VISUAL ANALYSIS METHODOLOGY BASED ON THE VIRTUAL REALITY TECHNOLOGY: CERCO'S GARDEN, MAFRA, PORTUGAL.

ABSTRACT

The aim of this study is to explore Virtual Reality (VR) technology, through the implementation of digital tools in the spatial description of urban environments. Particular emphasis is given to places of cultural importance and heritage value, like the historic garden. Cerco's Garden, a baroque garden of eight acres divided among woods and gardens, is analysed as a case study. It is located between the Convento-Palácio de Mafra and the Tapada Nacional de Mafra, in Portugal.

This paper combines research interests of several areas, such as Virtual Reality, Virtual Heritage (VH), panoramic photography and image manipulation programs, to create a cultural heritage dissemination instrument. This tool is intended to work as an active learning environment for the recovery and conservation of the location, through data processing and analysis collected from primary sources. It is designed to match multiple digital educational settings (whether via the Internet or Multimedia) aiming to meet different teaching strategies.

This text is organized into four parts. First, the historical and geographic contexts of Cerco's Garden, from 1718 to the present, are summarized. Next, several technologies used to support the dissemination and preservation of cultural heritage, are reported. At the third part the methodological procedures applied to the case study – Cerco's Garden – are described. Finally, the strengths and weaknesses of the project are identified and future implementations that could facilitate and enhance similar studies are proposed.

KEYWORDS

Cerco's Garden, Virtual Reality, Virtual Heritage, Architecture, Education, Cultural Heritage, Electronic Interactive Means, Virtual Walk.

1. HISTORICAL AND GEOGRAPHIC CONTEXTS OF CERCO'S GARDEN

In 1718, fulfilling royal directives, António Rebelo da Fonseca had sealed off a tract of land beginning the construction of the convent gardens, the current Garden of Cerco.

Its emergence is closely linked to the Convent-Palace of Mafra which, it is said, has been erected because of a vow made by King John V. After his marriage (in 1708), and finding himself still with no successor, he promised to build a convent in Mafra if he had an heir. Recent studies point to a different view of this story, the king had a venereal disease and his life was in danger, but such an explanation would be kind of embarrassing, and so the first story was popularized. In 1711, months before the birth of his first heir, the king ordered the construction of a convent in Mafra, designed to accommodate thirteen religious monks of the Franciscan Order. In 1717 the first building stone was launched with unusual solemnity.

From an initially modest idea, a convent for thirteen monks, the building to erect at Mafra has undergone several major changes, resulting in a real monument of four hectares for three hundred monks, integrating a royal palace. This vast architectural complex was planned to house about 5,000 people. Despite all the changes from the original plan, the church is essentially the same as when it began to be built in November 1717, because it was originally designed for a very large religious community. The palace came to be in front of the building and the convent premises at the rear, enjoying wide views of the Cerco's Garden.
In 1744 the real building was officially finished, although numerous details would still be unfinished. The monument of Mafra, sacred on the 22nd October of 1730, Sunday, the 41st anniversary of King John V, was a work that the monarch would devote to himself, becoming his most faithful self-portrait.

It was envisioned the creation of the magnificent Royal Hunting Reserve of Mafra (*Tapada de Mafra*), to provide a landscape and environment framework for the Convent of Mafra Palace and to be used as a recreational hunting resort to the king and court. With an area of 1200 hectares, its lands were acquired by purchase or expropriation, between 1744 and 1748, by order of King João V and "would always retain dependence of the palace" [Ivo 1906]. As stated Ivo et al. (1906), *Tapada* would be divided into three parts.

The royal family would live in the palace of Mafra from time to time, being that use related to the *Tapada* and to its organized hunts. As for the convent, it was occupied by several religious orders at different times. "Inseparable from the monastic occupation of the convent is the use of convent Garden of Cerco, a privileged leisure place for the the friars." [CMM 1997].

After 1840, at the convent premises stayed part of the military corporations and Mafra Hunting Reserve was partially ceded to the military. With the establishment of the Republic in 1910, the remaining area of the Royal Hunting Reserve would become state property and its name was changed to National Hunting Reserve of Mafra. The palace stopped being private property and was transformed into a museum, named the National Palace of Mafra.

Originally used by the royal family, the court and the friars who lived in the convent of Mafra, Cerco's Garden existed as a unique entertainment space and was structured to allow woodland walks, the practice of horticulture and gardening, and also the performance of games. In this garden there were initially seven playground games: four for ball games, two for "*little orange*" games and one for ring games. All these were reduced to only one of the ball playground games, with dimensions of 226 x 40 feet (49, 8 x 72, 8 m), surrounded by stone benches. This building, formerly belonging to the friars of Mafra, is the only one in Portugal which remains in good conditions.

Guilherme de Carvalho Bandeira (1730 - 1744) mentions that the Cerco has streets with dense forests, where rabbits populate in abundance, and several woods where the sun does not enter. The streets present themselves arranged in symmetry with the Convent, extending the central axis through the woods, representing the concern of reproducing outside the main axes of the monument.
Ayres de Carvalho stated that "If the garden of the convent gave frugal food to the community, there were also virtuous and wholesome herbs planted to supply the "botica" (pharmacy) of the infirmary ward." [CMM 1997]. This medicinal garden stood on the north side of the convent, at the convent limits, next to the Houses of Botica.

