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## ABSTRACT

Changes in the global economy and the extensive use of the internet implied a conceptual redefinition of the working and social structure, and consequently an enhancement of educational systems that instruct engineers. This paper presents a repository of remote multimedia information such as formatted or non-formatted documents, hypertext pages, figures and images. The main goal is to provide an electronic directory to organize knowledge that can be easily accessed to support the elaboration of virtual lessons, seminars, and training courses. The project aims to improve productivity, enhancing communication among students and educators, and providing a common environment in which to place interdisciplinary engineering objects. The proposed system being developed by the Ocean Engineering Department at the Federal University of Rio de Janeiro within the Engineering Education Restructure Project supports distance education and can be used as another learning vehicle. (Author/YDS)

# A Remote Knowledge Repository System for Teaching and Learning

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*Abstract - Changes in the global economy and the extensively use of the Internet implied on a conceptual redefinition of the working social structure, and consequently, an enhancement of educational systems that instruct engineers. This article presents a repository of remote multimedia information, such as formatted or non-formatted documents, hypertext pages, figures and images. The main goal is to provide an electronic directory to organize knowledge, which can be easily accessed to support the elaboration of virtual lessons, seminars and training courses. The project aims at improving productivity, enhancing communications among students and educators, and providing a common environment to place interdisciplinary engineering objects. The proposed system, that is being developed by the Ocean Engineering Department of the Federal University of Rio de Janeiro within the Engineering Education Restructure Project, supports distance education and can be used as another learning vehicle.*

## Motivation

An engineering project is a creative human activity related to methodologies to formalize the way people design, validate and realize engineering solutions, to organize working groups to tackle these problems and to identify the techniques appropriate to accomplish tasks established to the groups. Engineering projects are becoming more and more complex because they tend to involve more interdisciplinary aspects which require cooperative techniques to help improve the activities of the working group members, considering situations when they are placed in different locations. Although many computing tools are required to support individual tasks within the whole process, there is an evident demand for tools and methodologies to cope with collective/cooperative activities not so frequent in the past.

The existence of a world network that allows accessing information placed in different servers, independently of their hardware, contributed to the enhancement of the communication means. In addition

to that, the changes in the global economy and the evolution of the information technology imposed conceptual redefinition of the social structure of professional working and employment. For that reason, it became necessary also to redefine educational systems that instruct professionals [1]. These characteristics push in the direction of researching (developing) innovative systems that store and retrieve diverse kinds of information (graphics, textual, dynamic, etc.), that offer a hypertext access to the data and allows the coordination of activities performed by distributed teams, all of these to be required by the engineering professionals in the near future.

The "Restructuring of Engineering Education Project" (REENGE) [2], held by the Federal University of Rio de Janeiro (UFRJ), aims at improving the educational system through seven lines of action: restructuring the teaching and learning dynamics at the first periods of the course; install an infrastructure to support the introduction of technological research into the engineering curricula; install a research laboratory on scientific and technological information, exploring the information technology available today; incentive the installation of academic engineering offices as laboratories to deal with real engineering problems in all areas; adapt and install specialized laboratories; stimulate academic projects towards continuing education in engineering; and develop exploratory studies focused on the Brazilian engineering perspective.

In the last decade, the Ocean Engineering Department (PENO) [3] of the UFRJ has been stimulating students on using computer programs as a fundamental engineering tool. Professors, researchers and students have intensively employed software systems to prepare teaching material, document research projects, demonstrate new or proposed models and store obtained results. All this information is stored in different machines and various formats. Moreover, other research groups also publish related data and contributions of their projects in the Internet. Based on this experience PENO has joined the REENGE Project, proposing to incorporate the modern information

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technology to improve engineering solutions with a special emphasis on the methodological aspects of engineering education.

## Goals

The main goal is to provide an electronic directory to organize knowledge, which can be easily accessed to support the elaboration of virtual lectures, seminars and training courses, and to serve as a learning tool. The repository allows the storage and the linkage of remote multimedia information, such as formatted and non-formatted documents, hypertext pages, figures and images.

The project aims at improving productivity, enhancing communications among students and educators, and providing a common environment to place interdisciplinary engineering objects as well as to serve as a tool to structure the development of learning material in such fields. The proposed system supports distance education and can be used as a new learning vehicle.

