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Etruscanning 3D project. The 3D reconstruction of the Regolini Galassi Tomb as a research tool and a new approach in storytelling

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Abstract

In the "Etruscanning3D" european project framework, the virtual reconstruction of the Regolini Galassi tomb, in Cerveteri, has been realized, in order to re-contextualize its precious funerary goods, today preserved in the vatican Museums, in their ancient space, digitally represented in 3D. The reconstruction has been preceded by a huge work of data collection, reinterpretations, topographical acquisitions through a variety of techniques, digital restorations, in order to create a plausible simulation of how the tomb could appear when it was closed, at the half of the VII century BC. The final purpose of the VR application is communication inside museums, so the narrative approach and the metaphors of interactions played another key role.

Keywords: *ETRUSCANS, DIGITAL RE-CREATION OF ANCIENT CONTEXTS, DIGITAL RESTORATION, VIRTUAL REALITY, COMMUNICATION, NATURAL INTERACTION,*

Resumen

En el proyecto europeo "Etruscanning3D" basado en la reconstrucción virtual de la tumba Regolini Galassi, en Cerveteri, se ha realizado con el fin de volver a contextualizar sus valiosos bienes funerarios, hoy conservados en los Museos Vaticanos, en su espacio original representado digitalmente en 3D. La reconstrucción ha estado precedida por un enorme trabajo de recopilación de datos, reinterpretaciones, adquisiciones topográficas a través de una gran variedad de técnicas, restauraciones digitales, etc., con el objetivo de crear una simulación plausible sobre el aspecto que pudo presentar la tumba cuando se cerró, a mediados del siglo VII antes de Cristo. El objetivo final de la aplicación VR ha sido generar un sistema de comunicación utilizable en el interior de los museos, por lo que el enfoque narrativo y las metáforas de interacción han jugado un papel clave.

Palabras clave: *ETRUSCOS, RECREACIÓN DIGITAL DE CONTEXTOS ANTIGUOS, RESTAURACIÓN DIGITAL, REALIDAD VIRTUAL, COMUNICACIÓN, INTERACCIÓN NATURAL.*

1. The Etruscanning project

"Etruscanning in 3D" is a European project (Culture 2007 framework) involving a consortium of museums and research organizations from 3 European countries: Allard Pierson Museum and the University of Amsterdam (as coordinator), the CNR-ITABC in Rome, Visual Dimension in Ename, the National Museum for Antiquities in Leiden, the Gallo-Roman Museum in Tongeren; the Vatican Museum, the National Etruscan Museum in Villa Giulia in Rome and CNR ISCIMA are associated partners, mainly for scientific -archaeological consulting.

Main objectives of the project, that has been included in the european network of excellence on Virtual Museums – V-Must.Net-, are:

- International cooperation in the development of digitization and presentation techniques in order to re-create and restore the original context of the Etruscan graves,
- Digital acquisition,
- Digital restoration,
- 3D reconstructions
- Final communication of Etruscan graves and collections in museums, through innovative VR systems and multimedia. Two important exhibitions, Richness and Religion at the Etruscans – Princes and Priests, and Princesses and Goddesses, have already organized and concluded in 2011-2012 in the Netherlands (Amsterdam and Leiden), plus one exhibition in Paestum, in Italy; now we are working on new VR implementations for temporary exhibitions in Belgium and Germany, and for permanent use in Italian and Dutch museums.

The project is in progress and will last until 2013.

The project focuses on two important Etruscan tombs, as study cases: Tomba Regolini Galassi, in the Sorbo necropolis in Cerveteri, and Tomba 5 Monte Michele, in Veio.

The finds from these tombs are mostly in museum collections and the existing (empty) tombs are not always open to public. By making 3D reconstructions of the tombs and of the objects

which originally were found inside, we can re-create the archaeological context of these Etruscan tombs.

2. Virtual reconstruction of the Regolini Galassi Tomb

a. Methodological approach

A digital 3D reconstruction is not simply a digital replica of a real grave. It is more than a simple logical collection of digital objects: the VR application we are developing uses storytelling and interaction to create an experience that can bring visitors inside the ancient etruscan mind and culture. According to our approach "Virtual heritage" means the elaboration of the information associated to cultural objects that modifies their character, interpretation and value. The final goal of a virtual reconstruction is the cognitive perceptual and communicative enhancement of the cultural object that translates into a wider and deeper exchange with the visitors (FORTE, 2008). Virtual reconstructions can restitute what is illegible, contextualize what is fragmented, isolated, can put back together cultural ties essential to the cultural object. It is thus an extension and a potentiation of reality, by putting together, as it does, real and imaginary, perceptual and experiential aspects to interpretive and symbolic ones. Through it we can establish a series of relations reconnecting the cultural object to the anthropological, historical, philosophical, social and technical themes of which it is a manifestation (ANTINUCCI, 2004). Themes that are seldom brought to the attention of the public in ordinary places of cultural transmission. The "Virtual Heritage" is the information associated to the cultural heritage that is transmitted through the digital technologies.

