# Historic Buildings through a Multimedia Experience

## A Research Project on the Palaces of Sintra (Portugal)

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We are currently in the process of making a series of interconnected multimedia applications in order to enhance and enliven the cultural heritage of the palaces of Sintra, Portugal. These applications rely heavily on making high-quality 3D models, which focus on replicating the original buildings with precision. This process is virtually impossible to accomplish unless the model is obtained by combining a set of state-of-the-art technologies, such as laser scanning and photogrammetry. These techniques alone allow for the creation of completely reliable models of the original architectural structure. This technology permits high-resolution and accurate digital recording of the geometry, dimensions, positioning, textures and materials of the building, and allows also to map pathologies and other issues.

The project *Fala Comigo* (Talk2Me) incorporates the 3D models in multimedia applications, which also include Embodied Conversational Agents (ECAs) as a means of conveying information for educational purposes. This is an interdisciplinary project since historians generate the content while engineers and technicians design content-driven multimedia applications. From the work that is being developed, we can highlight a set of Serious Games, which also include ECAs with voice recognition and speech synthesis, along with expressive facial animations to suggest complex emotions.

Any application created for cultural heritage purposes only proves advantageous if the users interact significantly with it. The user's engagement with the created applications is established by creating the spirit and excitement of the age while the information is delivered. The 3D models play a very active role in transmitting information, mainly from their correspondence to the original buildings. The model's authenticity guarantees the user's immersion in the application, thus aiding in the learning process.

## Motivation

Enjoying our country's cultural heritage is a right we all share. Hence it needs to be made available to each and everyone of us. If cultural tourism is to play a major part in the economic development of a country, it is important to plan means to sustain it. For this to happen, there must be a clear guarantee of quality, both academically and in terms of safeguarding our artistic heritage. Furthermore, the approach to numerous historical, cultural and scientific items featuring in the school curriculum can be made through works of art. Cultural heritage contains other components, a wealth of expression that must be explored from a scientific and cultural perspective.

Our two main target audiences are therefore in cultural tourism and schools. The seasonal nature of these groups can be advantageous, as the high season for the one is the low season for the other. In addition, despite their divergent needs, these two groups have many things in common, which enables heritage authorities to establish a coordinated and focused plan of action. To achieve this, there must be a commitment to producing renewed content, offering discourses aimed at different age groups and raising the awareness that preserving artistic heritage is important. These studies must be presented in accordance with modern ways of diffusion, based on emerging technologies that capture the attention of these new audiences, and establishing a framework that allows for both the dissemination and the enjoyment of heritage.

## The Project

From the awareness of these needs the idea arose to produce a project combining research with proposals of implementation, with the aim of creating new products that can spread heritage information in an innovative way. Such products have already been produced in Portugal, but without an effective multidisciplinary approach. To satisfy these requirements, it was thought sensible as well as beneficial to set up a consortium based on a partnership between I&D (specialising in the History of Art and Information Technology), companies, and a body responsible for heritage management, the Parques de Sintra – Monte da Lua (PSML), which looks after the Sintra palaces.

Running for around a year now [2012], the *Fala Comigo* (Talk2Me) project aims to give users a whole new experience: attractive, simple and functional. In addition to being brought into direct contact with the monument, users are invited to immerse themselves in a virtual world, moderated by a realism that seeks to confer authenticity to the experience. While the content provided must be of the highest academic standards, the discourse must be appropriate in order to fulfil the proposed goals. Working on a project of this nature therefore implies renovation at various levels. This has to begin with an intensification of the historical and artistic research, since we need to know more about our monuments and art works to replace low-quality or even incorrect information.

The entire process stimulates creativity and implies the development of capacities. At a time when entrepreneurship and competitiveness are the order of the day, it is not hard to understand that this new approach to heritage management can be a factor in sustained development, a means of challenge and progress, which also involves considerable economic incentives. There thus needs to be a balance in the enjoyment of these direct benefits, between research and development, and between the companies, the heritage management and the general public. Fundamental to this enjoyment is the safeguarding of the cultural/artistic object. Greater accessibility should therefore be a factor in its preservation. In the discourse underlying these new 'products', there need to be warnings about the fragility of the artwork, the materials of which it is made, and the dangers it is subject to. This can subtly be presented via the historical-artistic content, but the modern heritage management programme requires that it becomes a genuine part of the visitor's awareness.

