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Towards the Creation of Adaptive Content from Web Resources in an E-Learning Platform to Learners Profiles

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***Abstract*—**The evolution of information and communication technology has made a very powerful support for the improvement of online learning platforms in creation of courses. This paper presents a study that attempts to explore new web architecture for creating an adaptive online learning system to profiles of learners, using the Web as a source for the automatic creation of courses for the online training platform. This architecture will reduce the time and decrease the effort performed by the drafters of the current e-learning platform, and direct adaptation of the Web content will greatly enrich the quality of online training courses.

***Keywords*—**Web Content, e-Learning, Educational Content, LMS, Profiles of Learners

I. Introduction

ONLINE training content are stored in a 'DB' database. It fed or changed by the editors, and not the pages themselves. This is called to websites and dynamic content: stored information is then presented in some form by "LMS" Learning Management System [1].

The presentation of the contents stored in base is defined in priori by a model, a template, often called "style sheet". She is responsible for the layout: how to extract information from the DB, which displays information, where and under what conditions [2].

With this separation of content-presentation, content can be adapted to all type of media from the same source. With the XML description language "Language Semantic Description of Documents" in particular [3], [4], one document can be adapted in various formats.

The web presents a very broad area of information requiring a good search and precise filtering to extract the most relevant information. We are facing a very large mass of information available on the WEB, and editors spend an indefinite time to create courses and more specifically, having a content database that will be adapted to the learners profiles. The base consists with the use of the publishers provided by the LMS.

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Our work is based in research results of the work named CADEL-WEB "Automatic Construction of an On-Line Learning domain with the Web", "Construction Automatique d'un domaine d'enseignement en ligne à partir du Web" [5], which introduced a system of automatic construction of courses via the Web. Then, the work when is proposed a new method of searching the Web for Web content customization to a community of Internet users especially educational [6].

In the continuation of our research, we presented throughout this paper a new Web architecture for search and automatic filtering of Web resources, and eventually an adaptation of the latter to profiles of learners.

E-Learning is a means of education that integrates personal motivation, communication, efficiency and technology [7]. Learn remotely, in any place and in any time to allow free, fast and the most important training custom. This is provided by the Internet and multimedia technologies that have a positive influence on the efficient use of online learning environments [8].

Although the removal of the limitations of time and space Web [6] which provides a means of finding the most relevant resources to create an educational support in an e-Learning platform to allow a good management of Web resources.

To create a practical learning environment for e-users, and to a broad audience (different objectives, knowledge levels, funds or learning abilities), it is necessarily that the designers of e-learning systems thinking on adaptive learning environments and flexible with this potential need, so they must improve the performance to the learners.

Recent works dealing with the problem of adaptation are a very powerful difficulty, because a profile such a learner can change a lot of time in period for learning.

And before the learners needs to cultivate, to deepen more on such a field or theme of learning, we are obliged to produce a system that uses the Web as a documentary medium, and provides techniques to custom navigation for learners.

Through our experiences on the Web domain, we found a solution [6] very effective for personalized search of Web content; this solution helps a user to find its educational needs with a free guidance, proposing multiple choices according to his mentioned query. However, we are obliged to use the principle of CADEL-WEB system with this solution to a creation of the automatic and custom profiles of learners.

We quote our secondary objectives to deal with the ultimate goal:

- The creation of a Web architecture playing two roles: research of Web resources and adaptation of these latest to profiles of learners.
- The creation of domain ontology for the presentation of the contents of courses or training on-line followed.
- Integration of a method of searching and filtering in the same architecture.
- Integration of a method for adaptation of content in the same architecture.
- The implementation of the various steps listed above on a single system, then the integration of the latter in the Open Elms LMS Version 6.x (open source) [9].

The rest of the paper is presented as follows:

Part two presents a background to the concepts related to our project. These definitions are necessary in order to properly understand the following of our proposed approach.

The third part provides examples of related works, to follow the recent approaches used by researchers in the field, so these work analysis, gives us a point very hard to take place our proposal by reducing a few weak points of completed systems.

Fourth part explains our proposed approach, citing the resolved issues and the followed principle. Subsequently we detail our system architecture. Then, we give the main objective.

The fifth part describes preliminary results after the implementation of most of the components of the system and our solution for adaptation Web content.

At the end part "the sixth", we accomplish by a conclusion and we include a few perspectives and our future work.