Digital documentation and 3D elaboration are just first steps toward the reconstruction of the cultural context but they are not sufficient. Knowledge of a cultural object is an interactive process: we learn by acting on the environment and observing the way it reacts to our action. Therefore tridimensionality, immersion, interactivity, embodiment, storytelling, emotion are fundamental to the cognitive processes. Learning in such an environment takes place simultaneously both in the sensorimotor mode and in the symbolic-reconstructive one. Cultural communication should try to answer very hard questions: how did ancient people live? How were their mind and their behaviors, their activities in the territory? Which meanings and symbolic values did they attribute to places? Which are our contemporary approach and reactions towards these contents? In this way from the space the places will emerge and their specific identity.

b. The tomb: discovery and interpretative problems

The Regolini Galassi tomb is one of the most remarkable Etruscan graves, famous not only for its rich contents, but also for the many objects that show the Middle-East influence (SANNIBALE, 2008). The discovery of the tomb in 1836 was made by the priest Alessandro Regolini and the general Vincenzo Galassi, who made some reports on the discovery but they did not document methodically. The first publication on the grave was quickly prepared in 1836 and L. Grifi, together with Luigi Canina, made the first drawings (fig.1). The objects were bought away from the tomb immediately after their discovery (COLONNA, DE PAOLO, 1999). Despite the fact that many scholars have studied this grave, some mysteries on the outline, confusion on the place of the objects and the interpretation of the whole setting of the grave goods remains. This explains the many different, often contradictory reconstructions that were subsequently published. If we compare the two drawings by Grifi and Canina with the actual situation (fig. 2), we see that none of the drawings was made really inside the tomb: none of the drawings represents for example the ceiling properly. The drawing of Canina represents a bit better the real tomb and represents better the real size of the objects. The big difference however is that Canina shows more objects than Grifi (HUPPERETZ et al., 2011).

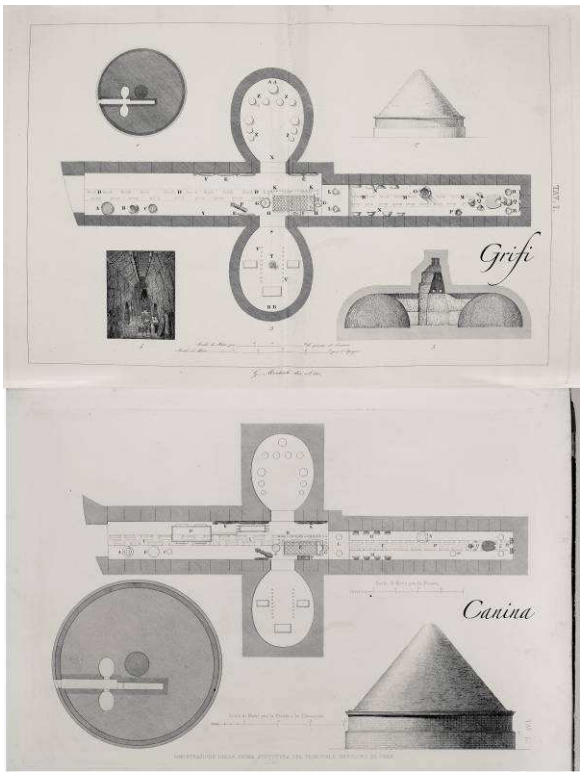

Figure 1. Ground plan by Grifi (1841, above) and Canina (1846, below)

As the process of virtual reconstruction of the Regolini Galassi grave tries to visualise this tomb at the moment it was closed (half of the VII century BC), we need to recompose the original set up of the objects and their ancient aspect, virtually restoring their shape and color (without touching the physical objects). We have had to re-evaluate and re-interpret all of the available sources in order to seek answers to difficult questions and make plausible hypothesis regarding the placement of the objects and their original position (PARETI, 1947). That's why 3D reconstructions can be useful both in the interpretative process and in public presentation. In order to use 3D reconstruction in a transparent way, we have realized a blog (http://regolinigalassi.wordpress.com/) in which we try to explain the main steps we have applied in interpretation process, showing the uncertainty in the reconstructions, and securing the data, and, finally, to enable and facilitate multidisciplinary research. The original tumulus, built in the 7th century BCE, was covered by a second tumulus, formed during the 6th century BCE, allowing for the construction of additional tombs, which were

probably meant for descendants of the same family. These peripheral tombs, though more vulnerable to tomb robbers, have protected the more ancient tomb inside from inevitable plunder.

