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## TECHNICAL SOLUTIONS FOR ONLINE EDUCATIONAL SERVICES IN OCTOPUS RESOURCE CENTRE

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**Abstract:** This paper presents technical solutions, which implements a new model for creation of online educational resources and associated e-Learning activities on a web platform aimed to support training on environmental field. The innovative pedagogical model has been technologically implemented as a dynamic system, able to offer the following educational services: online creation of the contents and of the self-learning activities, resources uploading according to a classification tree, personalised access to educational material, advanced tools for information retrieval, communication tools to facilitate collaborative training, facilities to support multilingual information presentation. The adopted technical solutions fits into the pedagogical model and their presentation will reflect the conceptual and architectural design as well as several specific functionalities.

**Keywords:** online resource centre, Octopus project, e-Learning.

### I. THE FRAME OF OCTOPUS RESOURCE CENTRE

The Socrates/Minerva Project “Octopus: Transnational online resource centre” ([www.octopus-eu.org](http://www.octopus-eu.org)) is an educational and knowledge repository in the multidisciplinary and multicultural area of environment training.

One of the main concerns in the implementation of this platform was that Octopus resource centre would not be just a list of articles and links to other web sites or references to external resources like CDs or bibliographical lists. For this system was required that it would allow the creation and hosting of its own resources. To achieve this, a set of management software tools has been developed in order to handle different kind of resources such as: simple texts, complex documents, images, sounds and videos, so giving to the resource centre an effective multimedia capacity. More, the concept has been extended to aspects relating with interchange of information among users, in order to let them permanently connected to such valuable information as well as for expanding their interaction possibilities as learners and as humans. For this, the platform is developed in six different languages: English, Portuguese, Spanish, Romanian, Italian and Greek, corresponding to the origin of the project partners and all these languages are available online. This facility is embedding the intercultural aspect, which is very important on this platform [1][2].

Another important concern, reflected in the technical implementation, is the usability for a large category of users starting from simple users accessing only for information the site, up to high specialised people, which are contributing with their own resources and share information and knowledge with other colleagues. In this sense, the users have been classified on different knowledge levels and with different technical skills, so the information is personalised for each user. The management structure allows to add, to modify or to delete resources, so the technical solution doesn't limit the growth of the information. For this reason, this approach is an “open end” solution, as it ensures the development and sustainability of the resource centre behind the end of the project.

The main technical proposals at the beginning of Octopus project are identified in the following perspectives: a) the organization and display of information, b) the way the options work and are integrated with others c) the basic architectural structure to be used.

After the development of alpha version a usability test has been done in all the countries involved in the project to evaluate the organisation and display of information [3][4]. We arrived to a screen layout, where the spaces are supposed to be different rooms, where each kind of information is grouped. Like this some basic “rooms” were defined as: *Reception* room, related to the attendance of the users; *to Learn* room, where users can access to Octopus resources; *Lab*, where the users with high level permissions can build and change the information related with the resources;



Figure 1. The main page of Octopus web platform

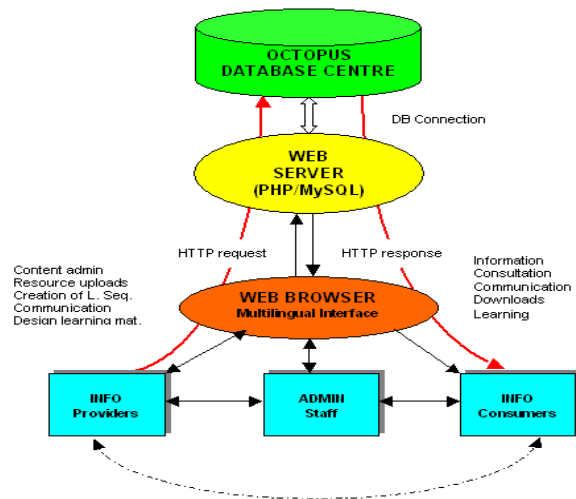


Figure 2. The functional technical architecture

Search, where the different ways of making the search were grouped. In spite of this kind of organization some of the options could be more hidden than expected. For this reason, it was necessary to bring alternatives with bigger visibility. The left side of the screen was used for that, allowing the system to put there the desired options (Figure 1). The adoption of this kind of organization allowed a great flexibility simultaneously with the growing of the resources centre and of the options displayed to the users.