## The Importance of Digitalisation

Within this campaign of disseminating and safeguarding our cultural heritage, the use of modern information and communication technology is in itself just one important preservation mechanism. Digitalisation and three-dimensional surveys are safe and reliable registers of artworks. They allow these works to be recreated virtually, so that they can be studied and even enjoyed interactively. Without even touching them, we can simulate situations and test hypotheses, for example when seeking to reconstitute parts that have been changed or lost.

The 3D survey of the monument works as an exhaustive document because it enables a complete set of architectural data to be recorded and stored. This high-resolution digital technology picks up the textural details of the materials, which makes it possible also to chart pathologies and degradation. It operates as a precise architectural information system, allowing users to explore a whole range of possible relations between the representation of the building (form, size, state of conservation, hypothetical reconstitution, record of observations over the years), as well as different kinds of information (technical, historical, artistic, and so on). It is therefore possible to create a model which provides a systematic description of multiple representations and related information, thus forming a framework for observation, analysis and multidisciplinary comparative study.

This capacity to view and review makes understanding easier as it allows working with a fixed or interactive, animated image. Underlining this ability to enhance heritage is a versatility that permits an effective dissemination through various devices, from immersive museographic tools to educational games.

These games are an important didactic means of conveying knowledge, principally for the young, who can learn by playing. Children and adolescents are the target audience for this type of product, which passes on new knowledge by linking information to the typical features of games.

A vital aspect of a Serious Game is its ability to immerse the user in a virtual world. The addition of an animated agent to the game's infrastructure allows for interaction, which greatly increases the player's experience.

The recreated monuments can perfectly operate as settings for such a game. Historical characters or ordinary, anonymous figures come to life through modern modelling and animation techniques to take part in stories or to act as knowledgeable guides to the monuments and museums or other cultural sites. These virtual agents rival reality even more closely when they are provided with an automatic voice recognition system and speech synthesis. The user can then ask these characters questions: he or she will be heard and understood, and will get an appropriate response, which is a great attraction within a conventional cultural space.

## Monserrate Palace as a Case Study

Monserrate Palace, built in the nineteenth century by Francis Cook, an English merchant and great art collector, was chosen as a case study for the development of the project. The property had belonged to the Melo e Castro family but, in the mid-eighteenth century, became the residence of a series of British tenants, including Gerard Devisme, who built the first Gothic Revival palace there, and the celebrated writer William Beckford. Cook bought the estate with the ruined house and commissioned the architect James Thomas Knowles to rebuild it. Knowles carried out his commission on the former structure through an exuberant revivalist decorative programme. The various rooms were lavishly decorated and filled with sumptuous furniture, paintings, sculptures, tapestries, porcelain and crystal.

The palace and its magnificent gardens were extremely well cared for until the Cook family fortune began to fail. This led to the sale of the property in 1946 to Saúl Sáragga, with the Portuguese state showing no interest in the transaction. As a result, the interior decoration and furnishings were split up at auction. Due to the new owner's failed intention to urbanise the property, it soon fell into neglect. It was only two years later that the Portuguese state purchased Monserrate, but without any programme for the use and regeneration of the property. Occasional work on the unoccupied palace has done little to prevent its degradation. A major recuperation programme was launched in the 1990s, but it was through Parques de Sintra that the first phase of this programme was completed, which focused on restoring the roofing, floors and other infrastructures. There is currently a sectorial plan underway to restore the palace rooms, while keeping the property open to visitors and available to host events. This 'open for works' policy does not disappoint those who come to discover the palace; quite on the contrary, it has stimulated a greater flow of visitors, who can actually witness the work in progress. The policy has also meant the continuation of revenue from visitors and from hiring out the palace.

