Authoring and Multimedia Technologies for Management and Presentation of Information on Heritage Constructions

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ABSTRACT: Given the amount of available data coming from different areas of expertise that results from the technical inspection of a heritage construction, the proposed paper emphasizes the need for alternatives and complements to the written technical report for presentation and interpretation of that information. Multimedia technologies in the form of interactive multimedia frameworks integrating pictorial, textual and animated information compiled in multimedia CD-ROMs are seen as potential candidates for complementing written technical reports. Advantages of such strategy for management, presentation and interpretation of information on heritage constructions are focussed. Two case studies were developed for two different heritage houses. The first case study addresses a house in the city of Vila do Conde, Portugal, and the second one addresses a house in the city of Porto, Portugal. Information concerning construction techniques and structural, architectural and general/local geographical aspects of the constructions are included in the applications. The development of these applications was found to be an interesting example on how simple multimedia tools and environments can assist in information management and presentation. Information presentation with the aid of such tools is seen as an affordable component of increasing importance within the current information society in which communication and visualization of data are fundamental issues.

1 INTRODUCTION

The process of rehabilitating the built heritage requires stages of technical inspection and diagnosis to be previously carried out, followed by the preparation of a document containing the full range of information related to the different areas of expertise involved. This single self-contained document, which is the fundamental asset for support of the intervention options, simultaneously serves as an important instrument in the rehabilitation decision making process, therefore contributing to an increase in the knowledge about the construction and highlighting the different approaches and interests of each area of expertise.

By making available to the multidisciplinary team of technicians involved a large amount of information, the preparation of such document efficiently contributes to the conciliation of the different areas of intervention. For example, engineers must be aware that a particular wall that needs to be retrofitted has an interior finishing (for example, paintings) that must be preserved, while conservators/restorers should know that the referred finishing is part of a wall that will be retrofitted.

As the complexity and the value of the construction increase, there is an equivalent increase in the amount of information that needs to be addressed and in the difficulty of finding efficient and appealing ways of presenting such information. It has been seen that multidisciplinary written reports presenting information on a vast number of areas of expertise are becoming less practical, thus each technician usually chooses to consult only the information directly addressing his area of expertise. Moreover, since this type of reports is, in many cases, also consulted

by persons outside the technical intervention team, though possibly associated to the decision stakeholders, the information presented in such reports must be very clear, self-explanatory, and should produce some sort of impact to increase the interest in consulting it, highlighting the value of the construction and justifying the need for the intervention.

Due to the numerous technical inspections and the amount of information resulting from each inspection, the Nucleus for the Conservation and Rehabilitation of Buildings and Built Heritage (NCREP), (NCREP 2006), of the Faculty of Engineering of the University of Porto has been confronted with difficulties regarding information management, organization and presentation. It has been also reckoned that classical written reports fall short in presenting the information in a suitable way and, simultaneously, are difficult to examine and handle when they include a broad range of the available information.

Therefore, from some while ago, NCREP has been interested in exploring and developing complements to the technical reports for information and knowledge presentation that may include information that in a classical written report format is not easily introduced or simply can't be included.. Within the scope of information treatment, management and presentation, and in the field of application of multimedia technologies for information treatment, NCREP has been developing two multimedia CD-ROMs referring to two different constructions. These two applications have the main objectives of improving, enhancing and simplifying the access to the available information on these constructions.

2   MULTIMEDIA FOR MANAGEMENT AND PRESENTATION OF INFORMATION

Multimedia communication is a recent technological advancement. Multimedia can be seen as an important technology that is able to facilitate data and information presentation, cooperative work, teaching and communication in general. The use of multimedia changes the way by which people are able to capture and understand information and, in broader terms, the way people communicate with each other.

The concept of interactive multimedia is undoubtedly the XXIst century technology. Benefits coming from interactive multimedia are intuitive and attractive, and can be seen to reach all areas of business. Working with multimedia is to understand that knowledge does not solely reside in the mind of individuals, books, journals, libraries, laboratories, databases or life experiences. Knowledge resides in a space covering and involving all of these. Thus, one must understand that information is not a static product but a dynamic and mobile one, and that multimedia enables the development of new means to access and distribute information.

