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ABSTRACT

This paper presents an experience with the development of multimedia systems for power systems education. An application of a multimedia course titled "Electrical Energy Generation" is also described. The main conclusions of this experience are discussed, emphasizing the most relevant aspects to be considered in the development of further similar systems. (Author/WRM)

The Use of Multimedia in Engineering Education – An Experience

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ABSTRACT

This paper presents the authors' experience in the development of multimedia systems for power systems education. An application of a Multimedia course of "Electrical Energy Generation" is also presented. The main conclusions of this experience is discussed, emphasizing the most relevant aspects to be considered in the development of further similar systems.

MULTIMEDIA APPLIED TO TEACHING ENGINEERING

Interactive multimedia is a powerful tool for engineering education that can be used in many different ways, such as: support to class presentations, tutorial for off-class consultancies or complementary activities, virtual laboratories, simulators, center of activities to be used in a laboratory or at home, distance or local guided study; case studies and virtual conferences.

With the multimedia, it is possible to meet some requirements of the new teaching-learning paradigms, in which the student is the center of the learning process. But, as stated by [1] *"... merely using the techniques and tools afforded by computing and information technology is not itself the solution to fitting education..."*, we are trying to reconcile tradition and modernity in an effort for applying new technologies in the teaching and, at the same time, a review to the whole teaching-learning process, independently than the use of new tools. This should be done, among others, to provide students higher motivation, active participation, better adaptation to multiple intelligence profiles, adaptation to individual characteristics and paces and activities based on education by design.

In engineering courses the use of laboratory practices and project development are common didactic resources aimed at complementing theoretical basis. These practices usually lead to good results, because they fulfill some of the requirements above mentioned. The use of multimedia systems can eventually substitute or, at least, enhance some of these practices. It may as well allow for a better use of theoretical disciplines, that conventional teaching methods are not completely satisfactory as yet. With these ideas in mind we started looking for an interactive multimedia tool that could complement theoretical classes on electrical engineering courses. One of the objectives of that tool is complementing already existing teaching techniques, taking advantage on previous developed contents as well as strong points based on existing methods, adapting them for an interactive multimedia system to be used as didactic support, for both, teacher and students.

To meet our goals the following steps of the project were established:

a) Planning and Design: a deep study on the chosen authoring tool (Multimedia Toolbook II Instructor); revision and structuring of the course content; definition of the interface metaphor, following guidelines presented in [2]; structuring of the navigation; project of the human-computer interface; project of practical exercises;

b) Acquisition of Information and production of media elements (texts, audio, videos, images and animations); production of interactive practical exercises; production of the iconography and other visual elements of the interface (buttons, controls, backgrounds etc.);

c) Prototype Implementation : the integration of the media elements and the development of the system prototype;

d) Tests and evaluation: application of the prototype in class activities; accompaniment and evaluation of the results and of the human-computer interface; improvement proposals;

e) Technical and functional revision: conception of the final version of the system;

f) Development of the final version: implementation of the final system to be used in the courses of our school.

MULTIMEDIA SYSTEM FOR TEACHING "ELECTRICAL ENERGY GENERATION"

As teachers of the of Electrical Energy and Automation and of the Computer and Digital Systems Engineering Departments, based on the verification of the new teaching-learning model, centered in the student and no longer in the teacher, we were motivated to use the multimedia as an additional tool to aid in this new stage of the process of teaching engineering.

Most of the current engineering courses are based on oral classes (almost always using chalk and black-board), laboratory classes, exercises classes, lectures of companies or specialists, monitored visits in engineering sites or in industries or project companies.

Students usually have to do examinations, exercise lists, reports of experiences, projects, research works and seminars. In general the evaluations are isolated and they don't really measure if the teaching-learning process is flowing naturally or if it corrections are needed during the process.

The use of multimedia resources that could serve as additional tool to aid in the correction of the teaching-learning process is the goal in whole the process of our work.

We chose the course of Electrical Energy Generation as the pilot of our first project and, implementation and application as the first experience of the use of the multimedia in the teaching of electric engineering. Through a final course project, under the authors' orientation, two students of last year projected and implemented an initial step of a course of Electrical Energy Generation in Multimedia [3] in Portuguese, under the focus of the sustainable development. This product is one of the two multimedia courses initially planned to be developed for Electrical Engineering teaching, being the other related to the "Training of Maintenance Teams for Electrical Distribution Utilities"[4]. A future version of both systems in English and Spanish is also foreseen.