## Applications

The *Fala Comigo* consortium plans to make various products using state-of-the-art technology and conceived in function of the monument's history and artistic value and in accordance with the dissemination policy of the responsible body, Parques de Sintra.


Fig. 1 The *Fala Comigo* consortium.

The palace already has a 3D survey, which was carried out by ArtScan in 2009 to support the restoration programme then underway. This was produced by using laser scanning technology, followed up by later work with various types of specific software. The laser scanner measures distances to objects, and the data coming from this tracking produces three-dimensional point clouds. Different scans along the building were carried out so as to ensure total coverage. The data produced by the survey as a whole was controlled *in situ* and in real time, allowing for immediate correction and for the gathering of additional data whenever necessary.

Producing orthophotos is a complex process deriving from the triangulation of a point cloud. Smoothing filters are applied to these triangulated surfaces, reducing their complexity. After this treatment, the geometrical surface of the object is texturised through the application of the oriented photographs.

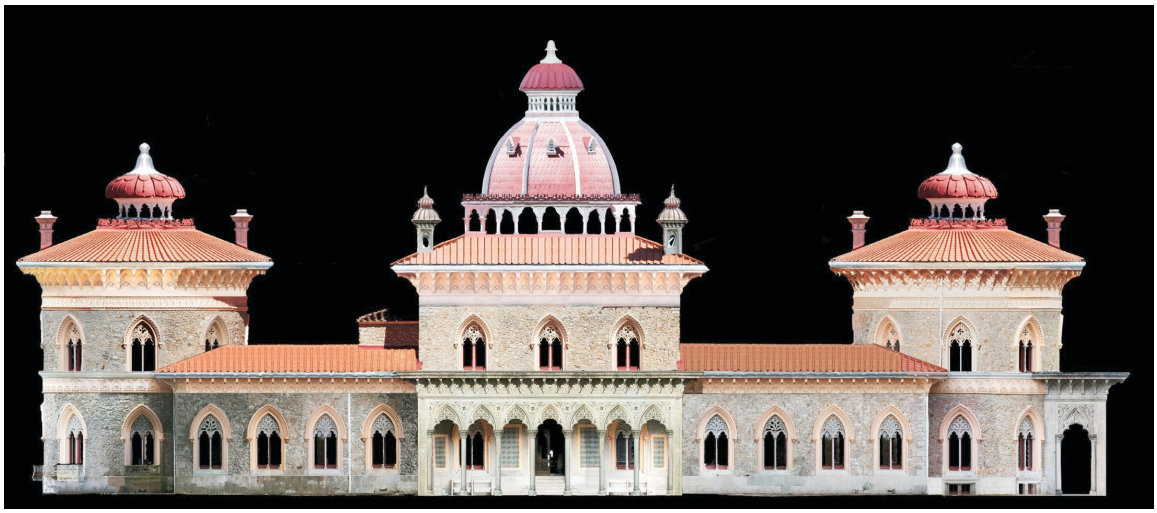

Fig. 2 Example of an orthophoto of Monserrate Palace.

The sections and elevations are processed as a result of the three-dimensional CAD vectorisation. These files, with the respective orthophotos (on the same plane as the section or elevation) enable us to complete all the decorative features and bas-reliefs of the architectural features.

New multimedia products were conceived to explore the 3D survey of the palace. This is a precious tool in recreating a virtual reality for the monument with all the desired accuracy and authenticity. Among the products being produced, the educational game *Tesouro de Monserrate (Treasure of Monserrate)* deserves special mention, as the 3D survey plays a fundamental role in it.