In 1910, with the proclamation of the Republic, the garden went into the public domain, being open to the general public for all to enjoy this beautiful space.
In 1921, through the initiatives of the "Friends of Mafra", recovery actions of the Cerco's Garden where undertaken, and the inactivity to which the garden had been condemned, cease. These recovery actions would be financed by profit made in parties promoted there and the sale of plants grown at site.
The second revival of Garden of Cerco, after 1949, is due to the Forest and Aquaculture Services. It registers evident concern to undertake the rehabilitation of this scenic area, with the recovery of some of the original structures of the old convent garden.

It is currently under the direction of the Municipality of Mafra, department of Landscape and Urban Furniture, which organizes numerous activities in the garden and keeps it cleaned and cared.
Besides being a place of leisure, this is a site that allows "time travel to times of the great achievements, the delight of kings and monks" [CMM 1997].

Figure 1: Aerial photograph of the Garden of Cerco. Source: Google.

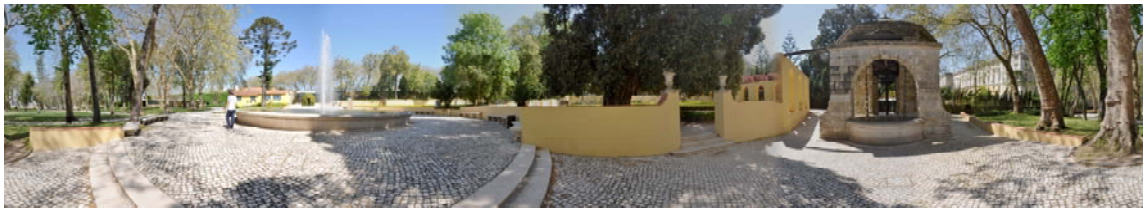

Figure 2: Panoramic photo of the area by the pool, at Cerco's Garden. Source: Ana Pedroso.

2. THEORETICAL APPROACH OF DIGITAL TECHNOLOGIES

The Virtual Heritage system has application in several areas and can be used either in educational settings (formal or informal) or as tool for the dissemination of information. Refer to the support offered by the Internet which by allowing to virtually visit a place, reduces the threats and damages to existing real space and features the advantage of distributing information, such as hypertext, on site in question.

The creation of virtual environments used in the system of Virtual Heritage should present itself as a realistic description - reconstitution - of a past period, but should not seek to represent them digitally with three-dimensional contemporaneity.

The digital reconstructions of monuments represent an effective research tool for Virtual Heritage, where as computational simulation and interactivity become ideal working methods for professionals in the field of heritage.

We present the techniques used for virtual environment modelling and the concepts of Virtual Reality (VR) technology and the Virtual Heritage (VH) system applied to the learning of the

built heritage. These tools of great technological potential provides means to improve efficiency in research and investigation, by preventing constant dislocations to the sites, this way optimizing work to be performed.

Photogrammetry:
Photogrammetry deals with the quantitative analysis of measurements from frames (pictures, videos, digital images, etc.). With this type of data and by resorting to computer programs, one can perform field work without having to return to the site at study.

Panoramas:
A panorama is an image that captures a visual field bigger than the one of the human eye, going up to 360º. In the digital age [Rigg 2010], a Panorama is defined as an elongated image that provides a wider visual field, presenting the image behind the observer. To produce a panoramic picture, multiple images are recorded, positioning the camera on a tripod and making it rotate around its own axis.
This is a low cost technique of easy implementation, that enables the sharing and discussion of ideas by allowing the visualization and understanding spaces, in a quick and innovative way.

Acquisition of 3D images using a scanner:
The acquisition of 3D images using a scanner is the most effective means to generate a three-dimensional model, but it has considerable costs associated with it. The acquisition of the images may by trough technical contact (small pieces) or trough no-contact (for large monuments). Besides cost, other disadvantages of the 3D laser scanning of monuments are the need for infrastructure support, such as scaffolding, mobile and fixed platforms and the specialized human resources associated with it.

The use of satellite images:
The Earth observation satellites watch successfully registered parks and nature reserves of the world's cultural heritage, contributing to the efforts of conservation. In addition to this heritage monitoring, they can provide images to be exploited in educational contexts.

3. METHODOLOGICAL PROCEDURES

The methods of visual analysis, based on the technology of Virtual Reality applied to the Cerco's Garden, in Mafra, are described here. The main tasks are summarized and the proposed method potential for describing space is discussed.
The methodological procedures used were structured in five sequential steps.

At Step 1 we started by performing a bibliographical research. Data on historical iconography, plant surveys and aerial photogrammetry was collected.
In Step 2 we carried out the fieldwork at Cerco's Garden. It included site visits and meetings with the garden management.
In Step 3, the requirements for the visual analysis system based on virtual reality technology using panoramic images, were selected.
At 4th Step the photographic recording of the object of study was performed along with the treatment of these photographs and the construction of panoramic images.
Finally, in Step 5 we developed a website, creating a virtual tour through scenes executed in the previous phase plus a series of hypertext and interactive photos added to the website. This site will be integrated in the In_Learning site.