The inclusion of new contents in the course, as other alternative sources of energy (tide plants, fuel cells, geo-thermal energy, etc) and the growing interaction of the user with the course, through tests that facilitate the assimilation and the concepts connection, and the introduction in parallel of connections with the Internet is foreseen in the continuity of the project of application of multimedia resources in the teaching of electric engineering.

Another Multimedia course to teach electric low tension wiring (residential, commercial and industrial)systems is being projected and implemented. There is a project to use multimedia resources in electric wiring laboratory. A training course to the electric distribution network maintenance is also one of the projects to use multimedia as a teaching tool.

. the envisaged multimedia system

The complete system, as it is envisaged now, will be formed by three main levels, from which the present version is a kind of seed.

The first level is dedicated to the whole context of Energy, Environment and Development. This will introduce the student into the theme from a global and holistic point of view. Appropriate linkage allows them to navigate - in the desired depth - the following seas: Energy and Environment - the role of Electrical Energy; Energy and Sustainable Development; Sustainable Development and Renewables; current Energy Scenario, future projections, and possible transition strategies to get to a scenario linked to Sustainable Development concepts; Renewables and/versus NonRenewable; Renewable Generation alternatives to be used in the short, medium and long run.

The second level has to do with aspects related to the introduction of electrical generation sources within Power Systems. The main concepts, characteristics and methods (with emphasis on existing data treatment and algorithm models and tools) to decide on new generation alternatives able to keep up with more substantial load(Peak and Energy) requirements are presented, along with the use of an expanded cost concept, including (in both quantitative and qualitative terms) external factors such as environmental, technological and socio-economic ones.

The next level, in a broad sense, is dedicated to the knowledge of the basic aspects of the main "Electrical Energy Generation" alternatives. It covers the following main possibilities:

a) Hydroelectric Generation (subdivided into small and medium-sized/large Plants);
b) Thermoelectric generation(subdivided into steam plants, gas-turbines, nuclear, diesel machines, etc);

c) Solar Generation Systems (Thermal and Photovoltaic);
d) Wind Generation;
e) Fuel Cells; and Other Forms of Renewable Electrical Generation, such as hybrid, tidal, geothermal systems, and so on.

In each of them, the following main aspects are covered separately, in linked blocks in the hypermedia configuration:

a) Basic Concepts;
b) Environmental Impacts;
c) Physical Configuration, Components and Equipment, Construction;
d) Operation and Maintenance;
e) Planning Aspects; Costs, Technology, Latest Trends; and
f) Dimensioning Methodology and Tools

. brief description of the present system

As already stated, an initial step of the "Electrical Energy Generation" multimedia course is presently available.

This prototype contains a meaningful part of the first (Energy, Environment and Development) and third (Generation Alternatives) levels described above.

The second level (Introduction within Power Systems) and the complementation of the first and third levels will be implemented along the time, with strong participation of the students and interaction teacher-students, as will be described later.

The main topics of the presently available system are: Electrical Energy importance in the Development Scenario; Electrical Energy interrelation to Sustainable Development; and Hydroelectricity, Thermoelectricity, Solar Generation Systems and Wind Generation. For these later the covered aspects are : Basic Concepts; Environment Impacts; Physical Configuration, Components and Equipment, Construction; and part of Dimensioning Methodology and Tools. Figure 1 presents the initial screen of this course.

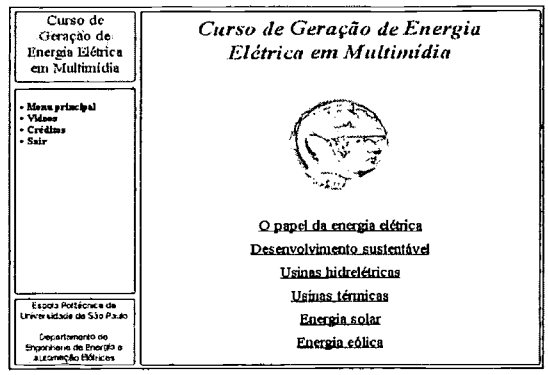

Figure 1 – First screen of the Electric Energy Generation multimedia course.

A narrator accompanies the user during the whole content of the course, what facilitates the student learning. The navigation is made by " hot-words " in the menu in the left of the screens as well as in the menu that appear in the contents of the pages. Other navigation options were used in the pages, as buttons with the text or buttons with icons that indicate the next page and previous page for example. Figure 2 shows a screen with one of the videos in the course.

Software tools are implemented in some types of energies allowing the user to know what are the principal parameters that affect the electric power. Figure 3 shows the screen of aeolic energy equipment.