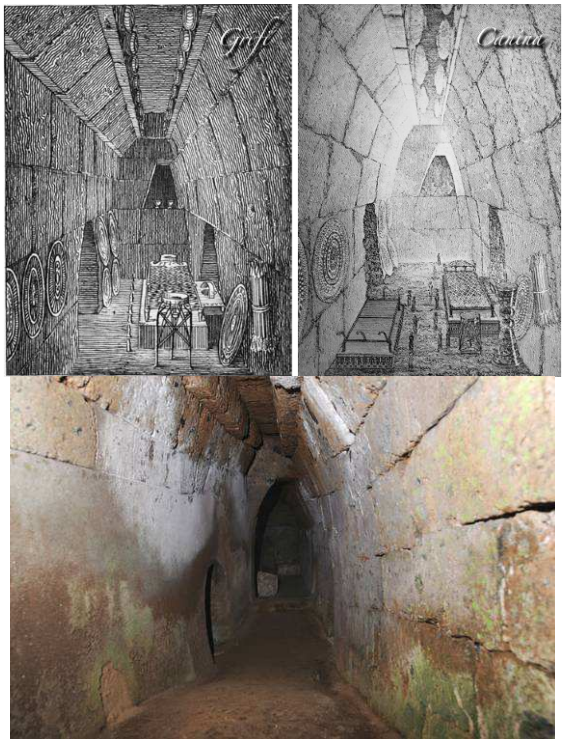

Figure 2. The Antechamber: Grifi (1841, up-left), Canina (1846, up-right), today (below)

The tomb has a short *dromos* in the form of a narrow corridor constructed of rectangular blocks and was plenty of funerary bronze and iron objects. A wall with a small window enclosed the main chamber at the end of the tomb where the princess was buried dressed and surrounded of marvelous golden jewels and silver artifacts. There were also two side chambers, oval in shape, which have been dug into the tuff. In the right cell the cremation remains of the man (probably a warrior) were put in a cinerary urn. In its construction, half of the tomb height was excavated from the naturally surrounding tuff, while the other half was built using square blocks to form a false roof in a wedge shape.

c. Digitization

The project has been developing through a complex methodological approach; from the collection of existing data, to new topographical digital acquisition. Several ontologies of data have been acquired and elaborated, according to the typology and topology of the artifacts, including point clouds from laser scanner, photogrammetric data (dense stereo matching), and computer graphics.

A "time of flight" laser scanner (*Riegl z390i*) was used to acquire the tomb in 3D as point clouds with high resolution (6 mm) and maximum accuracy of 2-3 mm. The 3D point clouds were aligned through the use of targets and successively processed in order to obtain surfaces. The mesh model was textured using the ortho-photomosaic obtained from digital photos. From the high resolution geometries (8 million polygon), normal maps have been calculated and applied to a low poly version of the tomb, optimized for the real time engine using natural interaction interface. Moreover, from the 3D model of the tomb as it exists today, we have expanded upon the model to present the tomb as it could have been in Etruscan age; with the objects contextualized inside, based upon historical sources and archaeological interpretation (fig. 3).

Figure 3: 3D model of the Regolini Galassi tomb and re-contextualization of the grave goods. In this image, captured from the VR application, we can see the final chamber with the buried princess.

The objects found within the tomb were digitally acquired at the Vatican Museums. We obtained some existing photos from the photo-library of the Museums, but we had to supplement this documentation by taking new photos of the objects, getting them out of the showcases. The museum did not allow us to use any other equipment, such as a laser scanner. We used a turn table in order to take photos all around each object (about 36 photos for each object); occasionally the photographer moved all around the object that remained still. As almost all the object are in bronze, silver, or gold, we needed to avoid reflections of the light, so we used a white tent to contain the object and the turning table (fig. 4).

This acquisition technique was useful both for 3D modeling made by hand, using 3D Studio Max (fig. 5) and Blender, and for dense stereo-matching techniques, using Autodesk Photofly/123D Catch, Photoscan and ARC3D Web Service. The first software seems to give best results in the dense stereo-matching process. In some cases, we also obtained good sequences for stitched panoramas.

On the base of photo interpretation and especially of the iconographic comparisons and similarities, we started the work of digital restoration on the deficient objects and decorations. Drawings in grey scale were elaborated upon in order to use them to generate normal maps and apply them to the 3D model inside Unity 3D; the real time graphic engine we used. The process of digital restoration was followed and verified, step by step, by a staff of external experts (figs. 6a-6b).