II. Background

We will give and define some concepts and theories necessary for the understanding of our work:

A. Learning

Learning is defined as a process where the knowledge is created by the transformation of experience [10]-[11]. The most common perceptions about learning include that it is a quantitative increase in the acquisition of knowledge or information, or make a good memory, or store information that can be replicated, the acquisition of gestures, skills and methods that can be stored and used according to the needs of learners. In a broader sense, it is to interpret and understand the reality in a different manner [12], [13].

B. E-Learning and Education

E-Learning is useful for education, businesses and all types of learners. It is affordable, saves time, and produces measurable results. E-Learning can be defined as learning by electronic means: the acquisition of knowledge and skills by using electronic technologies such as computers and tutorials on the Internet and local and extended networks of another definition of e-learning is education via the Internet, network, or a stand-alone computer. E-Learning is essentially the transfer network of skills and knowledge. E-learning refers to using electronic applications and learning processes [14].

C. Adaptive Hypermedia Systems (AHS)

There are the systems that use usage patterns and the concept to provide customized version information for the end-user [15].

D. Adaptive Hypermedia Systems for Education (AHSE)

They are the ones that create a unique learning experience for each student based on learner-base knowledge, goals, learning style and so forth [15]-[16].

E. Adaptation of learning content

There are two general approaches for adaptation of content for learning [17], [18], [19]. The first approach seeks to adapt learning content with special needs, and the second focuses on providing the most appropriate order of learning content to the needs of learners.

The first is called a content adaptation and the last is called adaptation at the level of links. None of these approaches was preferred over the other in the literature.

III. Related Work

Some researchers are in making extensions for learning content standards to improve the quality of the learning process. These researchers argue that current standards do not support an adaptive system so that they must be changed, for example there is works of (Lu & Hsieh and two teams of Rey-Lopez [21], and Sampson [22]).

There is another necessity as the metadata for learning content standards is somehow insufficient for some applications, other researchers make the emergence of new work trying to replace these standards with ontologies on the Semantic Web, as a basis of (Chi [23], Yang [24], Junuz [25] and teams of: Jovanovic [26], Lee [27], Verbert [28], Shih [29], Wang [30] and Zitko [31]).

Our objective aims to claim that the current adaptive systems are not stable, given differentiation in the profiles of learners and the difficulty instant before the drafters of course to make the latest update according to the needs of learners, thus types trainings based on the informational side and non-semantic, so currently there is no education system online which is adapting in the market.

We want from our system the integration of our approach into an LMS open source, in order to receive the benefits of the adaptation of content really in online teaching platforms.

IV. The Proposed Approach

The amount of learning material on the Internet has grown rapidly in recent decades. Accordingly, the information consumers are confronted with the challenge of choosing the right things. In e-Learning systems such an approach has led to confusion for learners. Inevitably, the adaptive learning has gained much attention in this area (the two teams of Wang [32], and Yang [33]).

The adaptive learning can be defined as the process of

generation of a unique learning experience for each learner based on personality of learner, interest and performance in order to achieve objectives such as improving university learners, satisfaction of learners from the learning process and so forth (Monova-Zheleva [34], and Rosmalen team [35]).

The proposed approach is based on the quoted points previously, where learners and even editors of course satisfaction, forms a very important point in our objectives. It is in this context that we pulled our problem.

In a commercial platform of online teaching, course management system offers a tool for creating courses, where manager which can be author or administrator, can upload courses already created. Other systems offer interfaces, where the editors create blocks of information that can be later creating courses according to profiles of learners.

In both cases we have the following weaknesses:

- The difficulty of creating courses in both cases (it should be a background before starting the creation by searching in the web or books. As a result: an indeterminate time spent by editors) ;
- The non-freedom of learners especially in the first case, because the authors cannot know the need, the level, the knowledge of learners to create a well suited courses ;
- The weakness of the training program, such as a lack of enrichment of courses by the recent news ;

To reduce the limitations suggested by the course authoring tools, we chose to develop a database of segments via the Web, and then adjust them using an open source LMS to have an adaptive content for learners.

We can explain the approach as follows:

Entry of system: the Web.

→ Internet access

→ Web Resources

→ Research + Extraction + Filtering

→ Create database of segments supported on domain ontology

→ Adaptation of segments to learners from the base and supported on pedagogical ontology and patterns principal

Result: Educational Adaptive Web Content.

The Web content is so large and not personalized or adapted to users, this is made by the method of indexing web pages. In last years, the pages have a new format called XML, but the great percentage is not fine indexed. In other case, the Web content presents many roles: educational, cultural, administrative, industrial …etc.

In our Web architecture, we use the Web to create an adaptive educational content to profiles of learners.

We will produce the architecture of the proposed approach, as in Fig. 1, to facilitate understanding and implementation of our system.

