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INTEGRATION AND COMMUNICATION OF CULTURAL CONTENTS: THE EXPERIENCE OF THE CERTOSA VIRTUAL MUSEUM

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Abstract (EN)

The application of Information & Communication Technologies (or, more specifically, Virtual Reality) to Cultural Heritage can certainly be deemed as one of the new frontiers of cultural policies. In particular, the idea of using visualisation as an interactive interface for accessing cultural database is extremely promising.
Starting from this consideration, the Nuove Istituzioni Museali of Bologna City Council has conceived the “Certosa Virtual Museum”, a project that has led to a scalable and multiplatform application.

Keywords: Augmented Reality, Virtual reconstruction, Database, Multiplatform, Collaboration

Zusammenfassung (DE)

Die Anwendung multimedialer Technologien (besonders der Virtuellen Realitaet) im Bereich der Denkmal- und Kulturgutpflege kann sicherlich als ein hochaktuelles Terrain innerhalb der Kulturpolitik angesehen werden. Das gilt als ganz besonders vielversprechend fuer die so genannte Visualisierung in Hinblick auf den interaktiven Interface-Zugang zu Datenbanken mit kulturellem Inhalt. Ausgehend von diesen Ueberlegungen hat die Abteilung Neue Museale Institutionen der Stadt Bologna ein virtuelles Museum der Certosa von Bologna konzipiert, ein Projekt, fuer das eine Struktur der stufenweisen Anwendung ueber mehrere Ebenen entwickelt worden ist.

Schlüsselwörter (DE): Virtuellen Realitaet, Datenbanken, Virtuelle Rekonstruktion, Zusammenarbeit.

Résumé (FR)

On peut considérer l'application des technologies informatiques (ou plus précisément, de la Réalité Virtuelle) aux biens culturels comme l'une des nouvelles frontières de la politique culturelle. En particulier, l'idée d'utiliser la visualisation comme interface d'accès active aux bases de données culturelles est très prometteuse. A partir de ces considérations, "Nuove Istituzioni Museali" (les Nouveaux Instituts de Musée) de la Mairie de Bologne a conçu le Musée Virtuel de la Certosa de Bologna. Il s'agit d'un projet d'application extensible et multiplateforme.

Mots clés:
Réalité Virtuelle, multiplateforme, bases de données, collaboration.

I. Introduction

The immersive navigation inside 3D interactive virtual models (city of Bologna, Certosa, Etruscan landscape, Cloister III, Partisan's Ossuary, Monument to the dead soldiers of the Great War, Memorial to the dead in the Liberation War) leads towards data and meta information. Sources and documents, organised inside a multimedia database, get to the final user through the virtual interface in a continuous and bi-univocal interaction between virtual reconstruction and historical, artistic and archaeological documents.
The project can be seen as a centripetal force attracting the efforts of several institutions, with cultural contents pertaining to different historical periods, integrating the output with cross media technologies that reach final users, divided into different categories.

a. **Institutions** – museums (Archaeological Museum, Parri Institute of the Resistance, ANPI -National Association of Italian Partisans, Museum of Risorgimento, Archiginnasio Library, Museum of Ancient Art), technological partners (CINECA, ENEA, CNR ITABC), academic partners (both as departments and as single researchers), private companies (for the aesthetics of the application, the realisation of the users' graphic interfaces and the production of communicative output);
b. **Cultural contents** – Digital acquisition of cultural sources. Elaboration of cartography, terrain models, aerial photos, etc. Management of cultural contents through 3D models and database. The database (Oracle DBMS, porting on a MySQL based system in progress) aims to maintain the complexity of contents. Thanks to the possibility of relating different sources, coming from different institutions, and highlighting the connections among the documents, the contents are made available in a user-friendly form. The structure of the db has been conceived as a complex and flexible tool, able to foresee future needs, with many fields for enabling wide-ranging queries and for managing contents in different ways. In order to make populating the db by the numerous suppliers of contents easier, great effort was devoted to an on-line interface. In the database about the Partisans, there are currently 1200 biographies, 80 cards about events, 35 about partisan brigades, almost 100 explanation cards, about 1500 photos, videos and audio files.