2.1 Multimedia frameworks

The multimedia platforms that were developed for presentation of the two referred constructions, in addition to the inclusion of information in classical format types such as text, photos and technical drawings, allows, among other options, the inclusion of components having different levels of interactivity. For example, one can include interactive damage maps allowing interactive switching between schematic representations of the observed damage and real photos of the damage, and its possible evolution over the time, at selected locations. Interactive tridimensional models of the construction can also be included. Such models may address the architectural aspects of the construction, the structural aspects, or even both. This type of information presentation enables real-time interaction between the user and the model, allowing the user to move, rotate or zoom the model, to turn on or off the visibility of specific elements of the construction by accessing the model tree hierarchy, to define 3D cross-sections and 3D measurements. Links to Internet websites are another interesting type of information that can be included in such multimedia CDs. Dynamic and interactive linking between different sources of information in the Internet opens a wide range of possibilities and opportunities for information organization and presentation. Finally, movies are another important type of information that can be included in such multimedia platform. One interesting and useful example of this type of information might be the inclusion of video recordings of dynamic tests performed during the structural assessment stage.

This information, usually accessible through a set of menus, must be carefully organized and systematized from the initial stage of data collecting, which normally coincides with the technical inspection stage. As can be expected, organizing and systematizing information is a step of increasing importance as the constructions under study become more complex.

2.2 Selected software

Since software development for creation of multimedia contents was beyond the scope of the work, in order to be able to develop the multimedia application, the selection of adequate computer applications allowing for the definition of the multimedia contents in the required form was a necessary and important first step. This selection was carried out considering two fundamental aspects:

- The complexity of the multimedia application development should be kept at a reasonable level.
- The software should enable the import/export of information on different formats. Thus, pre-existing information would not have to be reproduced so as to be compatible with the selected software.

With respect to the first factor, the multimedia authoring software Macromedia Director (Macromedia 2005a) was chosen. Authoring systems such as Macromedia Director allow for the full development of multimedia applications, from simple or complex presentations up to interactive training applications. Authoring software usually consists of high-level computer programs that allow designers or application developers to work with everyday concepts to build interactive presentations. The main functions of such programs is to allow the user to combine text, graphics, animation, sound and video within an well defined and integrated interactive application.

The development of multimedia applications using Macromedia Director is closely tied to the movie/theatre metaphor. The different media elements in a project are called **Cast members**. These elements interact on a **Stage**, which is the front-end of the application. The behaviour of these media elements over time is defined in the **Score**, which works as the basic storyline of the application. The multimedia designer becomes the director of a **movie**, the application created using Macromedia Director. Considerable flexibility for managing multimedia contents is added by the use of the programming language Lingo, available with Macromedia Director. Lingo enables interactivity (the capacity of the application to respond differently according to choices made by the user) to be added to the application.

With respect to the second factor previously referred, Macromedia Director also offers important benefits. Macromedia Director was found to be compatible with a large number of image, video and audio formats, usually sufficient for the majority of multimedia applications. However, AutoCAD (Autodesk 2005), one of the more used computer aided design software applications in civil engineering, does not produce 2D ou 3D drawings in a format compatible with those supported by Macromedia Director. Therefore, two additional applications capable of dealing with AutoCAD native format drawings were used to integrate that information with the Macromedia Director platform. In what concerns the 2D drawings prepared with AutoCAD, these were transferred to Macromedia Flash (Macromedia 2005b) and then, using the Macromedia Flash native file format, transferred to Macromedia Director. With respect to the 3D models developed with AutoCAD, these were converted to a different 3D format using the freeware application ModelPress Publisher (ModelPress 2005a). This new format can then be interpreted by the freeware application ModelPress Reader (ModelPress 2005b) which in turn can be executed from the multimedia application. The use of ModelPress Reader presents several advantages from the usage point of view. This application performs very well in real-time manipulation of complex 3D models and offers direct support to the way information was set in the original AutoCAD drawing, particularly, supporting AutoCAD layer definitions and enabling layer visibility/invisibility. In addition, ModelPress Reader also allows real-time definition of cross sections of the 3D model and measurement of distances directly onto the model.

