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Improving Interaction for eLearning Complex Contents: a Showcase in CH Environments

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Abstract

Learning of Conservation and Rehabilitation Tasks in AEC [Architecture, Engineering, Construction] environments poses hard challenges for integrating materials, context and processes. Our approach is focused towards different multimedia representations [text, image, video, laser scan] with a common reference given by an evolving representation of a 2D or a 3D model. In a similar way to usual GIS (Geographic Information System), our approach can support different layers where tasks to be developed are designed, tracked and evaluated. Design involves 2D/3D/4D modelling by using different kinds of photogrammetric surveying, including images, laser-based information and previsible behavior in the next future. Our approach tries understanding complex interactions in damaged architectural objects having in account time evolution and successive interventions as a whole. Our software application intends to become an educational and corporative learning platform (e-Learning and e-Working), which will enable instructors to do an effective design of on-line courses and to improve an efficient management of learning techniques and collaboration activities on the web. Our contribution is focused towards the design and development of collaborative working environments, where specialists with different expertise can share their knowledge in a common open-source framework. This tool has been applied for planning intervention strategies, products and methodologies focused towards surveying, planning and executing conservation policies in architectural elements of the Spanish Cultural Heritage.

Keywords

New Learning/Teaching Model; eLearning Standards; Technology-Enhanced Learning; MACE

Introduction

The general objective of this work is to provide models and software tools for eLearning architecture and, more specifically, tasks to be accomplished in regard to interventions (conservation, restoration) in Cultural Heritage buildings. The application of ICT to learning strategies has introduced several new topics which concern different ways of knowledge representation, including e.g. (a) materials (what does multimedia support?), (b) information relative to context (where is the object and how is related with near objects?) and (c) involved processes (who are the agents and which are the interests of students and trainers?). All these issues concerns the Semantics of eLearning which is strongly related with the meta-evaluation of eLearning tools, and provides some links with the more general Semantic Web framework.

The large diversity of advanced software tools for architectural design and information management systems poses hard challenges for their integration which eases knowledge transfer between them and their application in very complex Cultural Heritage architectural objects. Two general strategies for interoperability issues consist of developing a common framework or, alternately, identifying common parts in a shared Semantics. An example of the first strategy is given by hybrid systems, which we have labeled as Documentation, Information and Management Systems (DIMaS). An example of the second strategy consists of aligning Ontologies. In our context, an Ontology is defined as a knowledge representation, with its lexicon (collection of key work), thesauri (collection of definitions and/or descriptions for key words) and taxonomies (sets of logical rules involving logic of classes, logic of predicates and descriptive logics). The main problem for interoperability concerns the lack of specification of the subjacent Ontology corresponding to hybrid systems used by experts; there is an implicit ontology which is necessary to discover, specify and compare at least at the lexicon level.

Essentially there are two approaches to KMS (Knowledge Management Systems) which can be labelled as fusion vs alignment of Ontologies. Each one of them has advantages and inconvenients. In general terms, the comparison between databases, information systems or more general DIMaS, can be computationally implemented in terms of fusion or, alternately, alignment of Ontologies: (a) Fusion involves a superposition which covers all the available information, but it can give redundant information or usefulness information, with increasing costs for information store and management; (b) Alignment identifies common elements which belong usually to lexicon, but it forgets the transfer between meanings of common words and logical rules in charge of knowledge management. From a computational viewpoint (minimize costs), ontologies alignment seems more appropriate, but this poses the problem of how to recover different meanings and different ways of reasoning about the same architectural object. Both issues have illustrated even at the 16th century in the Palladio work (1567), where different strategies for composition and construction are proposed following a coarse-to-fine strategy, including the seemingly first set of rules for construction activities. Palladio's work provides an excellent strategy because it provides a method which is graphically supported by lots of examples which illustrate models at different levels of detail (LoD), compatibility rules, problems to avoid and constructive settings. In other words Palladio's work provides the first historical predecessor of Building Information Model (BIM) of the history of Architecture.