Our project aims to reduce the time spent by editors to create the basis of the course in a first place, so the time spent by developers to adapt the content to learners in another place.

We can summarize the approach as follows:

1. The web presents documentary support to the creation of content courses;
2. Search tool based patterns, and more semantics extracted for ontology;
3. A filtering tool enabling extraction of different segments and stored results in the database of patterns;
4. And finally, a tool for content adaptation which will be detailed in the next part.

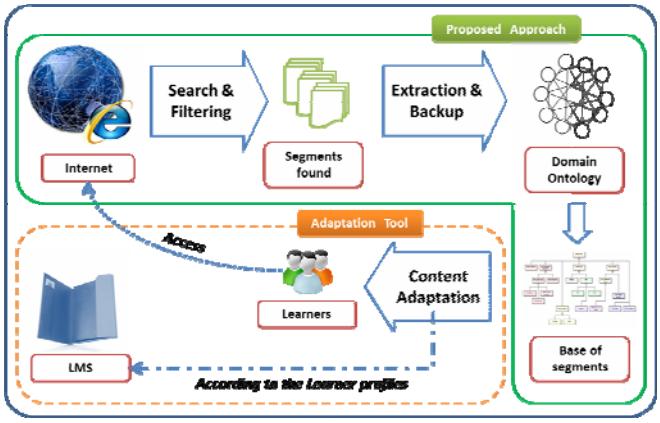

Fig. 1 Proposed architecture

V. Preliminary Results and Solution for Adaptation

We chose a specific domain (medical domain). Our ontology is created by the tool Protégé 2000 version 3.4, and validated by experts in the field.

Fig.2 presents a graphical extract of created ontology through the graphic model named Jambalaya.

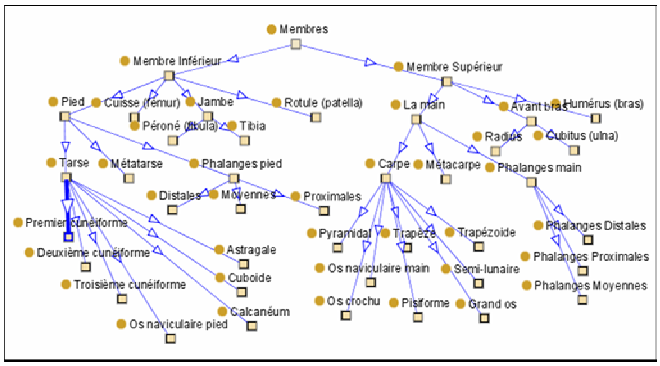

Fig. 2 A graphical extract of the created ontology

Each concept of ontology has a set of keywords and a set of semantic relationships. Keywords are required in the calculation of the degree of relevancy of each segment found in the Web, in order to choose the most relevant among all extracted segments and subsequently save these latest in a database of segments.

For Web access, we use the Google API of search. This API allowed us to have a Web result like that found in the use of the search engine (title, link, textual description), as in Fig. 3.

Fig. 3 shows an example of using our tool to search, we choose two documents type: PDF and DOC, then the downloading tool that will save the Web resources found in a physical medium, to the later reused.

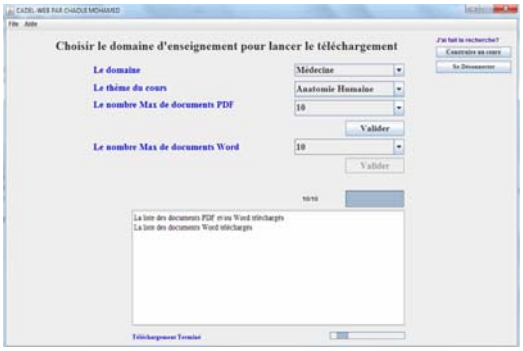

Fig. 3 Research of Web resources via our system

After finding the necessary information, we turn to step of filtering and retrieval. We tested our method of filtering (1) [5] with the abstract of this paper and its keywords, and we found a degree of relevance "0.0862069" as in Fig.4.

Extraction consists of finding the highest degrees of relevance to assign each part extracted in the concept associated in the database of segments.

$$DR = (F_c + \sum_{k=0}^{n} (F_k * W_k)) / N. \quad (1)$$

Where:

DR is the Degree of Relevance

F_c : present the frequency of a concept in a segment.

c : The concept.

k : The keyword.

$\sum_{k=0}^{n} (F_k * W_k)$: The sum of the frequencies of all keywords (k=0…n) of a concept in the same segment multiplied of the weight of correspondent keys.

n : The maximum number of keywords.