c. **Historical periods** – five main focuses (Etruscan period, Middle Ages, XIX century, Great War, Liberation War) and the present time as a starting point;
d. **Technologies** – desktop, Virtual Theatre, palm top, web, virtual set. An important aspect is the evolution towards Open Source, particularly suitable for Cultural Heritage. The Open Source movement (open codex software, often free) is spreading also in Italy, triggering new social and cultural dynamics and enabling fully multidisciplinary research. A functional protocol has been developed within the project for the generation of real-time 3D landscapes, in particular for the landscape of the Etruscan necropolis.

II. CERTOSA VIRTUAL MUSEUM and Augmented Reality

With "Augmented Reality" we can encompass all those solutions that use digital technologies in order to increase the quantity of information achievable from a certain reality, such as it usually is. As in many other fields, Cultural Heritage can gain interesting contributions applying this concept. For example, there are frequent difficulties in communication with the public or problems due to the fragmentation of information. Intertwining the above mentioned resources the Virtual Museum of Certosa in Bologna aims to start a mechanism capable of valorising a set of monuments and cultural sites, giving them a renewed visibility.

The project has started in 2002 and, at present, has already reached captivating goals, fostering a fresh awareness towards areas that were sunk into indifference, both from tourists and citizens.

Each of the four relevant areas selected inside the Certosa (Etruscan landscape, Cloister III, Partisan's Ossuary, Monument to the dead soldiers of the Great War, Memorial to the dead in the Liberation War) has become a theme, set inside an application of Augmented Virtual Reality, with general and specific aspects.

The starting point was the 3D reconstruction of the territory of Bologna, the Certosa area included, implementing a textured DTM (Digital Terrain Model). The blue-prints of the buildings, delivered by the Territorial Information Service of Bologna City Council, have been used for its realization. The volumes of buildings were extruded from the polygons in the shape files by reading the information that specify their heights directly from the database nested in the shape file.

This object is a visual portal, conceived for managing different cultural sites pertaining the same historical period and diachronic sites, set more or less over the same area. Hence, from the terrain model it is possible to access detailed reconstructions of the selected four areas of the Certosa cemetery (in addition to other models).

Fig. 1: A view of the digitally reconstructed Cloister III

At the same time, cultural information were gathered. First of all, we developed a database for holding historical data. Its earlier version was conceived for an off-line use. Soon we realised that, having already an on-line access for the historians to populate it, it would have been more useful to enable on-line access for final users as well. The first set of data was about the partisans who died during the Liberation War. The Sacrarium gives too few information about them, since on each grave there is only the partisans' name and family name. The other Memorial, commemorating partisans in the main square of Bologna, is just a little bit more talkative, with a wall full of surnames and, not always, portraits. After sixty years, only few people remember those names and those faces. The database should help in reviving the memory, starting from the biographies of the partisans and connecting them with historical events and their partisan brigades.

The biographies have been used also in a specific application for PDAs. Visiting the Monument it is now possible to ask for a palm top; each grave inside the Monument has a number and, by selecting it on the device, it is possible to read and/or to listen to the biography of the person buried there.

This brief description makes evident the importance and usefulness in "augmenting" the reality, in adding information that, otherwise, could be precluded to the majority of people, both for personal research limits, increased by the dispersion of the sources, and for the lack of the information themselves, that were created *ad hoc* for the database.

What is more, relations among historical sources produce a result that is greater than the simple sum of the same sources. These are sources usually kept as autonomous instances and not as if they were capable of entering a relation; besides, they are located in archives physically far from, for example, the Memorials. Last but not least, some skill in retrieving historical sources is needed, and not every user can count on it.