Building Information Modeling (BIM) is an international standard for software tools applied Architecture, Engineering and Construction (AEC) environments. Currently, BIM and AEC environments display a very large heterogeneity of scenarios with a large portion of implicit knowledge, a large heterogeneity of techniques and links to an intricate jungle of administrative norms and construction parameters. Nevertheless an increasing acknowledgement as construction standard, its application to restoration and rehabilitation issues still has not been developed. From professional viewpoint, very often technicians and workers do not have enough specific training to solve conservation and restoration interventions, and need an additional support which is not covered by academic institutions nor advanced BIM solutions which are more focused towards industrialised construction. Thus, it is necessary to provide additional information which enables a higher capacitation before training at workplace.

Furthermore, Conservation and Restoration Interventions (CRI) techniques are changing in a continuous way due to changes in administrative constraints and/or the incorporation of new technologies. This situation is especially critical in Cultural Heritage (CH) environments where variable resources and recent developments involving materials (non-destructive or semi-destructive techniques) are continuously changing the conceptual framework and, consequently, their applications in the workfield. Furthermore, the economic crisis has destroyed a very large portion of AEC workers with skills which could be adapted to interventions in CH Environments with meaningful social effects (Cultural Tourism) and their multiplicative effects in disfavoured or low rent regions.

The above considerations and the development of ICT tools for supporting technological paradigms changes have provided a general professional and socio-economic framework for developing new eLearning tools, such as the software tool presented here. From an academic viewpoint, our tool provides a support for solving additional qualification needs by reducing costs at two levels supporting students of Architecture and/or requalification of unemployed workers in AEC environments.

New ICT technologies provide a support for developing new eLearning tools. The Learning Management Systems (LMS) provide standard software tools which are used to distribute and manage eLearning activities. Moreover, the use of LMS to develop learning situations is becoming more common thanks in part to the success of systems such as Moodle, Claroline, LAMS, LRN, Blackboard or Sakai. Each LMS usually includes different tools (questionnaires, chats, forums, etc.) that support and facilitate a support for eLearning and eTraining tasks. However, trying to generalize and systematize the currently available possibilities is not an easy task due to its multipurpose character involving different application fields, and their different architectures and functionalities. In a very simplified way and from the contents viewpoint, we can distinguish two application fields: educational and business field. In this paper, we pay special attention to the former one, but with a view to its exploitation by using an extended eLearning framework. In the next future, we intend to develop virtual learning frameworks for supporting exploitation from the business viewpoint in regard to the assistance of good practices for working environments, which can be applied by enterprises in charge of restoration and rehabilitation tasks. In a more specific way, in this work we incorporate the advances related to rehabilitation tasks in historic buildings in an eLearning software tool. Such advances concern to Documentation, Information and Management Systems (DIMaS) with a shared Ontology.

According to the above, this paper is organized as follows: We start with an overview about how the new learning techniques are improved in AEC and CH environments. Next, we introduce the use of LMS for the development of our software eLearning application for Rehabilitation in AEC environments ATRAECOM[1]. In the fourth section, we introduce the most important tools that have been developed. Section 5 illustrates some functionalities of the application through a real example. Finally, some conclusions and on-going work are presented.

Improving the Interaction

The interaction through eLearning software tools must involve (1) the architectural design, (2) an evolving dialogue of architectural work with the rest of fabric and the environment and, (3) dynamic aspects concerning the feedback between different agents (professionals, citizens, entities in charge of administration and management) and the "story" of building. First aspect concerns a "static" support involving different resources for documentation which is usually performed in terms of photogrammetric surveying and/or 3D reconstruction strategies in Computer Vision (3D laser and high resolution video provide relevant inputs for both of them); the resulting information is referenced to geometric models which are parametrized in terms of vector information. This parametric representation can be managed by recent standards related to BIM-based construction strategies for AEC environments or to GIS-based solutions arising from CityGML, e.g.. The availability and increasing use of these tools provide commonly accepted standards which are the natural extension of methodology proposed by Palladio in the 16th century. Their fusion gives a complex space-temporal model which provides the support for the evolving dialogue and dynamic aspects which are mentioned above. From an eLearning viewpoint, the main purpose is the development of a realistic immersive environment which can be "augmented" by means of simulations to provide enhanced new knowledge from complex interactions including simulations and virtual visualizations.

