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# Virtual Acropolis. Digital recreation of a Sicilian Archaic sanctuary

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## Resumen

*Este artículo trata de un proyecto de reconstrucción virtual integral de un sitio arqueológico, el santuario arcaico de Sicilia en la acrópolis de la Montaña de Polizzello. El programa de investigación, denominado 'Virtual Acropolis' se ha desarrollado con el fin de permitir que la experiencia de visitar un entorno 3D reconstruido de forma completamente interactiva e inmersiva en un paisaje realista. Es una visita que es imposible realizar hoy día a causa de los trabajos de restauración aún en curso. Para mejorar la hipótesis de los arqueólogos acerca de los rituales y las actuaciones que se llevaron a cabo en el santuario, todos los objetos votivos y las ofrendas fueron recreados digitalmente y situados en su posición original. Un avatar de un adorador se usa en el modelo interactivo para experimentar cómo era un día cualquiera en este santuario arcaico. Tal recreación ha sido posible gracias a la ayuda de las fuentes arqueológicas y literarias recogidas. Además, la aplicación de esta técnica representa la frontera más reciente en las políticas dirigidas a la promoción del patrimonio cultural y arqueológico.*

**Palabras Clave:** RECONSTRUCCIÓN VIRTUAL, BLENDER, AVATAR, POLIZZELLO, SANTUARIO ARCAICO

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## Abstract

*This paper deals with a project of virtual reconstruction of an entire archaeological site, the Sicilian Archaic sanctuary on the acropolis of Polizzello Mountain. This research program, called 'Virtual Acropolis' has been developed in order to allow the experience of visiting an interactive and immersive 3D environments reconstructed in all and set in a realistic landscape. A visit that in the reality is currently impossible due to the still ongoing restoration works. For improving the archaeologist's hypotheses about rituals and performances that were carried out in the sanctuary, all votive objects and offerings were digitally recreated and located in their original position and an avatar of a worshipper was implemented within the interactive model in order to directly experience, thanks to the archaeological and literary sources collected, how was one ordinary day in an Archaic sanctuary. Furthermore, the application of this technique represents the more recent frontier in the policies aimed to promotion of cultural and archaeological heritage.*

**Key words:** INTERACTIVE 3D MODEL, BLENDER, AVATAR, POLIZZELLO, ARCHAIC SANCTUARY

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## 1. Introduction

The current importance of Computer Graphics in the four main steps of the archaeological research - field work, recording, interpreting and dissemination of results - is currently indisputable and it is gradually recognized by more and more scholars. If during an excavation its application is restricted to use of laser scanners and 3D GIS, where archaeologists are just 'users' of technologies made available by the research efforts of computer scientists, in the cognitive moment of decoding ancient data and in subsequent phase of encoding and simplifying them, research strategies and goals of archaeology and computer science coincide (EVANS, DALY 2006).

A significant example of this synergic approach is represented by the case study of the Sicilian Archaic sanctuary on the Acropolis of Polizzello Mountain, analyzed by the scholars of 'Archeomatica Project' of Catania University ([www.archeomatica.unict.it](http://www.archeomatica.unict.it)), a research program of digital archaeology (ARCIFA et al. 2010, GALLO et al. 2010, GALLO et al. 2011, SANGREGORIO et al. 2008, STANCO, TANASI

2008, STANCO, TANASI 2009, STANCO et al. 2010). Occupied between the 10<sup>th</sup> and the 4<sup>th</sup> century BC, the site of Polizzello reached its climax in the Archaic period (7<sup>th</sup> -6<sup>th</sup> century BC), when the indigenous community built on the upper part of the Mountain, the so called Acropolis, a huge sanctuary composed by a complex system of precincts where indigenous deities were worshipped according to Greek customs. After a massive campaign of excavations, which unearthed most part of all the buildings of the Acropolis, the 'Acropolis Archaeological Park', scheduled to be open, remained closed to the public due of logistical problems.

For this still standing reason and also because some structures are buried and not yet brought to light, the team of Archeomatica Project decided to carry out a research program of digital archaeology, called 'Virtual Acropolis', aimed to virtual version of all the buildings of the Acropolis in the same preservation conditions as at the time of the discovery.