Making the relations among the archives evident and delivering the results to the unskilled user is the main goal of the Certosa Virtual Museum, and digital technologies are a strong resource for more effective results. However, the process is time-consuming and composite, as we are going to see.

III. Memory and Reality: Monument to the dead soldiers of the Great War

Starting from the recently restored Monument set in the Certosa cemetery, First World War was one of the themes selected to be submitted to the public attention. Built during the Fascist era with instrumental purposes, it hosts 3130 funeral niches with just name and family name of the dead soldiers. For the main part they are Italian soldiers from other provinces who died in Bologna after being taken into one of the several hospitals arranged in Bologna, immediately behind the front lines. There are also a couple of hundreds Austrian prisoners of war, who died during their stay in the city. Soldiers coming from Bologna and its surroundings and buried in the Monument are chiefly deceased in the city for wounds or illness as well. Only the last group,

consisting of more or less two hundred dead, was taken to Bologna after the end of the war, coming from the war cemeteries (1923 – 1924) on the front lines.

At the Certosa cemetery the archive keeps a document with some additional information about the soldiers, often the death day. This list was cross checked with the list of all the dead soldiers dwelling in Bologna and its province, published in 1927, that gives also their short biographies. At the same time, it was possible to locate more or less sixty more soldiers, buried in family graves or in individual graves in some of the fields in Certosa, and their names also were cross checked with the list published in the Twenties.

Afterwards, the cross checking was made with the *Archivio Caduti*, an archive made of nearly 3000 folders, each one dedicated to a different dead soldier pertaining to the area of Bologna, with more than 7500 documents. This archive was established during the war years and the ensuing ones, collects different sources such as personal letters and postcards written home by the soldiers, official documents (birth and death certificate, etc.), cards produced by the *Archivio Notizie* (an office that kept contact with the soldiers' families), photographs, articles from local newspapers and so on.

The tombs outside and inside the Monument linkable to a biography are more than 500. 150 of them have also documents coming from the *Archivio Caduti*. The cross check was made also with lists of names written on commemorative tablets set in the city and included in a photographic census made in the Twenties all around Italy.

The information about the soldiers have been included in the database and linked to other more general historical resources. Inside the Monument, the main Italian battles are commemorated and as the name on the grave leads directly to the biographies, in the same way the names of the battles enable the access to each war event. If one of the 500 people in our list died during these events, there is a relation also between the two records.

Thanks to an interactive time-bar, reachable through every card in the database, it is possible to continue the navigation among cards about specific topics and various multimedia resources related to the local, national and European historical First World War environment. Our desire was to attach as many different multimedia files as possible (music files and official speeches, historiography, video files and photographs, the digitised version of the local newspaper "Il Resto del Carlino" for all the war years). The data can be reached via Web directly through the

database or, on an off-line basis, through the 3D interface, too heavy at present for a Web fruition.

As before said, there can be other sites outside the Certosa perimeter but in relation to the same theme. For the Great War topic, for example, we included the other Bolognese cemetery that, during the First World War, was part of an autonomous city council. Even if it is not very large, it is very interesting since the entrance is a “Memory alley”, with commemorative plaques below each cypress. In the inside there are also some individual tombs.

Part of the resources kept by the library of the Museum of Risorgimento is now easily and quickly accessible, giving back to life that unknown name engraved on the Monument.

The decision of starting from the people perfectly matches the desire of highlighting the troubles of the individuals before placing them inside the wider mechanism of war that, all of a sudden, overwhelmed their lives.