The large heterogeneity of scenarios, techniques and situations, requires try of finding a balance between complexity of learning and customization to particular needs involving each type of professionals and adaptation to changing environments. Tools to be designed must satisfy competences to be acquired in an individual way, but having in account 1) constraints linked to the need of a cooperative work in complex dynamic environments, and 2) advances of competitiveness by SMEs (Small Medium Enterprise), in charge of executing the interventions. These constraints pose new challenges which extend traditional learning approaches, where the accent is put on learning as acquisition of individual skills, which must be balanced with general access or even social aspects related to collaborative environments focused towards unruled learning at different levels for user communities self-organized in mash-ups with usual resources (blogs, chats, groups of news, wiki). Its articulation between ruled learning (supported by Living Labs, e.g.) is a challenge which still has not been developed in our application.

The integration to be achieved requires the acquisition of new knowledge to improve the efficiency and performance involving skills, abilities, attitudes and behavior by their employees. LMS provides a framework which allows increasing the human capital value of a company, their competitiveness and effectiveness, and consequently improving its relative position in the market. Development of intellectual capital is a crucial element in business success for SME working in this sector. Some social and economic advantages of virtual learning are the following: (a) Meaningful financial savings for companies through training of its employees, (b) Flexible schedule, avoiding the overlapping of different employees in time and space, (c) Just in time access to timely information necessary for the performance of their duties and (d) Less threatening environment that encourages participation of workers.

From a pedagogical viewpoint, our work is included

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[1] ATRAECOM is the Spanish acronym for *Aprendizaje de Tareas de Rehabilitación en entornos AEC sobre diferentes soportes Multimedia referenciados a escenarios 3D*

in a more ambitious goal which concerns the development of an innovative technology able to profit conceptual models and experiences arising from different knowledge areas. A key issue concerns interoperability between different tools for information management; in absence of acknowledged standards for this kind of interventions. To achieve this goal, we have developed a specific Ontology which supports different layers which are geometrically referenced. In a very similar way to usual GIS, all these layers have a common geometric support for making easier the reference of another aspect concerning historical, artistic, structural and materials issues. Each one of them has a collection of key words, definitions, rules-based methods, links to norms and examples of interventions, suggestions and validation of proposed interventions. Information management is performed in terms of a specific shared Ontology.

ATRAECoM

To achieve the proposed goals, we have developed a software platform which is based on a specific ontology for Cultural Heritage which is called ATRAECoM. It provides a support for technical issues concerning Learning of Rehabilitation Tasks in AEC environments on different Multimedia supports which are georeferenced to outdoor three-dimensional scenarios. Technical issues concern mainly the application of scientific and technological applications of different tools which are of common use in Rehabilitation and Restoration tasks. The information fusion is performed on vectorized digital images or volumetric representations. To achieve this goal, one can apply segmentation techniques which extend well known techniques in Computer Vision. A *segmentation* is a decomposition of a 2D/3D representation in a disjoint union of regions which is obtained after applying processing and analysis tools (filtering of digital information). The decomposition can be performed by using geometric and/or radiometric properties. Resulting regions are supported by geometric elements for planar (vertices, lines, polygonals, e.g.) or volumetric objects (planes, archs, vaults, e.g.) which can be vectorized in an automatic way. The conversion of pixel coordinates in spatial coordinates is realized by using usual 3D Reconstruction techniques. After vectorization, one can superimpose additional contents arising from other analysis (materials, geothermal, acoustics, radar, chemical, etc.) on each meaningful element; currently, this superposition is manually performed on each layer of the Information System linked to the geometric object representing the cultural good.