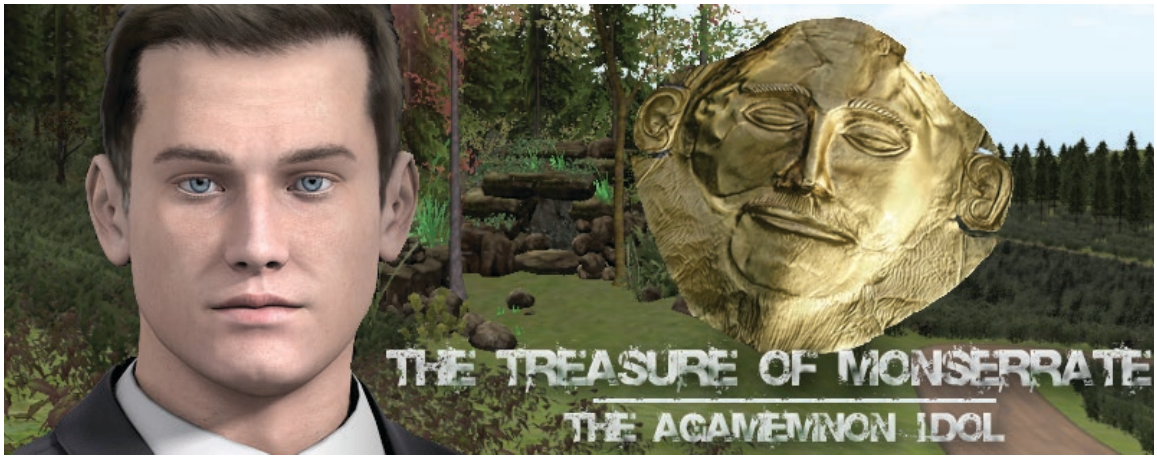


Fig. 3 The game *The Treasure of Monserrate.*

Based on the story of the palace, the fictional plot centres on a group of precious artworks purchased by Cook which have disappeared without a trace. The players must find out where in the palace gardens these pieces are hidden. They subtly receive cultural information and their success depends on the amount of knowledge they learn about the monument's history. To make this possible, an immersive 3D environment was designed, based on Monserrate park. Using a topographical map of the terrain, the relief of the Sintra hills has been imported to a game engine (Unity 3D). Having acquired the natural environment, three types of setting have been created:

- An invented setting, based on some real features, but in which imagination is the major creative force.
- A setting inspired by the gardens' main features. Exact reproduction is not the aim here; only recognition of their most emblematic locations, such as Beckford's Waterfall, Vathek's Arch, or the Cromlech.
- And, finally, a real setting conferring the historical and artistic authenticity required for this type of Serious Game. What better to achieve this than the use of a 3D palace?

The 3D model of the palace had to be adjusted for use in the application, since the game's engine could not deal with the complexity of the initial AutoCAD model. This process demanded a painstaking plan of adaptation which, layer by layer, simplified each of the palace's elevations by significantly reducing the initial number of triangles.

In view of the user's virtual immersion, various other multimedia applications are being produced. Some aim to make the most recent historical and artistic research on the monument better known and exploit new documentary sources, such as the palace inventories from the time of the Cook family. The ongoing restoration process on the property has likewise been subject to greater dissemination through a multimedia system. The screening of the virtual palace is used to show how the work is progressing, exploring the visual contrast between the 'before' and 'after' stages of the campaign. The user interacts with a pedagogical agent that conveys, through simple discourse, information on the palace's history and restoration. As in the Serious Game, these applications are created in the virtual environment of the Unity 3D game engine so as to fully exploit the technological characteristics of this tool. The surrounding environment is thereby used to enhance the user's multi-sensorial experience.

Our innovative enhancement of artistic heritage also takes into consideration the kind of platforms on which multimedia applications can be installed and used. For *Fala Comigo* it was decided to focus on fixed desktop platforms as well as portable devices with the most current operating systems (Apple's iOS and Google's Android).