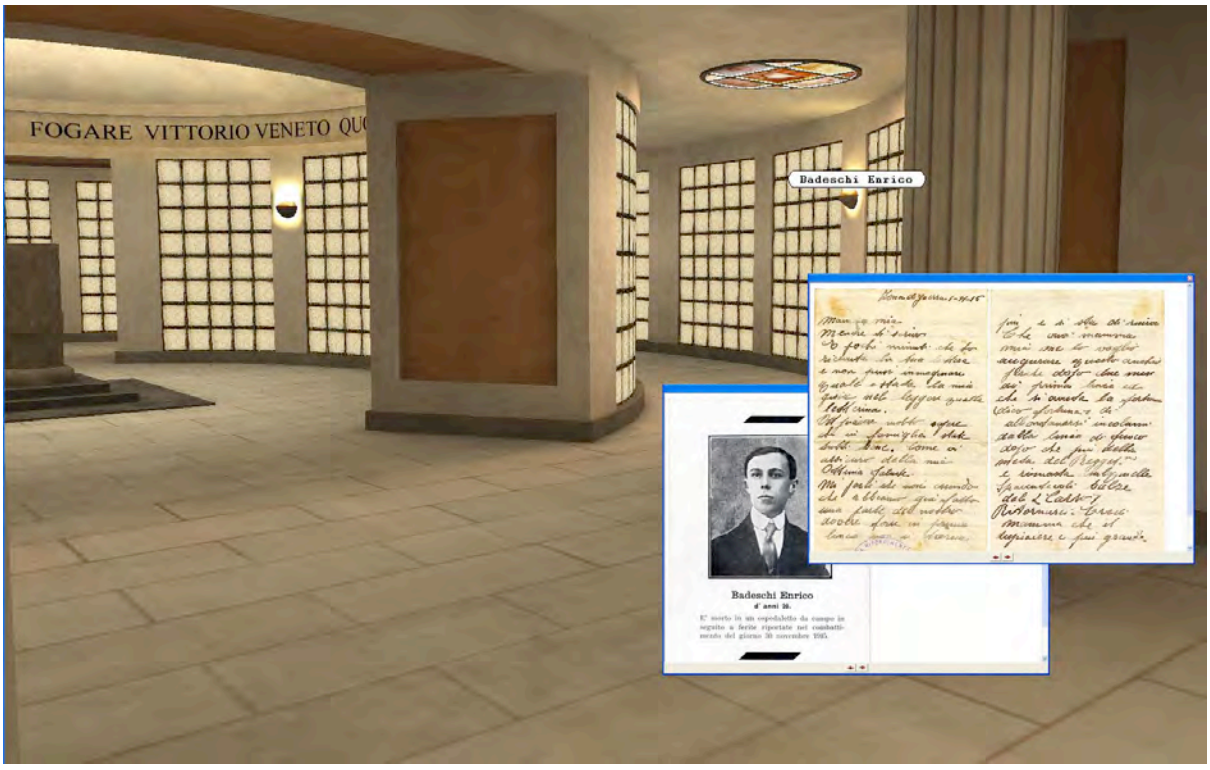

Fig. 2: The interiors of the Monument to the dead soldiers of the First World War; the flag with the name of the soldier appears at the passing of mouse over the niches; two documents of his, coming from the Archivio Caduti.

Memorials and monuments dedicated to the dead, as Winter says, are functional to the mourning relatives, for elaborating their grief; once this task is over, monuments attain new meanings. In our situation, after ninety years, they enable us to recall an historical period, beginning from ordinary people's daily life during troubled times.

IV. Communication

The effort set in digitising and organising historical sources, in putting them into relation through the database, can reach partial goals if the whole application is insufficiently communicated.

1. The Arts and Humanities Data Service And Standards For Audio

Since the beginning the 3D model has been conceived as a organisational portal for accessing the available huge quantity of data. Therefore, it was very important to pay particular attention to the visual impact of the models. After a first commitment on the accuracy of the modelling phase, the 3D models were handed over to graphics specialists for caring the aesthetics aspects. All the textures have been enhanced thanks to the computing of shades and radiosity inside the scene, definitely increasing the appeal of the whole output.

Fig. 3: The exteriors of the Monument to the dead soldiers of the First World War.