To assure the working of the resource centre with different languages simultaneously, the administrative structure couldn't be high hierarchic and with several levels of decision. To avoid this problem Octopus has a shared administration with each partner as an administrator. This allows a quicker updating of information. It was our permanent concern the integrity of information, because of using different tools and working styles in creation and editing of information. This could bring to the users different formats and styles that would confuse them and make them to feel uncomfortable in using this site. So, it was developed a set of tools able to generate a standard format for all learning sequences. The submission of the information to Octopus in this way, would obey to an adoption of a unique tool, an editor with characteristics and working like the well-known instrument: "Microsoft Word". Many aspects that are basic to Octopus development are supported in a cooperative way of work needed to assure its growing and development. Based in this idea, Octopus allows the registration and identification of the users. The Octopus hasn't restrictions in using and exploring by the unregistered users. We wanted to have means and mechanisms to allow that information consuming users could be more participative and become creators of information in a cooperative philosophy of work [5][6].

## II. THE MAIN TECHNICAL SOLUTIONS

The basic functional architecture of the application is presented in Figure 2. It consists of two major parts: server side, which hosts the web pages and the Octopus databases, and client side accessible through the web browser.

For the server side, taking into consideration the main features to implement, in the kind of services to bring to users, in the degree of needed interaction and in the dynamic generation of contents, our option was made to the platform LAMP (Linux, Apache, MySQL, PHP), as the technological base to develop the Octopus project. This decision was made based in its robustness, flexibility and scalability, also as the lowest costs. The Apache server allows responding to the browser requests when a user demands to see an Internet page using the HTTP (Hyper Text Transfer Protocol) communication protocol. This protocol has a specific language that assures the connection and change of information between server and clients in Web environment. The Apache server is the most used in the entire world, according to an all world study from the Netcraft entity with 64% of web site all over the world using this software. Some security mechanisms are also assured by the using of this server. Having Octopus Resource centre a great dynamic, in the management of all the information, related with menus, graphics, users administration and others, all the information must be registered in a non-volatile database. The chosen system to do that was MySQL, also a public licence software project, having all the characteristics needed as easiness of managing, security in maintain data integrity and accessed protection. The Octopus system must have intelligent mechanisms that respond to users interactions and their functional and informational dynamics. With these demands the HTML, doesn't have the power to do it, because it just describes the displaying of the information and doesn't do its manipulation. To solve these problems it was decided to use the PHP language as the tool for the computer programming. This language, also a public licence one, can be used for different purposes and is good for web developing uses.

For the client side the tasks are more volatile and are based on the principle that they should free the server by additional processing and to avoid loss of time for Internet communication. So, the Javascript language and Java were