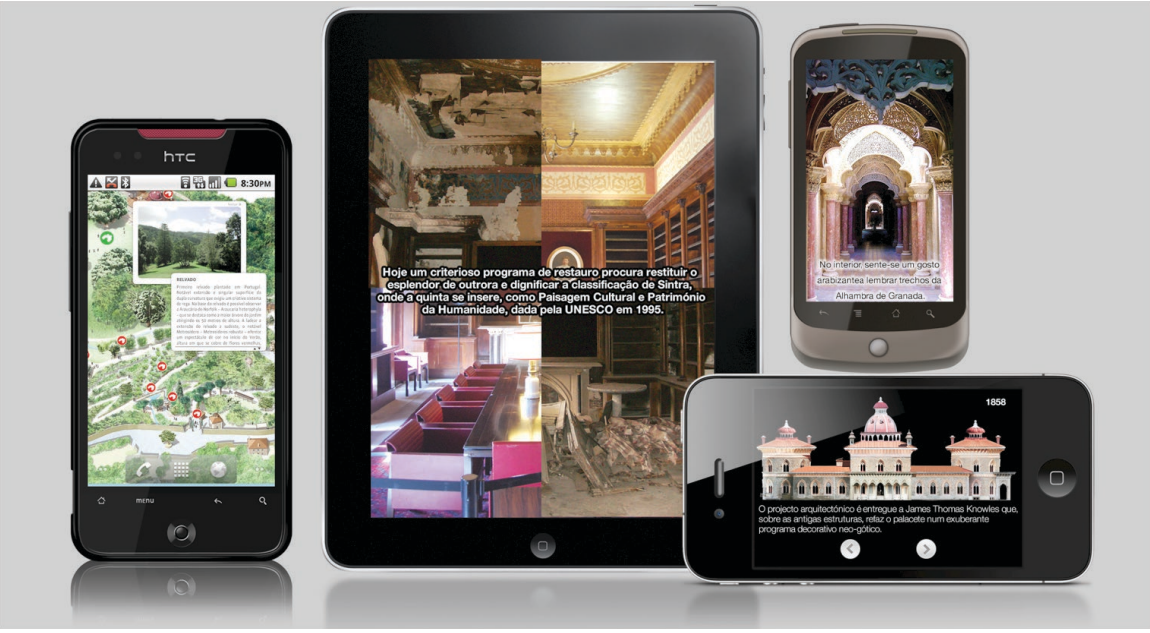


Fig. 4 Mobile applications.

One application allows visitors to watch the history of the palace on their mobile phones. A sequence of images from the 3D survey is included to give non-specialist visitors a better perspective of the monument's volume and space than can be achieved with plans or 2D elevations. This way, users get a remarkable autonomy and can therefore orient their visit as they please, though always supported by concise, accurate and clear information. Once acquired, the informative digital content belongs to the user, who can store it in his mobile phone for later use, for example to create a digital reference library of places visited.

## Future Work

The main aim of the final phase of project development is to explore the 3D model of the palace's interior, so as to map out the course of a virtual visit. This will make it possible to recreate, in detail, the atmosphere of the period by means of furniture and other decorative features. The possibility of offering visitors a faithful reconstruction of the palace in its golden age will certainly contribute to renewing interest in the monument. By virtually exploring rooms that are actually empty at present, visitors will get a genuine feel of how life was lived in these interiors at the time of the Cooks.

The success of this group of applications will decide the fate of similar applications that are conceived for other palaces in Sintra under the management of PSML.

## Conclusion

3D surveys of buildings are today recognised as important information systems in various fields. For a historic monument it is also an essential aspect of its safeguarding. Its use, however, is not limited to these important areas. Because a 3D survey can play a suggestive role in reproducing, recreating or simulating reality, it can be used in multimedia applications for the dissemination of knowledge of our cultural heritage. The immersive power of the 3D image pulls users into a world, which might be parallel to the real world, that stimulates our senses to be fully active. It is now within our reach to create an educational game which recreates a time and a space, passes on cultural content, reconstructs the life and times of a particular monument, and makes it possible to travel in time and virtually visit that monument. We hope that this new initiative in the world of emerging technology will generate widespread and sustained benefits for artistic heritage and may thus contribute to its preservation.

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## Ilustrations

Fig. 1, 2, 4 João Nuno Baptista Neto.

Fig. 3 ArtScan.