Although not used in the development of the present multimedia application, the authors feel that attention should be drawn to a recently launched version of Adobe Acrobat that might unveil interesting opportunities for multimedia content presentation. This new version called Acrobat 3D (Adobe 2006) includes the ability to embedded, view and navigate 3D content in PDF files. It is able to convert 3D models to PDF format from a large number of computer aided design file formats without the need of the authoring application. After 3D content is embed in the PDF, a set of tools for navigating 3D content is available, including multiple display modes, the ability to create dynamic cross sections, and the display of a model tree which allows the visibility of different parts of the model to be manipulated as required. Adobe Acrobat 3D also comes with an associated utility called Acrobat 3D Toolkit, which allows the 3D content in the PDF file to be enhanced by editing lighting, adding textures and materials, and creating animations.

3 MULTIMEDIA APPLICATIONS OF THE SELECTED CASE STUDIES

3.1 Bried description of the constructions

The two constructions under study, though considerably different in terms of areas in plan, architecture type and insertion in the surrounding environment, exhibit some similarities with respect to the organization of the spaces, an aspect that may be associated to the way of life of that time. Both houses possess a main central staircase around which there is a corridor with a balcony that gives access to the several rooms. The staircases of both constructions are toped by roof a skylight which, due to their considerable dimension, enforces the development of special adaptation measures of the supporting roof structure.

The first presented construction is a house located in the city of Vila do Conde that has a ground level, an elevated storey and an attic (Figs. 1 and 2). Interest in this house comes from the fact that it represents a rather common XIXth century rural construction of the northern part of Portugal that has undergone little alterations over the time. This construction, though currently there are no persons living there, required a structural repair and strengthening intervention in light of the pathologies that were observed in the course of the technical inspection and were seen as a possible threat to the safety of the neighbouring public street. Special care was taken on the definition of such structural intervention in order to minimize the intervention as suggested in (ICOMOS 2001). Besides the fact that the construction has undergone very few alterations with respect to its original form, whether it is in terms of the granite masonry walls, or in terms of the floor and roof timber structures, the covering and finishing techniques of the interior walls present interesting details. Some existing interior architectural elements also add to this interest and also enable to understand and document the way of life of that time.

Figure 1 : Main (East) and South façades.

Figure 2 : North and West façades from an illustrated postcard from 1910.

The second construction is a rich urban house of the bourgeoisie of the city of Porto, also from the XIXth century, where the architect Marques da Silva, an important architect of that city, has lived (Figs. 3 and 4). Although severe structural pathologies were not detected, the house requires, nonetheless, conservation interventions to be carried out due to non-structural pathologies that were observed in the covering and finishing elements, mainly due to water penetration.

Accounting for the considerable size of the house and for the diversity and quality of the finishings, pathologies were, in this case, logged room by room.

Figure 3 : Main façade.   Figure 4 : Interior detail of the skylight.

3.2   Multimedia contents of the applications

Accounting for the distinct value of the houses and for the differences in complexity and areas of intervention, different approaches were, thus, defined for the two houses in terms of the multimedia presentation and organization format.

In the case of the first house, a global menu giving access to the several infomation elements that are available was defined (Fig. 5). The available information includes global damage maps of the house, pictorial representations of the pathologies by façade that integrate interactive photos of the real damage (Fig. 6), data concerning the proposed strenghtening intervention (Fig. 7), photo surveys of different in-situ tests that were carried out (Fig. 8) and a photo survey of the strenghtening solution application (Fig. 9). Through the general menu one can also have acess to information about the geographical location and the urban surroundings of the house (Fig. 10), to data concerning façade finishings (Fig. 11), interior wall and ceiling finishing techniques that include text descriptions of each technique, obtained through extensive bibliographic research (Dias, 1999), and photos of their application on the house (Fig. 12). Another important available piece of information is the 3D model of the house (Fig. 13). This model, althouhg presenting architectural elements such as interior walls and door openings, was mainly developed so as to characterize and define with sufficient precision the house structure. With this model and the application that runs it, one may, for example, perform dynamic cut-cross sections to view parts of the house, measure the depth of structural walls, the length of the timber beams of the floors or visualize the connection points of the floors and of the roof to the walls.