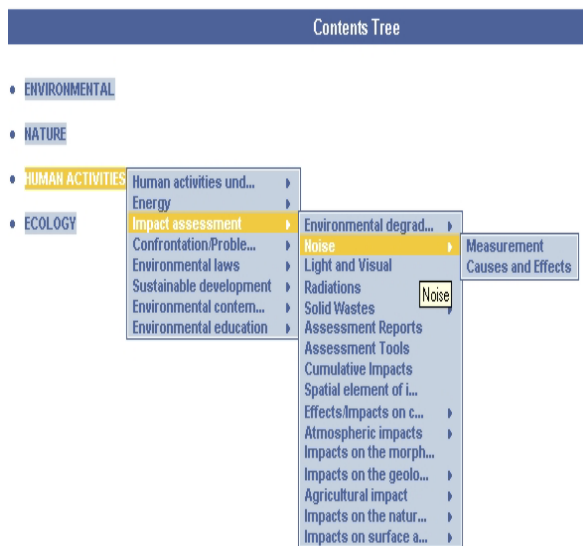


Figure 3. JavaScript generates the tree of contents

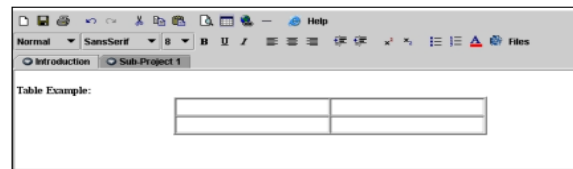


Figure 4 – Visual representation of a table

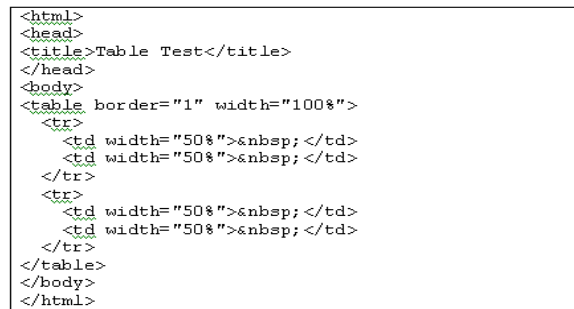


Figure 5. The associated HTML code generated for the table

used to support the local processing tasks and the user interaction with the graphic objects of the interface. Also, CSS (Cascading Style Sheet) was used to standardize the appearance of documents. Using the table of contents, as an example (Figure 3), we can see that all the items are kept in data structures present in the memory of the local computer.

When the user chooses a new menu option that is connected with another sub-menu, an internal event is generated and managed by the JavaScript programming, which obtains from the data structure the list of items from the selected menu and generates a graphic box with the displayed options. Java applets have been used for the online editing of educational documents. The development of such editor supposed a great challenge, because they have added difficulties comparing with off-line versions. It is caused by applets action restrictions in assuring security to the users that charge them in browser (reading files from local disk, copy/paste actions and the access to restricted properties from the system). To solve these problems the technique of signed applets was used which allow adding a digital signature identifying the author and allowing the users to accept or not the added privileges that the applet provides. Each one of the functionalities the editors have, like the table management, must have an associated description of the HTML elements [6].

This characteristic obliges that all the graphic and visual elements should be mapped in their own HTML elements. This operation is based on a parser (a syntax and lexical analyser) and on a loader, which allows presenting the structure into the corresponding HTML document to be saved (Figure 4 is the visual document and Figure 5 is the generated HTML document).

In the previous versions of the document and learning sequences editor we had some difficulties in saving the learning sequences, which were built with some sub-projects and when were created in computers inside of institutional networks, controlled by routers and proxies. To solve this problem we had to use another server based in technology XML/RPC (eXtensible Markup Language/Remote Procedure Call) that have the function of receiving HTTP requests from browsers sent by applets or JavaScript code. These requests have the information about the tasks that should be done inside the server, like activate PHP scripts to access and write in the database [6].

### III. EDUCATIONAL SERVICES FOR CREATION OF E-CONTENT AND FOR SELF-LEARNING

An important technical feature of this resource centre is the possibility to change at any moment the structure of the contents tree. For this, the empowered administrator can add more topics in the main branch or add subtopics in the tree of contents. Figure 6 presents the administration interface for creation of the contents tree where the resources will be further classified using specific forms that contain metadata descriptors. Metadata descriptors will help in the information retrieval process, in order to present to the user the required educational resources. The technical solution offers flexibility in items creation. Also, it is dynamic and can be easily adapted to other disciplines, such as Geography, Biology, Telecommunications, etc.

For information retrieval four types of search were defined and further implemented. The so-called *search*, the simplest, is just an introduction of a sentence in a field that verifies its occurrence. The *Advanced Search* uses more than a description sentence and it could be used in several fields such as: author, organization, date of resource creation, person who published the resource (example is given in Figure 7). *Metasearch* is the most complex, because the user can build his own search, choosing the fields where he wants the search to apply. This mechanism allows the user to build a search using a composition between fields and logical operators. The fourth one is the *Directory Search*, which uses the structure of the Octopus table of contents to select its elements where the search will act [6].