The version of the DB for specialists, the historians populating or consulting it, is very complicated. Therefore, for the non skilled final users, a simpler interface has been realised, capable of selecting the most important information in an immediate way.

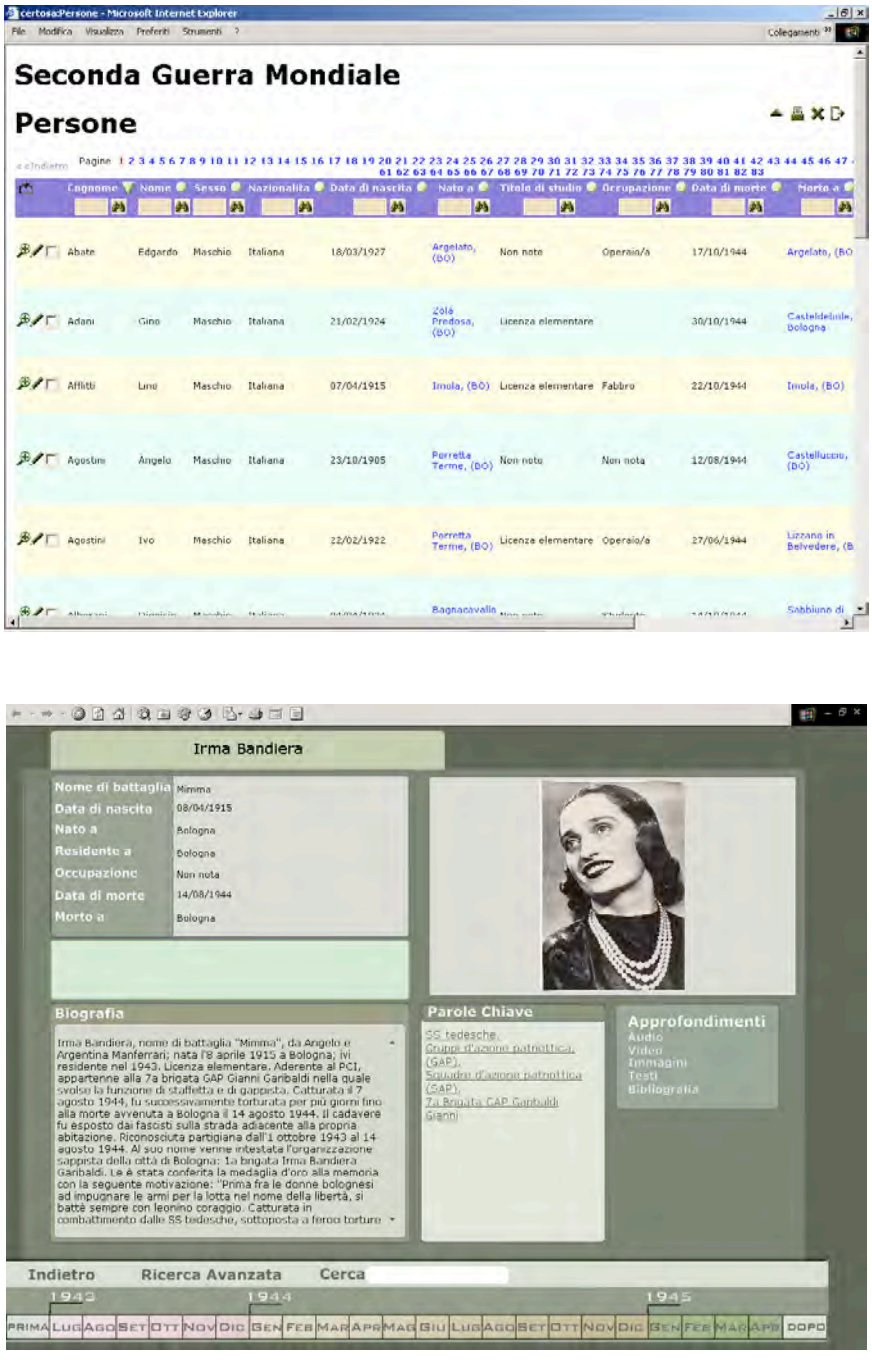

Fig. 4-5: The technical interface to the database:
the section with synthesis of the data already put into the database for populating the table about partisans.
The interface for final users: a dynamic card about a partisan formed with data dragged from the database.