Furthermore the protection degree of cultural good, the choice of optimal solutions to be applied must integrate cultural components involving historical and archaeological aspects. Such aspects are incorporated as additional labels which are superimposed to the digital vectorized support which is the main component for Documentation System. Labels (including url relative to similar interventions) can be activated along an interactive navigation system which is added to ease consult, learning and training issues. We suppose that all these issues are already performed in the two first stages (Documentation and Information) of the integrated DIMaS. In other words, we include Learning as a component of the Management System to be developed.

Objectives

The *main objective* of eLearning software tools is the development of strategies, products and standard methodologies for making easier the learning of techniques and resources of interventions in architectural environments related to Cultural Heritage.

LMS framework Claroline

The developed software tool ATRAECoM follows a constructive methodology inside the LMS framework provided by Claroline[2]. A general approach to the use of Claroline resources for e-learning issues can be found in (Karlovcec et al., 2005), which we have adapted for the current work. We suppose that users of our application are aware of the utility and advantages of ICT for learning CH contents (Ott and Pozzi, 2011), and consequently our effort is focused towards an effective management of interventions on our software application for e-Learning and working at place.

Our adaptation of eLearning tools displays different advantages: (a) it is customizable depending on the user's knowledge and qualification; (b) it makes easier the representation of processes which appears illustrated along intervention processes; (c) it contributes to the continuous formation of specialized personnel; (d) it provides an access to different kinds of functionalities by means of a simple and interactive interface; (e) it uses open source software; (f) it is

[2] Claroline "A pedagogical model for eLearning". http://www.claroline.net/pedagogical-principles-3.html

extensible; (g) and it is interoperable with software tools arising from other knowledge areas (including modelling or image processing) thanks to the use of standards.

Software Tools

ATRAECoM incorporates different kinds of functionalities involving users management, courses, vocabulary, metadata, tracking of learning processes (through supervised learning paths), personalized access to course resources (depending on user knowledge), and management of multimedia contents (including use of planimetric resources, graphical and three-dimensional models to different scales). Usually, metadata of different levels are introduced by the user according to standards which involve the learning process, also; we have adopted the IEEE standard for learning object metadata[3]. In the next future it will be possible to incorporate more sophisticated software tools for semi-automatic recognition of pathologies involving the building fabric.

Multimedia Tools

To adapt typical methodologies of Learning Management Systems based on AEC environments, it has been necessary to develop multimedia tools. These tools are used for representing learning activities which are used in an interactive way.

We have designed and implemented a shared Advanced Visualization framework which includes different modules for modelling, learning of non-destructive techniques, scenarios virtualization, and systems for consultation and evaluation of interventions. All of them are based on cases of use to improve the knowledge acquisition in an interactive way in regard to the daily professional practices.

Our methodology is compatible with traditional tools for CAD-based representations, image- or range-based photogrammetric surveying or 3D volumetric representations, including models to different levels of details and proposals for interventions. Furthermore, our representations provide a support for real and/or augmented identification of pathologies. So, traditional CAD representation is integrated in a common Information System with different layers involving materials characteristics, the external envelope and/or structural aspects. The Fig. 1, illustrates different kinds of pathologies involving the envelope; in this case, it is composed by different kinds of bricks, stone, or masonry in the walls. Each pathology is identified by means of a colour code, and different solutions are proposed to perform conservation or restoration interventions. In this way, a unique geometric object provides a support for inserting different diagnoses, solutions and text comments (including the use of old artisanal techniques).

FIG. 1 PATHOLOGIES NORTH ELEVATION OF THE MAGDALENA CHURCH (VALLADOLID, SPAIN) THROUGH IMAGE MAPPING TOOL

The Information System linked to the Documentation module follows a typical GIS methodology, where raster information (relative to materials, composition, etc.) is in our case subordinated to geometric aspects. This choice is more "objective" than the choice based on raster information, it is the same as the one adopted in CityGML and can be reconverted in parametric representations (typical in BIM-based models). Hence, it simplifies the interoperability with different standards used in AEC environments. Furthermore, it provides a support for collaborative environment, where different experts can insert their methods, pose questions, text solutions and compare results in dialogue elements which can be referenced by using a vector support. The heterogeneity of problems involving materials and structural problems poses additional problems to extrapolate analysis of well known cases of use. To solve this trouble, we have developed an approach which is based in cubical decomposition which is inspired in BIM-based solutions and it is compatible with CityGML standards by using appropriate tools for transformations between models (affine transformations for each cuboid). Nevertheless the morphological diversity, the superpositions of cuboid maps allow adapting and managing the available information at different LoD for Cultural Heritage

