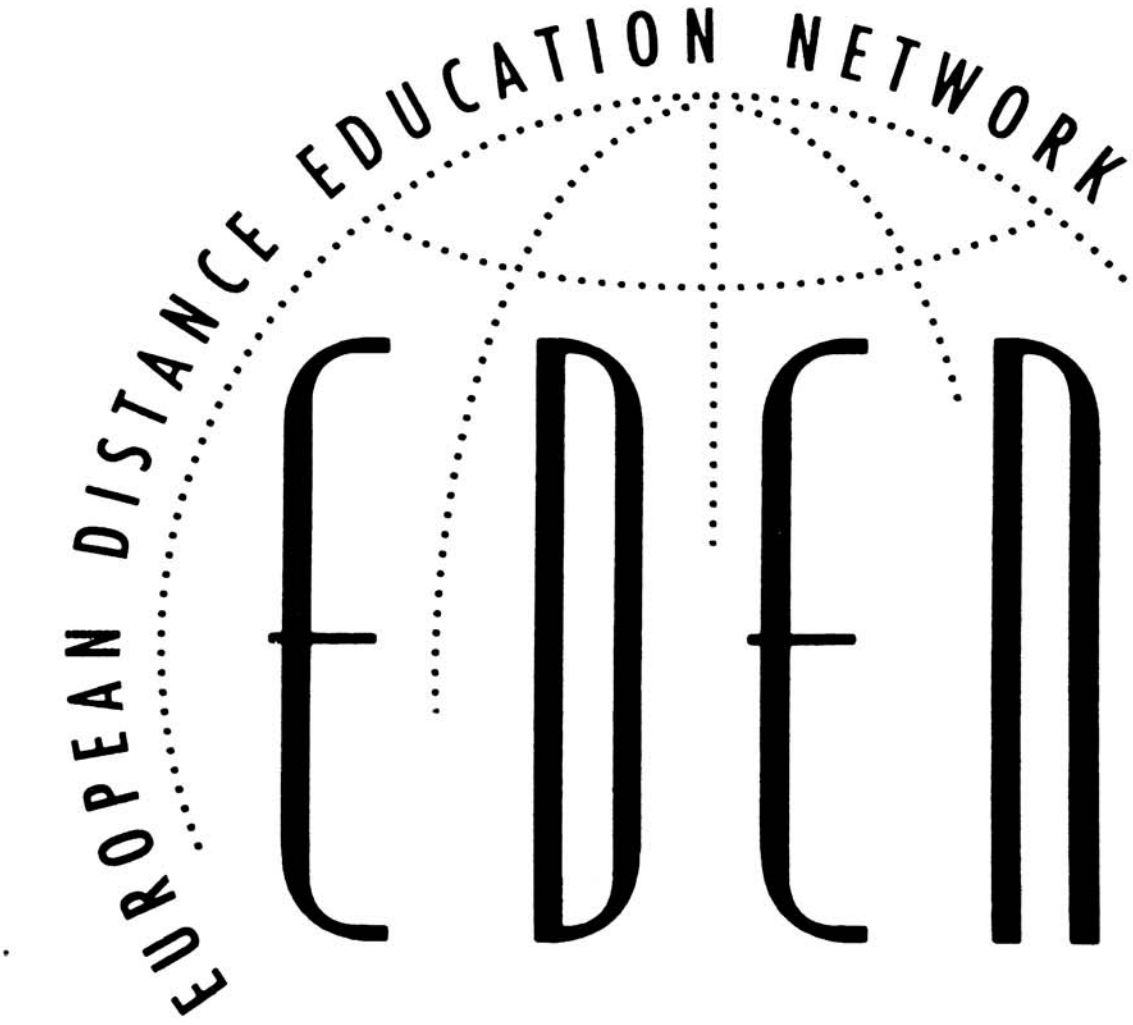

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