W_k : The weight of a keyword k.

N : The total number of words in the same segment.

Fig. 4 Test of degree of relevance with the abstract of this paper

Before judging the degree of relevance, it must first calculate another degree based pattern, he will bring the most relevant information associated with a given concept. The degree is as follows:

$$DBP = N / (NS_c + (\sum_{k=0}^{n} (NS_k * W_k)) \quad (2)$$

Where:

DBP : Degree Based Patterns;

N : Number of words in segment;

NS_c : Number of sequence of a concept c;

k : Keyword;

$\sum_{k=0}^{n} (NS_k * W_k)$: The sum of the number of sequence of all keywords (k=0…n) of a concept in the same segment multiplied of the weight of correspondent keys.

n : Number maximum of keywords;

The DBP will provide another level of relevance, more the basic elements of information (concept + the list of keywords) are distant, more the degree increases. Therefore, the best degree is the smallest, where the basic elements are close, which means that the segment presents the relevant information to the concept.

In the end, we can integrate our base in Open Elms LMS; which is open source; to build adaptive courses to learners. Adding on a tool responsible for adaptation of content in our system, this tool is the sequel to the use of our ontology, because in the latter, we have a hierarchy of a course. A course is a set of concepts, if we know the level of a learner and its goals; we can associate a course to each learner. The course will be created in an automatic manner via our tool for adaptation of content and from different bricks / segments stored in the database segments.

Profiles of learners are also presented in other pedagogical ontology, to give a direct adaptation via the current state of the learner by making a test or examination. According to the test, we can know their conditions according to the pedagogical ontology; the latter will initiate a process of construction of course using segments stored in the database.

More generally, Web resources will be adapted directly to learners during their navigation in the system. We conducted our research based patterns method [6]. Through this work, we will provide a basis for patterns, it is necessary for Web content adaptation to profiles of learners. We give part of performed adaptation by our system, as in Fig. 5.

Our adaptation is based on the following points:

1. The States of learners;
2. The choice of patterns in research action from the Web;
3. The backup of extracted segments into database;
4. A courses constructor tool based on level, the choice of the patterns and segments database, this tool will create educational and adaptive courses to learners.

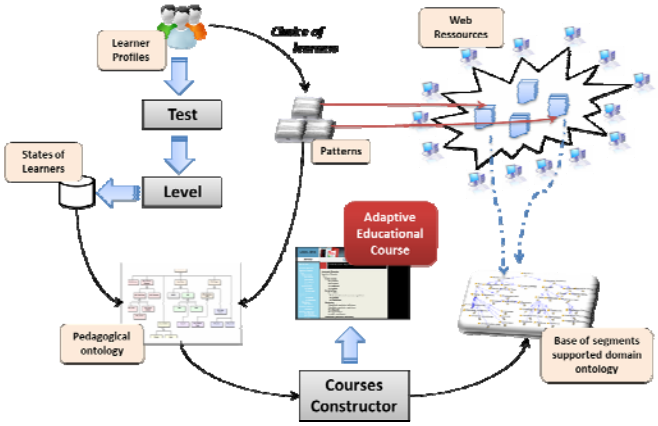

Fig. 5 Architecture of our Adaptation

From this principle, we can benefit from the reuse of Web resources stored in the base of the segments, in order to reduce the time for search and filtering.

In the strengths points of our system, we can see the use of patterns, learners have the opportunity to choose freely the details of the courses, this is provided by the pedagogical ontology improved and enriched by the authors.

The instant update of learners states in the associated database, allows good adaptation of segments. And in the other hand, learners can use a quite powerful tool who gives researched custom from the Web [6].

VI. Conclusion & Perspectives

After considering all consultation, creating tools and management of information, we have reached a conclusion that gives us the opportunity to have a new Web architecture to extract the most relevant Web resources, and then classified them in database of segments via domain ontology. The base is integrated into an Open Elms LMS with adaptation to the profiles of learners.

Through this study developed, we succeed in building Web architecture for adaptive resources to learners in an e-Learning. The architecture offers research and filtering of Web resources, after that, creating areas of learning with the possibility of adaptation of content for the platform to the profiles of learners.

The world in the last years saw very rich side resources available on the Web; our method is to reduce this informational space in an adaptive educational space, personalized and mostly reusable for the entire community of learners.

In our future work, we plan to have an experiment made by a very large number of learners (students, teachers, researchers …etc.), and in various fields (not only in the field chosen by our approach). Thus, we want to make a fusion between resources found from the Web, to improve the quality of the segments stored in the database, and the quality of courses construction.

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