[3] IEEE 1484.12.1 - 2002: "IEEE standard for learning object metadata". http://ltsc.ieee.org/wg12/files/LOM_1484_12_1_v1_Final_Draft.pdf

buildings in urban and rural environments. Our application supports suggestion systems for similar cases by following typical benchmarking strategies. The evaluation and optimization of results require a higher number of examples, methods and proofs, and the evaluation/validation of results to be performed by professionals and SMEs working in Conservation and Restoration in historical buildings.

The availability of 3D virtual models allows navigating the object, to acquire an advanced visualization of the whole object (see Fig. 2). The main purpose of this application is to acquire not only a global view corresponding to the object and its environment, but to explore the possibilities linked to data insertion, analysis and evaluation of superimposed solutions and simulation of effects, in the next future. To achieve these goals, we are using open source software tools for advanced visualization. These tools allow linking planar and/or volumetric objects with the information corresponding to the different layers of DIMaS described below. They are very useful not only for learning, but for planning and tracking rehabilitation interventions. An obvious limitation of our approach is the lack of connection with standard design tools (which concerns to creative and projective work) and the management tools which are necessary for effective tracking of accomplished work along restoration and rehabilitation tasks.

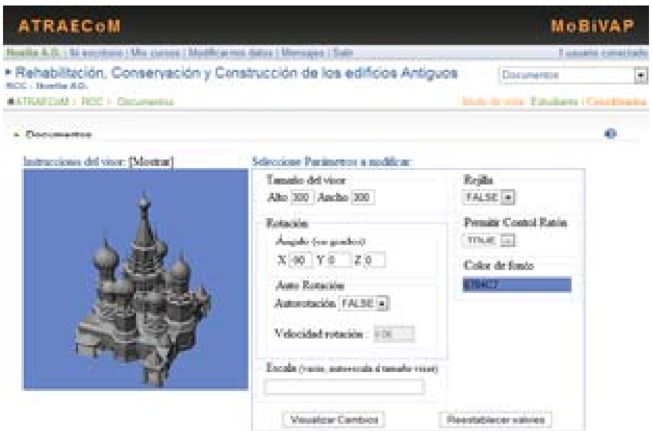

FIG. 2 3D VISUALIZATION OF A TOY MODEL SUCH AS THE VIRTUAL OBJECT KREMLIM (MOSCOW, RUSSIA) THROUGH 3D VIEWER TOOL

Glossary Tool

A common problem for Knowledge Management Systems concerns the heterogeneity of data and data sources arising from different knowledge areas. From a conceptual viewpoint, the information requires the design and implementation of a shared vocabulary with links to different methods to be applied by the underlying expert systems. Our approach is organized following a typical scheme with layers concerning specific glossary or vocabulary (key words), thesaurus (definitions or descriptions) and taxonomies (sets of logical rules for knowledge management). A specific Spanish lexicon for Rehabilitation and Restoration tasks was developed by us in the Strategic Singular Project Patrac.

In our case, the glossary includes a vocabulary related to objects and tasks to be performed in Cultural Heritage environments by experts. We have developed a tool that allow maintaining a repository which can be easily modified. An extensive collection of terms has been incorporated following suggestions of architects who are expert in Conservation and Restoration interventions. Different taxonomies are needed for managing coincidences (logic of classes), correctness of definitions (propositional logic) and adequate descriptions (probabilistic or inference procedures based on descriptive logic). Till now, we have developed taxonomies based in logic of classes and propositional logic for knowledge management. It is well known that W3C or Semantic Web supports the development of more sophisticated software tools able to managing descriptive logic based on OWL dialects. However, they have not still been implemented by different reasons: There are no still acknowledged standards, they require more advanced software tools for their management and there is a lack of financial resources to accomplish this task.