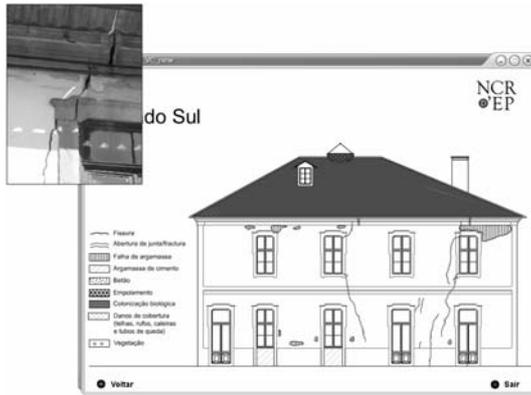Figure 5 : Menu for selection of the different contents

Figure 6 : Interactive pathology representation.
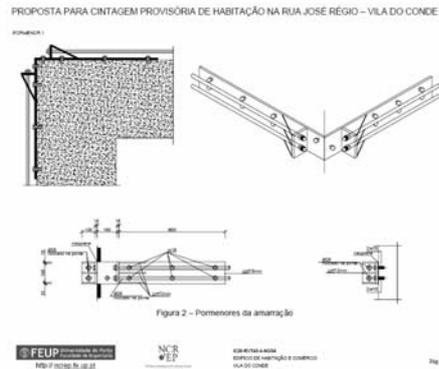

Figure 7 : Details of the structural solution.

Figure 8 : In-situ probing of the foundations.

Figure 9 : Execution of the structural solution.

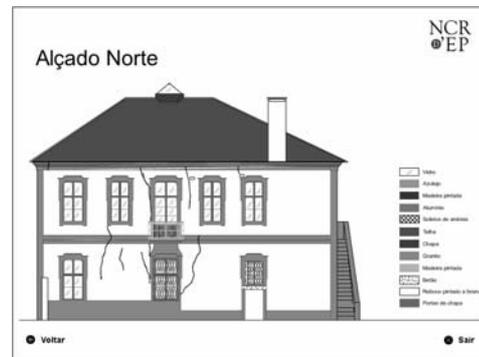Figure 10 : Urban surroundings.

Figure 11 : Exterior finishing representation.

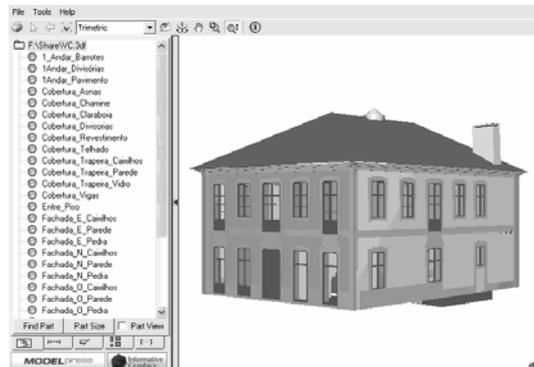Figure 12 : Interior wall finishing techniques.

Figure 13 : Interactive 3D model of the house.

In the case of the second, due to the considerable size and quality of the interior finishings, the option was taken to build a global interactive architectural model giving access to room by room information. After selecting a particular room, it is possible view information addressing