## Architecture

The Remote Knowledge Repository System for Teaching and Learning consists on a prototype that group information in the PENO Web server as a set of files organized hierarchically in directories. The user would handle both files and directories in a transparent way - independently from Unix file system under which the prototype runs -, accessing them wherever clients are placed [4].

The architecture is composed by a relational database system and a set of mechanisms to structure, create and modify components, search for specific data and show differences among elements or group of elements. A prototype was developed using the World-Wide Web [5] technology and the advantages offered by the browsers. The Web server interfaces with the repository through a CGI (Common Gateway Interface), which contains all the rules and functionality of the system. Clients access the prototype through HTML (HyperText Markup Language) forms and JavaScript programs, which locally validate input data and avoid network communication traffic.

## The Database

Within the system, a knowledge data can be an unit (file) or a set of units, composing a directory or a root. A directory is made by files and other directories. A root corresponds to the top directory of the structure.

Each local unit has the following attributes: name, type - which is loaded automatically from the system -, description and contents. The contents of an unit can be modified only if it is placed in the server and links to units placed in other servers can only be browsed. Links to remote units have the name and URL (Uniform Resources Locator) as attributes.

The system works with two "control files". One stores the logical structure of the roots and the other holds the unit description, the date it was created and the unit type. These files are maintained by the system and users have no access to them. This approach speeds up the server, which does not have to browse a root each time its contents have to be displayed, and makes the prototype portable to different operating systems.

## CGI Programs

The CGI programs are implemented using the C programming language and shell scripts under a Unix platform. They are executed in real time then, allowing the display of dynamic information. CGI programs work as gateways between the HTTP (HyperText Transfer Protocol) server and the local data or other programs [6]. Within the prototype, they are responsible for reading the data input through a HTML form, accessing the databases, performing a query and displaying the result as an HTML page.

## Functional Mechanisms

The system encompasses a set of mechanisms in order to handle the knowledge components. The user can create a new unit, which can be a local file, a remote file that actually is copied into the knowledge repository or a link to existing files placed in other servers. Directories and roots can also be created interactively. In order to copy a remote file into the local server, the system offers an HTML interface to the ftp (file transfer protocol) command.

The open mechanism displays the selected unit name, type, description and contents. Units and directories can be renamed, removed and copied/pasted. The system displays the differences between two roots, which allows creating more than one version of a root and then, comparing them. The system also offers a search mechanism based on keywords.

## User Interface

The interface is composed by a set of HTML files and JavaScript programs, which validates data. As a hypertext interface, when selecting an unit through

a "clicking with the mouse" action, its contents are displayed in another window. The same action over a directory, displays its components: unit names, descriptions, and other directories. The information is presented to users through frames: directories are presented indented in the left frame and unit files, in the right one.

The following figures present the Interface of the Remote Knowledge Repository prototype and some of its functional mechanisms. Figure 1 corresponds to the main interface, where the left frame presents the directory tree, i.e., the structure of the repository. The right frame shows the units of a selected part of the directory tree. Clicking over an item, its contents are presented in another pop-up window. The top frame of the interface presents the prototype commands and an online help.

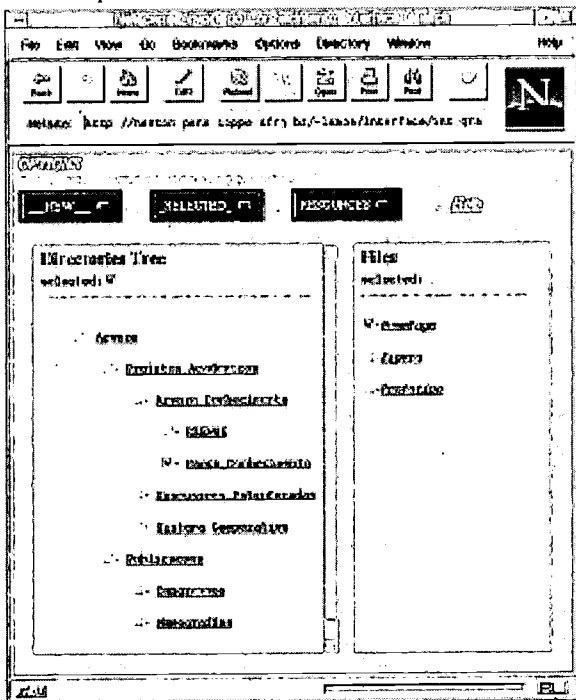


Figure 1. Remote Knowledge Repository Interface

Figure 2 presents the some examples of the prototype command windows to access a remote file, create a new link, present the contents of a directory tree and show the contents of an unit tree.