The use of standards makes easier the exchange of information and the interoperability issues (according to CMI Guidelines for Interoperability) between low- and mid-level resources which are used in our *eLearning application*. To achieve these results, we have developed a scheme with seven layers involving communications, formats of educative contents (following the specification provided by the IMS Content Packaging), representations of metadata (following LOM), structures between objects and homogenization involving profiles of users. All of them are encapsulated in a high level module in charge of linguistic, cultural and social education.

Metadata Tools

To facilitate the search, management and re-use of learning objects, we have used standards in this tool to define a structure for interoperable descriptions of educational resources. The LOMv1.0 standard is the standard for metadata currently used most often. The scheme of metadata used in this tool is the LOMv1.0 standard extended as MACE (Metadata for Architectural Contents in Europe) to allow the continuation of this initiative (Arlati/Bogani, 2009). Using this approach is very simple to identify between digital objects and real world objects. The platform allows extending and modifying this scheme.

However, although management is allowed, it is advisable not to extend it until there is another standard recognized. In the meantime, we have used standard tools (PHP, AJAX, JavaScript) to maintain the interoperability. There are a lot of Java-based applications for e-Learning issues; our application uses an extension of JavaScript which makes possible the display of three-dimensional contents in an interactive way[4]. Currently, the metadata tool allows metadata management for all documents which are contained in the course. Also, we are able to generate and manage multiple profiles of metadata, where metadata are grouped depending on the profile choice.

An additional advantage of management based in metadata consists of standardization of learning process. To achieve it, we have implemented a solution based in a language (EML) developed by the Open University of Netherlands (OUNL) for creating Unities of Learning (UoL) which are grouped in three levels. We have adopted a general open framework for developing our applications by following the methodology proposed by the IMS, including the models developed by ADL (with its SCORM reference model) and by the IEEE LTSC initiative with their proposal of metadata for eLearning objects.

A Meaningful Example

The methodology followed in Conservation and Restoration Interventions (CRI) module involves three phases: (1) knowledge and documentation which are included in the first subsystem (Documentation) of DIMaS, (2) comprehension and diagnosis which are included in the second subsystem (Information) of DIMaS, (3) and intervention proposal which is included as a stage 0, the third subsystem (Management) of DIMaS. Next, we display a real case where we illustrate the use of this tool for learning the proposed methodology for CRI in Cultural Heritage domains.

[4] Quick3dApplet "A java applet for displaying interactive 3d". http://sourceforge.net/projects/quick3dapplet/

The application guides the user for learning CRI methodologies through an appropriate tracking of learning processes (through learning paths) from the knowledge level of user and the necessary information. After filling a test that fits the user at the right level of learning, the user can have access to course resources suitable to his/her level. The course consists of adequate training and learning through interactive and visual exercises, and enables application. This goal is achieved thanks to the incorporation of multimedia tools that encourage the type of learning by following the constructivist approach.

FIG. 3 INCLUSION OF MULTIMEDIA CONTENT ON MAP AS A STEP LOCATION OBJECT IN THE FIRST PHASE THROUGH MAP TOOL. (NUESTRA SEÑORA DE CANTECES CHAPEL, VEGA DE VALDETRONCO, VALLADOLID, SPAIN)