2. Users' Test

Once the graphics for the interface of the db and that for managing the virtual world have undergone a uniformity process, it is time to test the application with final users.
The attention is focused on the real effectiveness of such a project in order to catch students' attention and convey them the cultural contents.
Navigation inside the virtual environment is quite similar to that of video-games and the user interface for the database has been simplified. At this moment, an evaluation over the real impact of the application is mandatory. So, during the next months, three high school classes – two first year and a second year classes, will be involved in a test. The two first year classes will follow a different path. The topic will be about the First World War and both classes will be introduced to it in school before visiting the Monument to the dead soldiers in the Certosa cemetery. Then, a class will visit the collection of real historical sources (objects and documents) at the Museum of Risorgimento, the other one will interact with the immersive virtual environment and the database at the CINECA Virtual Theatre. The second year class will follow the technological path for evaluating differences in reaction depending on the users' age.

3. Share and communication of Information through an OpenSource approach

The teams of CNR ITABC and CINECA have lately focused their attention on the development of a new generation of virtual reality applications, suitable not only for home computers or collective spaces, such as virtual theatres, but also for the Internet. This specific interest started experiments on OpenSource protocols and tools. A digital protocol has been signed by the two research groups in order to increase freedom in the acquisition and elaboration of data. The process going from the archaeological field research to virtual reality is therefore characterised by several steps aiming in first place to integrate data and make them available. The preference fell on the use of open tools, projects and protocols, for social and economical reasons as well. The interest toward the Internet, thanks to the use of two OpenSource projects (OpenSceneGraph, http://www.openscenegraph.org, and Virtual Terrain Project, http://www.vterrain.org) enabled to take part in the community, sharing the available tools, managing different protocols, using the available code for developing new applications, using the

code over and over, to improve, modify and increase the code for further developments and, in the end, give the code back to the community. The use of OpenSource software has also enabled the realisation of sustainable projects and investments (scarce as they are in cultural fields) were finalised to engaging young researchers and focused on the spreading of contents through the developed applications.