Figure 1. The Acropolis during the excavation.

## 2. Archaeological context

The indigenous settlement of Polizzello Mountain in the territory of Mussomeli (Caltanissetta, Sicily) is situated on the top of an 877 m high, precipitous mountain that is almost completely encircled by the valleys created by the watercourse of two tributaries of the Platani River. Strategically located in the very core of central Sicily, Polizzello represented the most important indigenous site that maintained a political and cultural independency to the influences of Greek colonies. In this perspective the evidence coming from the cult place on the upper part of the Mountain, the so called Acropolis, is currently the best example known so far of Archaic sanctuary in which non-Greek religious rituals were performed by native communities. Explored through several campaigns between 1984-1996 and 2000-2006, the Acropolis restituted five circular buildings interpreted as open shrines (Sacelli), A, B, C, D, E, and partially enclosed by a low wall, called *temenos* (Figure 1). Furthermore, on the central part of the plateau, a large and low rectangular precinct, probably used for keeping cattle, called building F, that contained traces of animal sacrifices, feasting activities, and pottery depositions, was unearthed.

The two well known buildings are A and B. They basically were circular or irregular precincts with entrance to the south, with elevation walls made of stone blocks in double curtain technique and paved with pressed earth floors. Inside several pieces of complement furniture were found as altars, hearths, and benches. Of great importance were the two buildings at the northern end of the acropolis, A and B, that performed different functions in the religious liturgy of the sanctuary activity. Building A, with a diameter of 8 m, probably kept the wooden statue of the deity, now disappeared, set on a rock base at the center, to which were offered votive gifts like vessels, iron weapons, and amber and bone beads, dated to the mid 7th century BC, accompanied by traces of animal sacrifices. The building B, built shortly after A and partially leaning upon it, with a diameter of about 10 m, was the real treasure of the sanctuary, where all offers to the gods, the most valuable and varied, were kept at end of ceremonies that involved community meals and libations. Inside it, a pressed earth floor, a hearth, a circular bench running along the walls, a recess and an altar were revealed. The circular bench may have been used as seating for the participants in the rites, while the recess seems to have been used to isolate and hold specific depositions. Seventeen deposits of a total of 193 objects of the 6th century BC were found on the floor, simply placed and not hidden or covered, mostly in the northern part of the building, including indigenous vessels, Greek craters and cups, clay figurines and models, metal items

such as iron daggers, spearheads and sickles, bronze arrowheads, ornaments such as bracelets, finger-rings, chains in bronze a multitude of ivory, amber, and bone beads related to jewelry items. Very prominent is also the evidence of building E, found in the north western part of the acropolis, close to building A. Its 14.70 m diameter and megalithic construction technique is unique in Sicilian contexts, and it must therefore have been a structure of fundamental importance within the sacred area. This huge building may have been used at least through three different phases: in the second half of the 8th century BC, at the beginning of the 7th century BC, and between the end of the 7th and the beginning of the 6th century BC.



(a)



(b)

Figure 2. (a) The 3D model of the votive deposition no. 6 in building B; (b) the 3D model of the bronze helm found in building B.

The sacred area represented by the central part of the acropolis, during the 8th century BC, was partially enclosed by the low and wide precinct wall of eccentric shape, the *temenos*, well preserved along the eastern and northern slopes. It was made with stone blocks in double curtain technique, with a constant width of 1.50 to 2.50 m. Totally obliterated on the western and southern sides,

as a result of the slip of land and weather agency, it probably included a monumental entrance on the north side in front of building A. Along its east side, the *temenos* was modified by the adjunction of a small rectangular ambient, later in chronology, Room III, partially built and excavated inside of it. Contemporary to Room III are two House belonging to a residential quarter, dated back to the end of the 5th century BC, namely the Temenos House, adjacent to the *temenos* wall, and the East House, in a smooth plain in eastern slope. The two buildings reflect the construction techniques of Greek Sicily and have such characteristics that they can be intended as part of a workshop district still partially unrevealed. The construction technique shows large rectangular blocks with two courses and a flat roof with tiles. Within the rooms, rolled on the floor by the collapse of the ceiling, was found sets of pottery and objects, such as between transport amphorae, table wares, cooking pots and storing jars, and especially some large mortars for grinding olives.