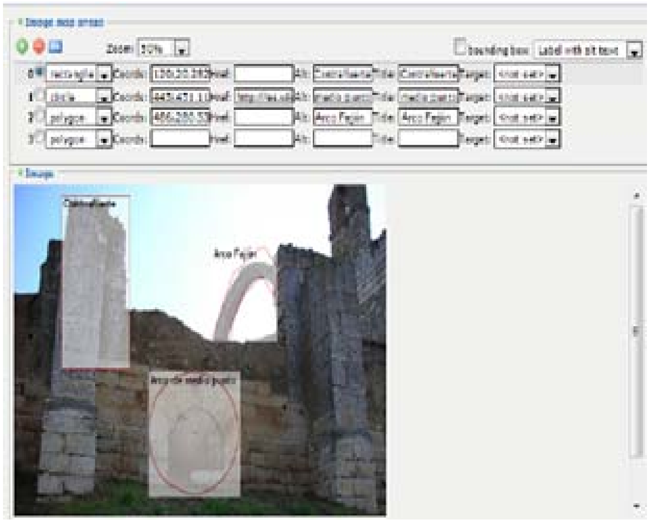

FIG. 4 RECOGNITION EXERCISE OF DIFFERENT TYPES OF ARCHES THROUGH THE IMAGE MAPPING TOOL

In the first stage, we study the location of the object in regard to its environment (Fig. 3), its history (for spatial and historical context), object recognition in terms of structural elements (Fig. 4), to evaluate current state, damages and previous interventions, if they would be available, among other information. Some appropriate tools for this phase incorporate cartographic and planimetric information for right georeference of multimedia contents (images, plans, sketches, 3D clouds, etc.) photogrammetric surveying, illustrative videos, or even augmented maps with superimposed multimedia content. We recommend the use of a specific glossary which makes part of a second order metadata extending the standard DCS metadata (first level for administrative management). Standardization eases the information transfer between different modules. All these data are referenced to a digital map including links to multimedia contents through url.

The second stage consists of analyzing the current state, including structural aspects and materials involving the whole fabrics. It is focused towards comprehension and diagnosis of structural pathologies (lack of verticality, deformations arising from structural stresses, etc.) and damages at materials (involving visible and non-visible effects from the use of non-destructive or semi-destructive techniques). Their goal is to carry out an analysis and diagnosis of pathologies at each specific case. We have used Image mapping tool for surveying problems with damaged materials, but the development of connections with structural analysis is not still performed.

FIG. 5 THESE IMAGES SHOW THE STATE OF THE CHAPEL THAT NEEDS AN INTERVENTION FROM WHICH A DIALOGUE IS IMPLEMENTED FOR LEARNING