the various pathologies that were identified and their location over that room through planar views of the walls and ceiling, Fig. 14. Through a menu availabe for each room, one gains access to additional information, such as cut-cross section of the walls and floors in which structural and covering materials are fully characterized (Fig. 15), maps showing the openings of the room and displaying the technical drawings of the doors and windows, and, when of particular importance, to technical text descriptions of the finishing techniques used in the room. As for the first house, a global 3D model defining the supporting structure of this house was also developped for this multimedia application, Fig. 16. Again, both architectural and structural elements are presented so as to gain perspective. The global 3D model gives a general knowledge about the structural behaviour of the elements of the house and, as in the previously refered model, allows to measure the depth of structural and interior walls, the length of the timber beams of the floors and roofs.
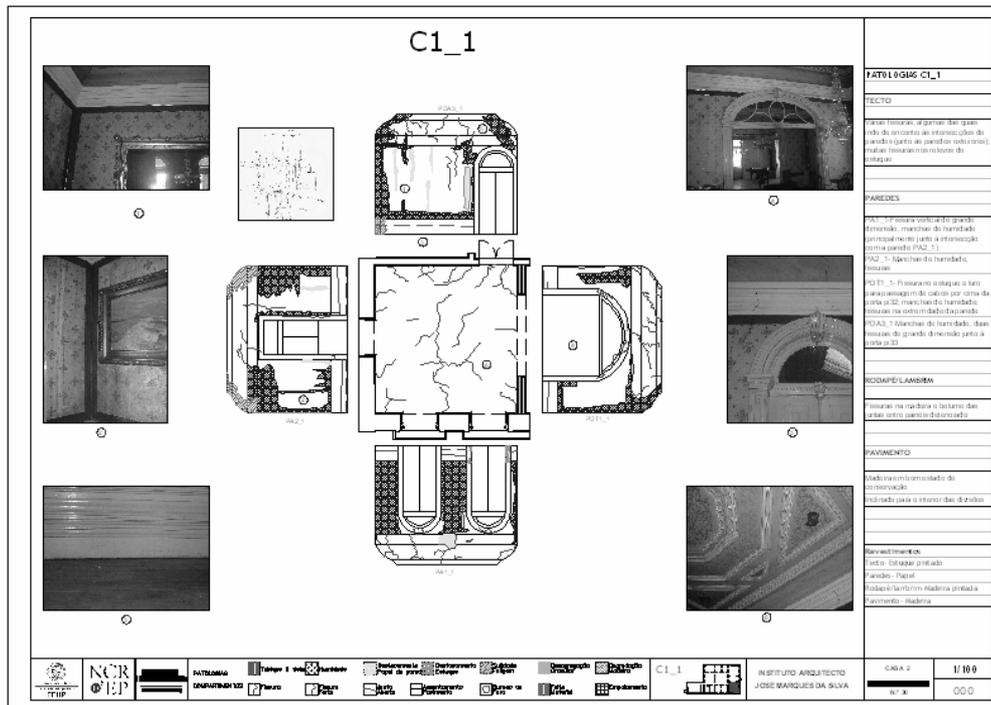

Figure 14 : Planar views of the pathologies of the walls and ceiling following the indicative representation suggested in (Henriques *et al* 2004).
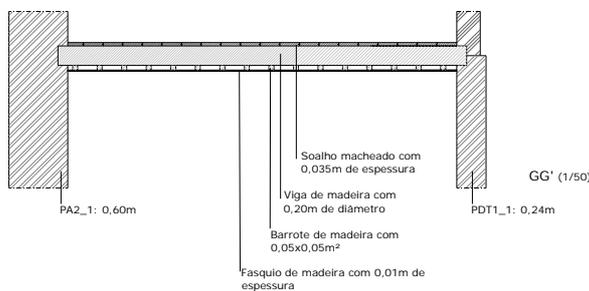
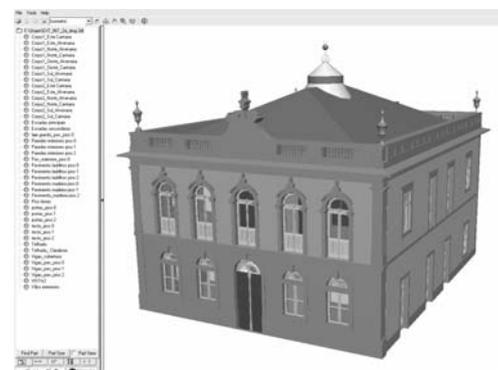

Figure 15 : Cut-cross section of a floor structure.   Figure 16 : Interactive 3D model of the house.

4   CONCLUSIONS

The proposed paper presents the use of multimedia techniques complied in the form of multimedia CD-ROMs for presentation, organization and management of technical information. The

fundamental aspects and contents of the developed applications for two case studies were addressed. The first case study addresses a house in the city of Vila do Conde, Portugal, and the second one addresses a house in the city of Porto, Portugal.

The multimedia application can be seen as a complement to the technical report as it can present important information otherwise difficult to integrate and compile within a text report. Multimedia tools of this sort were recognized to be a valuable aid for presentation of the different types of information involved and provide a simple and enlightening way to classify and organize the available data. Since the developed multimedia applications weres seen to be adequate for information logging and distribution, similar applications should be developed for larger constructions for which a greater volume of information might be available, thus taking more profit of multimedia capacities.

It was seen that multimedia frameworks, such as those developed, greatly enhance and ease the exchange of information between different members of multidisciplinary teams involved in assessment and rehabilitation of constructions, thus increasing the overall efficiency of the project management. In sum, information presentation with the aid of such tools is an affordable component of increasing importance within the current information society in which communication and visualization of data are fundamental issues.

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