Figure 3. Virtual reconstruction of the Acropolis.

### 3. 3D modeling and archaeology

Archaeological 3D modeling is basically the recreation of landscapes, architecture, and objects by digital means based upon the current state of the salvaged monuments integrated with the data coming from historical and archaeological researches using software for developing 3D models (MARGOUNAKIS 2008), without the application of reverse engineering methodology. It is probably the most popular computer-based technique applied to cultural heritage as it represents the core of the “serious games” used in many multimedia projects (ANDERSON et al. 2009). The archaeological 3D modeling is not just a simple cognitive tool to reproduce virtually aspects of the past, like objects of everyday life, to improve the knowledge and the comprehension. It is also, above all, a methodology of recording all the archaeological data in a much more complete way than the traditional photography and drawing and it is also an instrument of interpretation for the researchers who are involved in the theoretical reconstruction of the past itself. From this point of view, it is a kind of virtual benchmark of the archaeologists’ theories where the hypothesis is tested and corrected in order to produce a truthful image of something buried by time. A kind of “solid modeling to illustrate the monument” becoming “solid modeling to analyze the monument” (REILLY 1992). For this reason, the privileged

application field for this technique is the archaeological research, where, the scarcity of iconographical sources and the poor state of conservation of the findings, makes extremely complex both the process of decoding the information and of transmitting the knowledge to the public.

The large amount of documentary data collected during the excavation about buildings, artefacts and their setting in the landscape offered a unique opportunity to attempt the developing of an overall virtual reconstruction of the Archaic sanctuary, in order to allow the experience of visiting an interactive and immersive 3D environments reconstructed in all and set in a realistic landscape.

A visit that in the reality is currently impossible due to the still ongoing restoration works causing to the Acropolis archaeological park to remain closed to the public for several years. For improving the archaeologist’s hypotheses about rituals and performances that were carried out in the sanctuary, all votive objects and offerings were digitally recreated and located in their original position (Figure 2) and an avatar of a worshipper was implemented within the interactive model in order to directly experience, thanks to the archaeological and literary sources collected, how was one ordinary day in an Archaic sanctuary. In this perspective must be considered the scientific importance of this project. In fact the technique of 3D modeling in the case of the acropolis of Polizzello gave two completely innovative and extremely significant achievement, to augment the cognitive ability of the archaeologist: the promoting of an archaeological site and the monitoring of its conditions of degradation. Moreover some of the buildings, the oldest discovered in the exploration, were buried and not yet brought to light, so it was decided to create a virtual version of all the buildings of the acropolis in the same preservation conditions as at the time of the discovery. The ‘Virtual Acropolis’, thus, allows the experience of visiting an interactive 3D environment (Figure 3).

For the development of this project, the researchers of the Archeomatica Project have chosen Blender ([www.blender.org](http://www.blender.org)) as a work tool, an open source cross-platform software for modeling, rendering, animation, post-production, creation, and playback of interactive 3D contents, extremely versatile, functional, and constantly open to implementations based on the research of its application in various fields. Where it was necessary for particular issues, image-based 3D modeling techniques, which consist in the elaboration of a 3D model from a set of high quality digital photos, have also been used (REMONDINO, EL-HAKIM 2005, VERBIEST et al. 2005).

### 4. Multi-layered interactive 3D model of the Archaic sanctuary

The first goal achieved with the Virtual Acropolis project was to overcome all the traditional documentation methods of the many phases and chronological stages of a multilayered site like this, through color plant phase, with the creation of a multi-layered 3D model, where all monumental evidences are organized into 4 temporal phases that summarize the history of site between the 8<sup>th</sup> and the 4<sup>th</sup> century BC (Figures 4 and 5). In this way it’s possible to focus better on the detailed evolution of the sanctuary and highlight the major functional difference of the last phase of the end of the 5<sup>th</sup> century BC. In this way it’s possible to focus better on the detailed planimetric evolution of

the sanctuary between the 8th and 6th centuries BC and highlight the major functional difference of the last phase of the 4th century, that was only residential. With this methodology the overall development could be integrated with the architectural features of a single building, like building E, which itself has undergone many complex transformations. Finally, only for the last phase, for which the evidence revealed during the excavation was particularly significant, it has been possible to propose 3D models of how original buildings had to be, even on the basis of other evidence known from contemporary and historical sources, both for what concerns the structural data, the pottery, and objects that were used in everyday life.