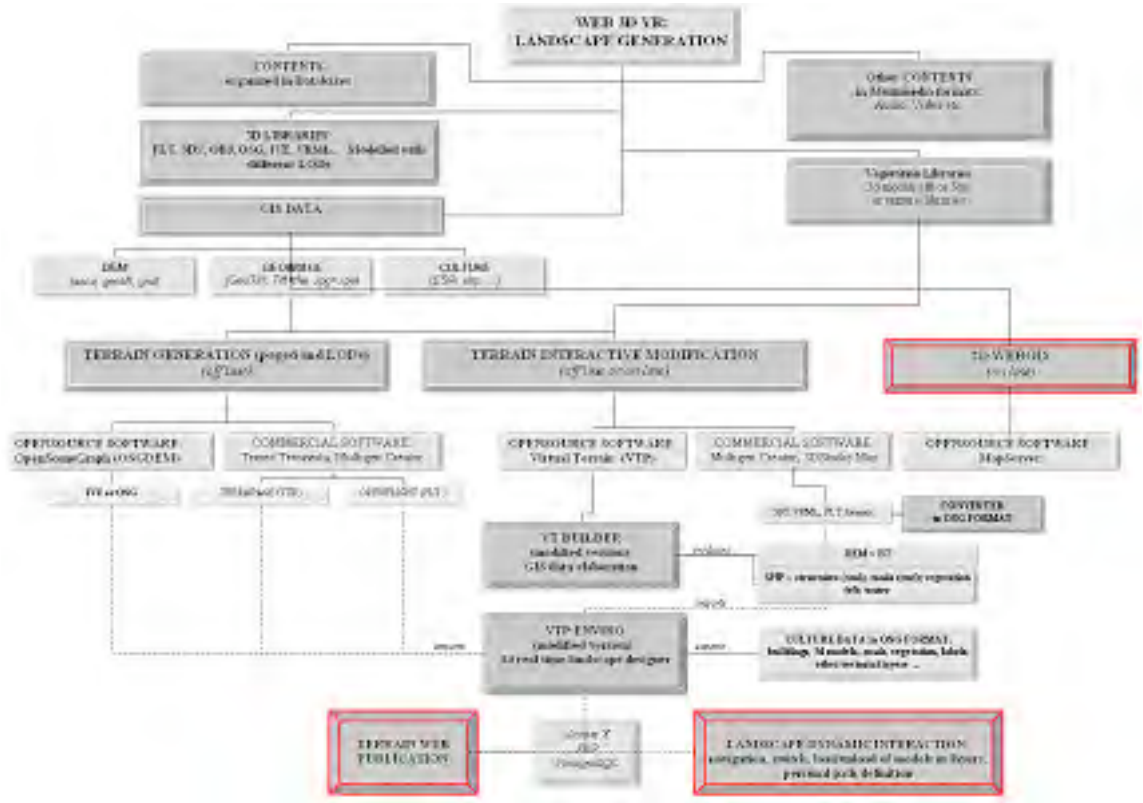

Fig. 6: Scheme of the "spatial pipeline". This scheme well represents the digital protocol. The final goal is to reconstruct in the more flexible way the archaeological landscape, safeguarding its spatial connotation.

The first project to exploit this new working methodology was the Certosa Virtual Museum project, in particular for the part of the application dedicated to the visualisation of the landscape of the Etruscan necropolis.

During the development of the Etruscan part of the application, there was the necessity of starting a co-operative reconstruction project for the Bronze Age landscape, together with the archaeological museum experts. This led us to approach the problem carefully and in an

updateable, open and scientific way, before getting to the VR application whose primary goal was the dissemination and musealisation of the Certosa history.

Such in the case of Appia Antica project, OpenSource tools allow to follow this approach. A GIS base was constructed, a database was realised and connected with the georeferenced object. A first attempt of Etruscan DEM and GeoImage was realised. The 3D terrain was generated with Terrex Terravista because we needed FLT flight files in the following phase of visualisation (Visman). GIS vectorial layers and the terrain were imported in a modified version of VTP Enviro, that was used as 3D environment to reconstruct dynamically the archaeological landscape. With Enviro it was possible: to connect 3d models of the steles and other archaeological objects in the position where archaeologists found them during 18th century excavations; create library of plants known to be typical of that area during the Bronze Age and add in real time the vegetation; control parameters and hypothesis in 3D.

Although the project is at beginning we have found that the approach used created a collaborative connection between different institutions and disciplinary teams, opening positive discussions aimed at landscape reconstruction, while at the bottom a scientific digital basis is prepared (GIS, DB) and continuously updated.