### Edit Contents Tree

1 - Environmental	Delete	Update
1.1 - Climate and Bio-Climate	Delete	Update
1.2 - Geological characteristics	Delete	Update
1.3 - Tectonic characteristics	Delete	Update
1.4 - Landscape	Delete	Update
1.5 - Water	Delete	Update
1.6 - Soil	Delete	Update
1.7 - Vegetation	Delete	Update
1.8 - Human environment	Delete	Update
2 - Nature	Delete	Update
3 - Ecology	Delete	Update
4 - Human Activities	Delete	Update

Add a new Item :

Number	Description	Add
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Figure 6. Online creation of contents tree

Quick Search   Advanced Search   Metasearch   Directory Search

RESULTS FOUND - 1

Layout: Layout 1: Index - Title - Description - Language - Type & Size (default)

Id	Title	Description	Language	Type
1	Pegadas de dinossauro no Cabo Espichel	Pegadas de saurópode	pt	

ADVANCED SEARCH

Keyword:

Criteria:

Audience:

Author:

Organisation:

Creator:

Results / Page:

Language:

Search in:

File type:

SEARCH

Figure 7. Advanced search of resources

Proprietatile Proiectului

Ce titlu dati acestui proiect?

Introduceti aici titlul proiectului

Definiti problema.

Definiti ce problema trebuie rezolvata. Specificati importanta acesteia.

Cat timp credeti ca e nevoie pentru acest proiect?

2 saptamani (este timpul recomandat)

Cate sub-proiecte veti defini?

4

Doriti crearea unui document cu structura predefinita?

Ajutor   Da

Figure 8. Definition of educational sequence structure

Add Learning Resource

Marime normala   Dialog   18   B   U   I   Fisiere

Intrducere   Sub-Proiect 1   Sub-Proiect 2   Sub-Proiect 3   Sub-Proiect 4

Procedura

Resurse

Secventa Temporală

Evaluare

Sugestii de utilizare


Figure 9. Online editor for creation of the learning sequence

Lista Resurselor Octopus

Lista Resurselor:

Titlu	Descriere	Tip
Instructions for uploadi...		file
Para Melhor Aproveitar ...		file
Sustainable agriculture ...		file
Land Cover of the Uppe...		file
Land Cover of the Uppe...		file
Aztec		file
Crocus		file
Lirio		file
Ombrothermic diagram		file
River valley		file
Petrological m4 Ombrothermic diagram		file
Para Melhor Aproveitar ...		file
Salted soil		file
Soil section		file
Characteristics of the M...		file
Land Slide		file
Geomorphology of a val...		file
CALDEIRAS DE ALTO		file

Pre-visualizare:



Gaseste Anteriorul   Cauta   Gaseste Urmatorul

Inseaza o Resursa   Inhide

Figure 10. Insertion of resources in basic document

Clasificarea Resurselor Educative

Realizati modificarile necesare apoi apasati pentru a salva:   Campurile cu (\*) trebuie completate

6. Tatu (\*) - Un nume dat resursei

0.1 Title in your Language -

0.2 Title in English -

1. Cine propune resursa - O entitate responsabila de propunerea resursei in Centrul Octopus

1.1 Persoana -

1.2 Institutie -

1.3 Departamentul -

2. Aria de acoperire - Extensia sau scopul resursei

2.1 Spatial -

2.2 Temporal -

3. Creatorul - O entitate responsabila pentru producerea continutului resursei

3.1 Personal (\*) -

3.2 Institutie (\*) -

Figure 11. Uploading and classification of the new resource

A self-learning activity could be a test that includes solutions after the resolution. An interactive-learning activity could be a forum by mailing about a topic or to exchange photos about the pollution. The schematic formalisation for the creation of self-learning sequences has been presented in several dissemination papers [5][6]. The project is decomposed into sub-projects, each identified by a specific goal. The goal may be accomplished by: a) active participation: searching data in the centre, documentation and analyses, experimentations using specific procedures described by the sequence creator; b) informative activities; c) communicative for collaborative learning, such as mailing lists, forum or chat, all realised at different levels: virtual, in the filed or in the classroom [7].