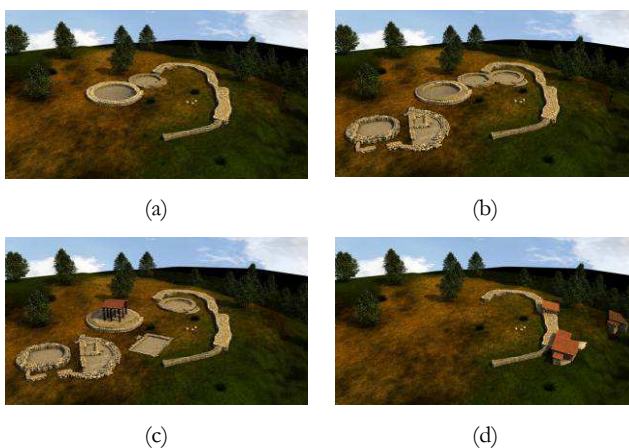


Figure 4. Multilayered 3D model of the Polizzello Acropolis: (a) phase I, half of the eighth century BC; (b) phase II, from the half of seventh to the beginning of sixth century BC; (c) phase III, end of 6th century BC; (d) phase IV, between the end of 5th and the beginning of 4th century BC.

## 5. Future Works

Since the future of virtual archaeology and of its applications in the field of research and promotion of archaeological goods seems to be linked in an unavoidable way to the evolution of augmented reality (AR) environment (MILGRAM, YIN 2006), the next phase of this project will be the development of an AR platform usable via mobile devices as smartphones and iPhones.

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This will take the virtual experience to the next level of immersiveness, allowing large public visiting in the future the Acropolis archaeological park to explore simultaneously an *en plein air* virtual museum of the Acropolis. In conclusion, the encouraging results of the application of the computer graphics 3D to the archaeological evidence has demonstrated that it is possible to use another “sense” to decrypt the traces of the past: three-dimensional recreation of ancient life and visual images are extremely effective in explaining the past because they allow us to experience it.

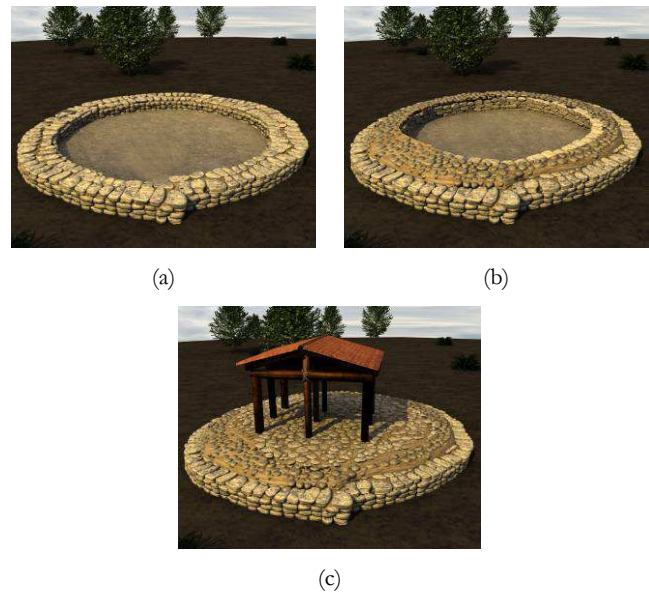


Figure 5. Building E: (a) phase I, second half of the 8th century BC; (b) phase II, beginning of the 7th century BC; (c) phase III, between the end of the 7th and the beginning of the 6th century BC.

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