. the construction and implementation along the time

The aforementioned configuration construction is underway by using available multimedia systems and considering the experience learned from the traditional (let us call it so in order to make this reading easier) course: texts, graphics and animation will be particularly used for theoretical conceptual points; the same media, videos and interviews for rather practical points; texts, graphics, animation and data handling/algorithm software for purposes of calculation and interactive module modeling.

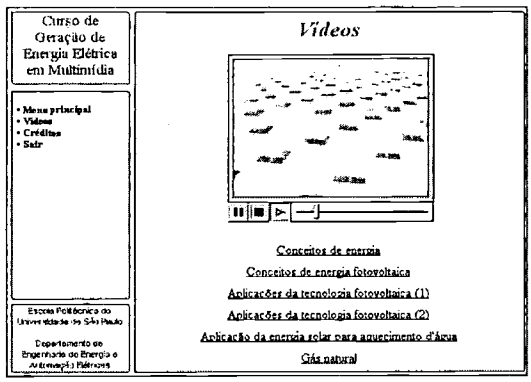

Figure 2 – Screen with one of the videos in the course

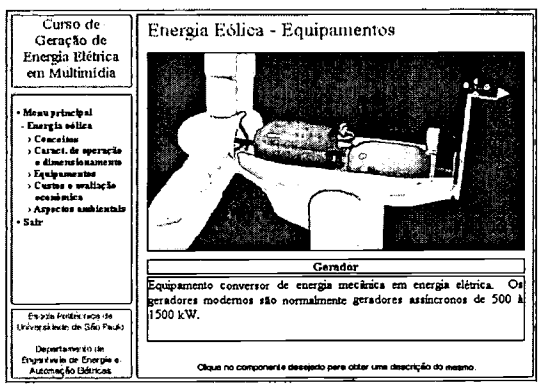

Figure 3- Aeolic Energy equipment screen.

This kind of construction has been carried out through the development of modules, each of them involving rather specific types of professionals. For example, conceptual modules are developed by teams formed by power/computer engineers and students; practical modules by teams formed by engineers and students and video professionals and so forth. All work related to each module is coordinated by the authors of this paper, who are also responsible for coordinating integration and linkage of the several modules.

As already presented, the idea is implementing the system in the course by steps, and increase as the course is repeated. This procedure allows that students themselves, together with teachers, help improving and evaluating the multimedia system. Implementation work is performed by the introduction of modules as the system construction evolves, so as to enable a complete, smooth, almost automatic transformation from a traditional into a multimedia course.

Finally, the student will also be informed and involved in the construction of modules not yet implemented in the course. The knowledge of such modules as well as discussions of their main characteristics and problems during the so-called traditional course allow users(students) to participate in the multimedia system. In this sense, student graduation projects related to the subject of the several modules are also conducted.

Following these principles and ideas, the present version of the "Electrical Energy Generation" multimedia course is already being used as a complement of theoretical classes in the Department of Electrical Energy and Automation Engineering at the Polytechnic School of São Paulo University. In order to proceed with the complete course implementation, the students projects were chosen to cover subjects related t o the missing second level and to the completion of the first and third level of the envisaged multimedia system. This is only the beginning of such experience for this is the first year it's been applied; however, preliminary evaluations and tests carried out by teachers and students of the department proved it can be profitable.

CONCLUSIONS

The application of new information media delivery like CD, DVD, Internet, video, cable TV at all levels of education shows that the world is changing quickly and people need, therefore, to be under a continuous education process. The ones that do not follow this new agenda could be considered "illiterate" in a near future, therefore, marginalized in this society.

In a world where information comes to us through a number of ways and in different forms, it is necessary that teaching/learning methods also make use of different media to present information so as to provide students with a rather pleasant, empathic learning process, taking into consideration students' pace and interests and being aware of the relevance of contents involved. Thus, the student will no longer be a passive element in the process but an active player capable of interacting with and constructing one's own learning, in a more positive manner.

Based on this verification, we, teachers of the Electrical Energy and Automation and Computer and Digital Systems Engineering have jointly worked on projects related to the use of multimedia in teaching-learning processes for our students as well as for students attending training/continuing education courses.

One of projects is a Multimedia Electrical Energy Generation Course, for which an initial prototype has been developed as a graduation project by two students in 1997. This prototype has been preliminary evaluated and tested by other students and teachers of the Department, proving to be successful. The course is presently being used as a complement of the theoretical classes and as a basis

for student projects, so that it can be further completed and implemented. This experience is now under way, but the students enthusiasm allows us to conclude that a successful result is to be expected.

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