The editing of the final material and shaders was made inside Unity 3D. In fact, the great potential of the latest generation

video game engine, in terms of an editing tool, has completely changed the traditional work pipelines: in the past we used to finish and optimize the quality of our 3D models inside 3D graphic software (3D Studio Max, Maya etc.), finally exporting them into the real time engine where they were directly managed at programming level. On the contrary, the actual engines have many editing tools that allow complex lighting calculations, generate normal maps and edit the materials and shaders, in order to have full control over the final result of the visualization.

Figure 4: Objects digital photographic acquisition in Vatican Museums with turning table and a white tent

Figure 5: golden fibula reconstructed in 3D (manual modelling)

d. Storytelling and final VR implementation

The digital reconstruction of the Regolini Galassi tomb has been implemented in a VR application using natural interfaces of interaction, that means that the user moves and interacts in the 3D space through the body movements, without using any traditional device (mouse, joystick, keyboard etc.).

The public has the possibility to explore the virtual tomb, to get near the artifacts, to listen to narrative contents from the voices of the prestigious etruscan personages buried inside to which such precious objects were dedicated. The princess and the warrior speak not from the past but from today, knowing our world, but nevertheless seen from their point of view as Etruscans. So they still speak as rulers of an Etruscan city-state, with aristocratic authority, but open and welcoming the people at the exhibition, just as they have welcomed so many people in their lifetime. Their point of view is that they indeed enjoy the afterlife; they keep on living so many years later, through the scientific research, the publications, the museums and exhibitions. They look upon us and how we deal with their culture, not giving away the secrets that we still haven't unravelled. The underlying message is the role of heritage and how much this Etruscan heritage has contributed to our society of today (alphabet, holy water, afterlife, symbolism …).

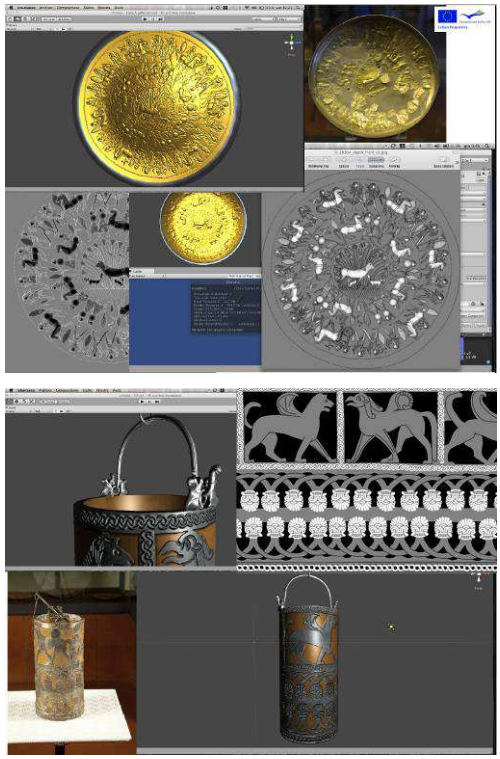

Figure 6a – 6b: examples of digital restoriation: situla (above) and golden phoenician patera below

The storytelling is used in non linear way, for interactive experience. The user walks on a real map of the grave placed on the floor, onto which some "hotspots" are attached. Changing his position from one hotspot to another, he also moves in the virtual space, going deeper into the tomb, closer to the objects and prompting the voices of the two characters to emerge.

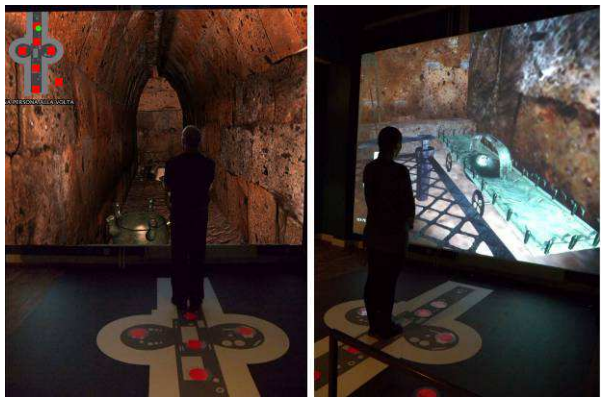

Figure 5: VR installation in Allard Pierson Museum, Amsterdam and at Archeovirtual in Paestum (2011, photo by Bartolomeo Trabassi).

The order in the choice of the hotspot activation is free, so every sequence can be activated. This solution not only makes the interaction amazing for the public, but allows people of every age and every "technical" skill to enjoy the virtual contents. The detailed description of the VR application and the research activity realized in the domain of natural interaction in the virtual space is not a subject covered by this paper.

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