This technology allows the integration of a wide variety of data and images in a digital and cultural inclusion environment.
Virtual reality enables the extrapolation of space-time limits, by allowing the exploitation of virtual places and acting as a sort of *time machine* [Dainese 2003].
By facilitating the acquisition and knowledge sharing on the urban form, virtual reality contributes to the recovery of its memory, while performing as an active learning tool.

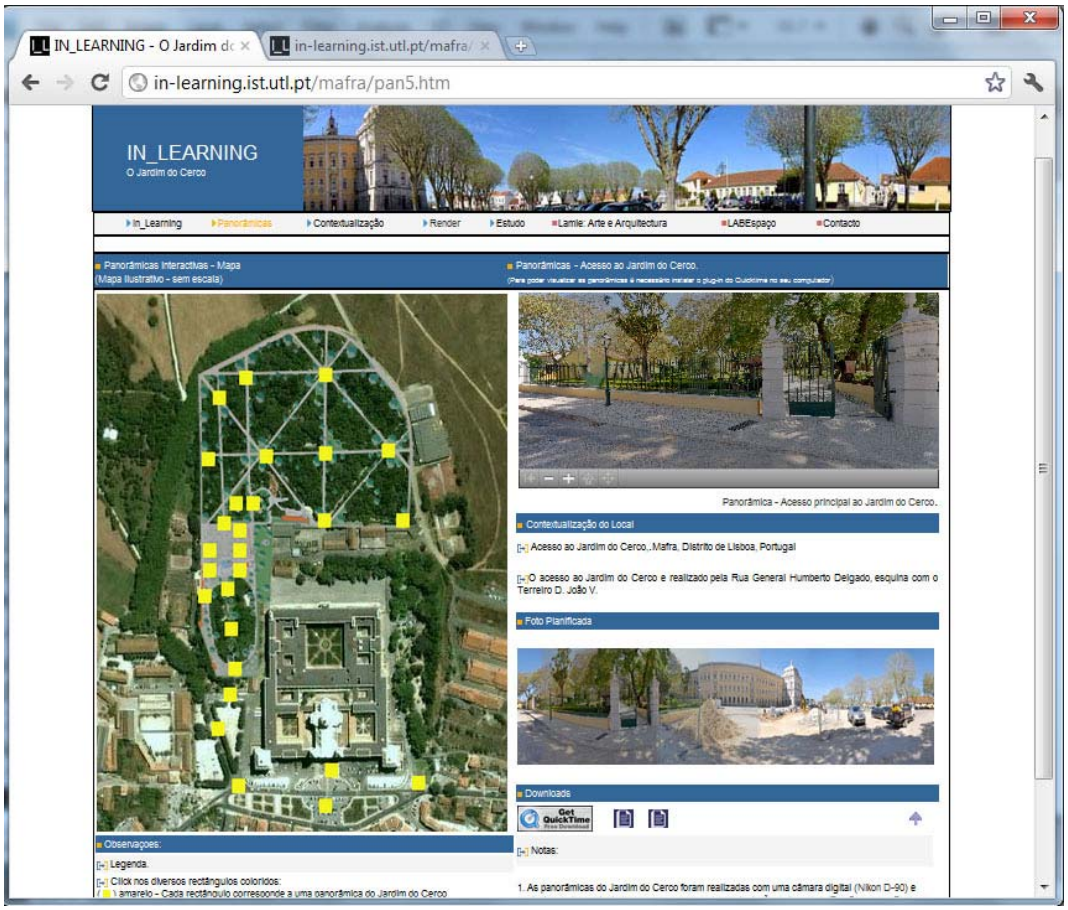

Figure 3: Website developed in this study. Source: Ana Pedroso.

4. FINAL THOUGHTS

The current landscape of the Cerco's Garden, in Mafra, combines natural and built elements. It is a unique landscape in the context where it belongs, asserting itself as an asset value.

The techniques and methodologies presented in this work support its study and preservation, either through an exhibit perspective, with virtual tours, or through a research perspective, providing a deeper study of heritage by the use of several tools of great technological potential.

Cultural identity is established dynamically, [Choay 2001] states that the function of the heritage is to be constructive, so it is essential not only to perpetuate the testimony of the past, but also to dialogue with the past, through its appropriation and reinterpretation, allowing your enjoyment.

As such, the Virtual Reality can be a tool of great efficiency through the system of Virtual Heritage, providing the solution and use of virtual environments in the areas of cultural, historical and architectural preservation, with highlighting innovation. As in many other areas, innovation does not necessarily mean replacing the old by the new, and Virtual Reality, as a new form of morphological description, will not replace existing technologies, but rather complement them [Campos 2005].

Through the virtual tour prepared as part of this work, the Garden of Cerco will have a better and more widespread acceptance among the population. It will be accessible to all those who are prevented from physically visiting the site and it will bring more visitors to the garden, as who will eventually decide to go to the site itself, after a virtual tour.

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