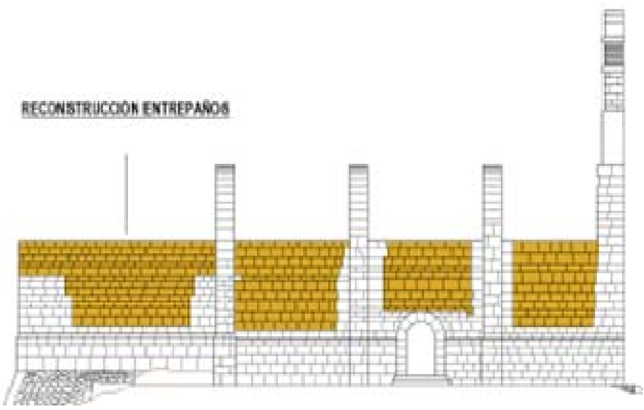

FIG. 6 CHAPTEL WALL RECONSTRUCTION AS PROPOSED INTERVENTION

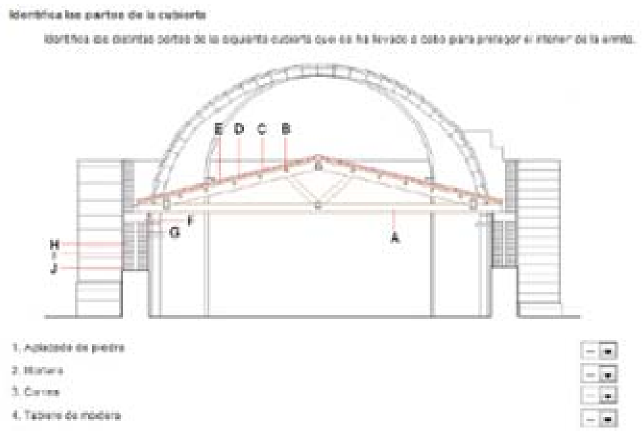

FIG. 7 ROOF DIFFERENT PARTS OF THE INTERVENTION PROPOSAL FOR THE CHAPEL

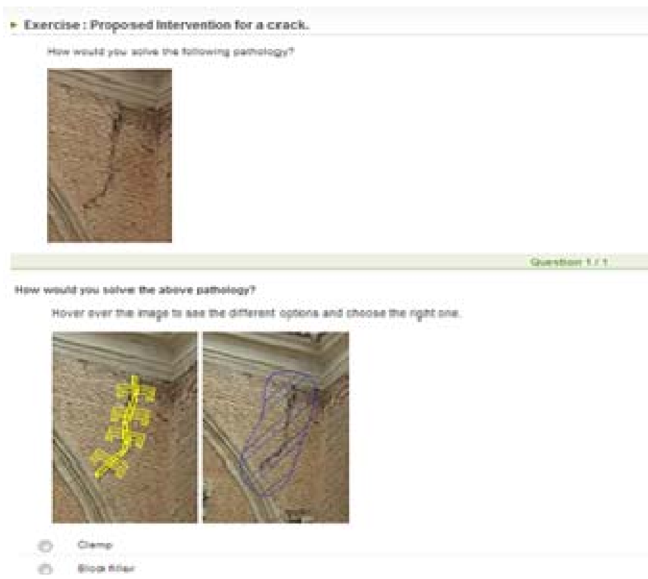

FIG. 8 EXERCISE PROPOSAL INTERVENTION ON THE PATHOLOGY ILLUSTRATED (THE MAGDALENA CHURCH, VALLADOLID, SPAIN)

In the third stage, the learning application must provide the skills to carry out an intervention proposal from the collected data and the performed analysis. Appropriate tools to achieve these goals are based on the use of a specific 3D viewer, which is compatible with image mapping, and embedded videos. Above, in Fig. 5 – Fig. 8 show some examples of exercises.

Conclusions, Discussion and Future Work

Through the development of the eLearning tool, ATRAECoM has developed a software architecture with relevant functionalities. The most relevant advantages of this tool are the incorporation of new multimedia tools and metadata classification in regard to other LMS toolswith more limited services.

We have followed a case-based approach near to (Chenaux et al., 2011) or the most technical contributions of (Musso/ De Marco, 2008), but by adding some KMS (Knowledge Management Systems) tools in a Semantic framework for integrating eLearning in the Management System.

Our application supports eLearning of Conservation and Rehabilitation Tasks in AEC environments with a special regard to Cultural Heritage buildings. The constructive paradigm provides an appropriate framework for the developed learning tools. The software tool contributes to continuous and customized education according to knowledge management of the different types of tasks to be developed by technicians and workers. Through this application it is possible to get a complete representation of a complete object in different layers which are superimposed to once a 3D augmented model which is linked to a database involving objects and tasks to be performed. The whole application is a *prototype* with an easy access, an attractive and interactive interface that makes it affordable to use for users without previous knowledge from Computer Science or advanced Rehabilitation tasks. The application allows interoperability with similar systems (through a conventional GUI) by using LMS standards. The software architecture is extensible, open and scalable. Its design will allow in the future the improvement of additional facilities in successive versions, depending on access protocols to the LFA-DAVAP repository[5].

Some additional contributions to be incorporated in the next future are: 1) A syntactic recognition of architectural features which is linked to terms appearing in Glossary; it involves the semi-automatic Recognition of architectural primitives and pathologies. 2) The incorporation of additional functionalities that improve detection and diagnoses of pathologies in the 3D viewer tool. 3) The incorporation of an intelligent avatar to guide the user in eLearning and eTraining processes through a more friendly application at working place. Currently, we are working in the two first extensions. A general framework for mid-term non-elementary challenges concerns the design and implementation of virtual learning situations on realistic environments which are based on real study cases. In this way, it will be possible to give an on-site remote assistance to rehabilitation and restoration tasks in AEC environments. Their integration in BIM is not considered, due to the lack of standards for interventions involving CH buildings.

[5] LFA-DAVAP repository: http://157.88.193.21/~lfa-davap/

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