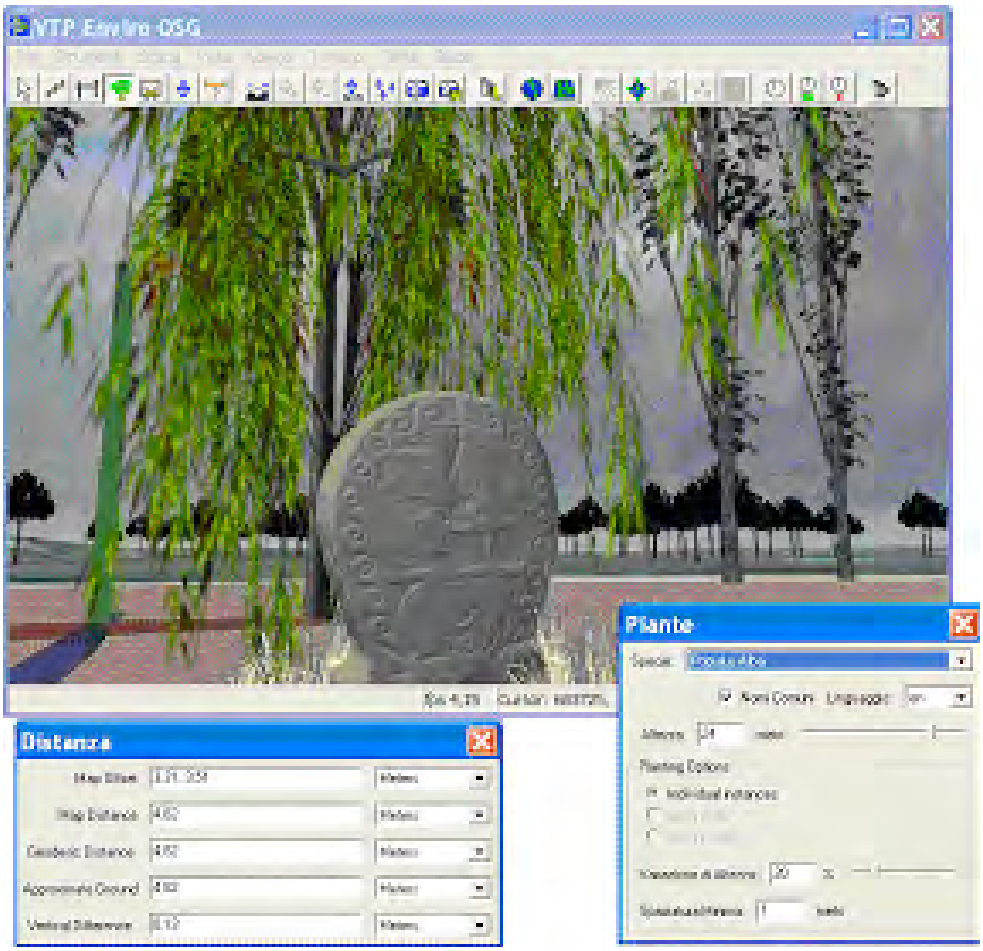

Fig. 7-8: The GIS database and VTerrain used during the phases of the 3D reconstruction of the Etruscan landscape.

V. Conclusion

In order to reach a wider public it is very important a good degree of communication; for delivering a significant range of information it is fundamental to integrate different skills and foster the collaboration among cultural and technical institutes; the data have to be collected, organised and managed. Anyway, in the end, augmenting the reality can really enrich it and prevent its dispersion or misinterpretation. A complex endeavour that, in our case, helps in democratising knowledge and valorising the territory and its cultural resources.

References

Ufficio Centrale Notizie Bologna (Ed.) (1927), I morti della provincia di Bologna nella guerra MCMXV-MCMXVIII, Bologna, Tipografia Paolo Neri.

Winter J. (1998), Il lutto e la memoria: la grande guerra nella storia culturale europea, Bologna, Il mulino.

Forte M., Pescarin S. (2004). The virtual reconstruction of the archaeological landscape. In J.F. Berger, F. Bertoncello, F. Braemer, G. Davtian & M. Gazenbeek (Eds.) *XXIV Rencontres internationales d'Archéologie et d'Histoire d'Antibes: temps et espaces de l'homme en société, analyses et modèles spatiaux en archéologie*.

Borgatti C., Calori L., Diamanti T., Felicori M., Guidazzoli A., Liguori M.C., Mauri M.A., Pescarin S., Valentini L. (2004). Databases and Virtual Environments: a Good Match for Communicating Complex Cultural Sites. In Proceedings of ACM SIGGRAPH 2004, Los Angeles

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