The above-mentioned formalism is embedded into a technical solution. The technical solution considers the implementation of an online editor. In the Octopus Resource Centre there are simple resources, which have been submitted without concerns about the use it will have and other kind of resources, which are destined to promote

learning. Each of these learning sequences has to work as a little project, where some tasks are asked to the users do, and they need to explore a list of selected resources (from Octopus, from internet or other) based on a specific problem or content. The editor is enough flexible to allow that creation process by several steps: definition of the basic structure of the self-learning sequence (Figure 8), using online editor to create the content and to define the specific activities together with the evaluation procedures and communicative tasks (Figure 9), possible insertion in the new document of some existing resources from the Octopus centre (Figure 10) as material for reflexion and analysis, uploading the new educational resource and its classification in order to be easily retrieved (Figure 11). This process of new resources creation may take some time, because it is a very complex activity both scientific and pedagogical, so the user has the possibility to work for a longer period of time on the document making it available on the web only when it is finalized.

#### IV. MULTILINGUAL INTERFACES AND INTERNATIONALISATION OF OCTOPUS

It was already presented in a previous section how Octopus resource centre works with several languages and the need for a correct use. This way of working doesn't solve all the problems concerned with the uses of different languages. The internationalization process had to be assumed in a more global way for any language. The global approach of this problem allowed to identify three distinct areas. These areas are: a) information area (all options and the menus), b) the contents area, concerning the documents and c) the code (messages embedded in the programming code of the site).

The translation of the information area was possible by the use of menu editor system as was presented before.

The translation of the contents has been approached in two different perspectives. In the case of written documents the translation was done using the document editor, which is the common tool with the high level permission. Concerning the high diversity of resources submitted to the resource centre it was defined that each author has the power to decide which language will be used for the creation of the resource. Knowing that this would cause the existence of many resources just in native language, the concern was to have a common identification base. This was done using two obligatory registration fields: one to mark the language of the resource, the other is the description in English. This procedure allowed a common base to broadcast the information about the submitted resources (e.g. in the News section, where recent resources are automatically cited) and to help the search process, as language is an important item for this activity [6].

In case of programming code the translation process was more complex, because the programmer couldn't reply each code section in a different language. It would be an enormous work, almost impossible to assure the information integrity. So, the solution was to make the identification and marking of all the sentences containing warnings and messages embedded in code. After this, it was developed a translation program that creates a list with the messages found in the programming code. This program was sent to the partners with the list of sentences in English, so they could make the translation. The translated lists in each language have been imported to a correspondent file that makes the translation to the selected language. The program that allows the partners to do the translation tasks was built in C++. This process had some problems related with the Greek translations, which has very special characteristics in the definition of its characters as the codification is different from the other western languages [8].



Figure 12. Example of multilingual interfaces for the Menu Editor (in Romanian and Italian)

## V. CONCLUSIONS

The Octopus Resource Centre is a web platform that is the result of a good balance between the initial idea, the need of identifying the requirements of the project and the identification of needed technologies to have results. In spite of many conditionings in the development process the final result is very promising, because it allows different perspectives of work, usage and a big increase of information in terms of submitted educational resources.

After two years of intense work the technical limitations are surely the least important, as the existing tools and the great flexibility of Octopus site are the result of a great concern with the final user: not only the information consumer, but also the authors of training materials in the environmental area. The problems became challenges that obliged to make difficult and risky options and finally to have opportunities to open new research and implementation areas.

The Octopus resource centre became a great and complex amount of programming comparable with some institutional sites as banks. It was possible with relatively few means and many creativity to have an Internet site very powerful, very complex, but mainly very flexible, that we can say without many presumption, a mark in the development of online resource centres.

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