### Prototype Validation

The UFRJ Electronics Engineering Department has started a cooperative activity with PENO by validating

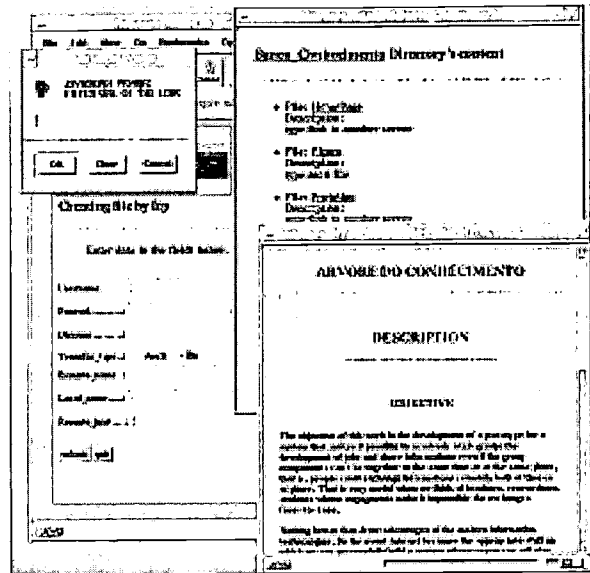


Figure 2. Functional mechanisms

the prototype. The idea is to use the system to store teaching material and administrative data held during a class period [7]. The teaching material will have links to other servers and related information, stored in other departments, creating, in this way, an interdisciplinary network. Administrative data concerns students doubts and questions with corresponding teachers answers, degrees, important deadlines, and so on. The knowledge repository is composed by the following directories: laboratories, which contains links to virtual experimental laboratories; bibliography, with references to books, technical reports and electronic documents; attendance, which presents the professor available times for meetings and stores administrative data; assignments, including the proposed work and the results of all students; classes, which describes the class planning and the list of items taught in each class.

PENO has already published educational material on its server. The next step is to use the Remote Knowledge Repository System to store and organize electronic information and links, both concerning teaching and engineering projects. The main goal is to provide an easy but powerful instrument where students can learn through previous experiences and start working collaboratively within engineering projects. Each new course period would "reuse" the elements of former courses.

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## Educational Aspects

Usually, the academic structure is rigid, imposing hours of passive dedication from students. They have to attend classes, read books, do exercises and perform daily tasks. Most of the time, teaching methods are based on the premise that knowledge is acquired but not constructed in a cooperative way among students and teachers. Traditional educational systems, where learning activities are pre-defined and performed at a given time, do not match with modern communication models [8]. Through the Internet, it is possible to have access to different knowledge domains and to have an active participation in the learning process by selecting and looking for complementary information. Our concern in this context is to provide means to guide students to structure cognitive schemes to sort out the massive information available in the Web and to process it into acquired knowledge, which we believe is a new role to be played by educators nowadays and in the future.

Remote education systems provide an user friendly, dynamic learning environment for students and professionals that want to update their knowledge. They speed and enhance learning activities by providing structured information, search facilities and communication aids. In our experience students have been developing course works which may now be used as references to other students, in which they have set links to material already stored locally or in other sites all over the Web. It proved effective as an stimulus for the students to incorporate the new technologies to their learning domain, but mainly it resulted in a promising line of work in the way of providing a fresh approach to evaluate and restructure the technological references to support engineering education.

## Conclusions

The prototype was very useful to identify restrictions and future improvements of the proposed model. The computing network and the Web technology proved that can be used as an efficient, safe and fast communication system. We also discussed the importance of implementing mechanisms for supporting the preparation of teaching material, configuration management and remote execution of programs. The best way to train engineering students to build new technological projects is to offer new approaches to prepare them.

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