A mythological tale lived again through the virtual reality

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ABSTRACT

The Edutainment approach could be the model to develop a new generation of VR applications for cultural heritage. In this way it could be possible not only to make the virtual experiences more attractive, but also more rich of historical and cultural contents.
In this paper we describe the first steps in the development of an application that would join the edutainment approach and the virtual reality technologies in the cultural heritage field. This application is inspired to an episode of the Herakle's life in which the user plays this legendary hero during his arrival at Kroton, and relives the events that drive him to make and consecrate a temple to Hera at Lakinion promontory (Capo Colonna), near the city. This approach allows us to improve the exploitation of the archaeological site of Capo Colonna, giving to the user the possibility to acquire the historical and cultural context related to the Lacinian's Heraion and the relations between the myths of Herakle and the territory of Kroton.
The techniques employed to create a realistic reconstruction of the site and to combine the game sequences with the learning of historical facts will be presented. And some of the problems related to the implementation of these techniques will be also described.

INTRODUCTION

The virtual reality (VR) has been already employed, with excellent outcomes, in the cultural heritage field. A virtual heritage application should not be limited to a simple walkthrough experience, but it is necessary that the users could navigate into the reconstruction of archaeological sites in an interactive way, receiving appropriate information. A further improvement is the possibility to integrate some entertainment elements in the application. So the virtual experience becomes a learning moment in which the user learns history while playing. In fact the importance of playing in the learning process is well known for psychologists and experts in education. The Edutainment approach could be the model to develop a new generation of VR applications for cultural heritage. In this way it could be possible, not only to make the virtual experiences more attractive, but also more rich of historical and cultural contents.
The classical mythology presents a lot of opportunities for the knowledge of the archaeological areas through the articulation of narrative elements. The study of the evidences makes it possible to propose an interactive experience to live again the mythical stories putting them in relationship with the reconstructions of plans and structures in the archaeological sites. So the user will be able to know the genesis of a particular myth in relation to the archaeological context.
Obviously, the VR and the game elements have not to compromise the accurate reconstruction of the archaeological sites, because the user needs to know what has been found in the site and what has been reconstructed with the suppositions of the archaeologists.

1. STATE OF THE ART

The virtual model is really a valid cognitive tool, able to communicate the nature of the finds, and it is a fundamental medium by which a user (scientist, student or simply a fan) can interact with the finds already classified and reconstructed. The pioneer in virtual archaeology has been Reilly (1990), who has invented this term. After him, many researchers have investigated the capability of applying virtual reality to archaeology, for its feature of interactivity, for its ability of visualization, and for its nature of being an interesting tool for education and for analysis purpose.
There have been many trials to use the virtual reality in archaeology (Barcelo *et al.*, 2000), but in most cases the possibilities to interact with the system are limited to the exploration. The possibility to employ video games technologies is under investigation, in order to improve the interactive learning and for research purposes (Meister and Boss 2003), (Anderson, 2003).

2. THE RECONSTRUCTION OF THE LAKINION PROMONTORY

The first step of our work has been the reconstruction of the Lakinion promontory. Considering some bibliographic

references (Spadea, 1996, 1997), (Guerricchio, 2001), (Giangiulio, 1982), (De Sensi Sestito, 1982), (Genovese 1999, 2000) we have supposed that, in the V century b.c., the distance between the coast and the temple was about two kilometres. Now the temple, due to the erosion of the sea, is at few meters of distance from the sea on a promontory at fifteen meters above sea level, so we had to recreate the ancient morphology of the coast. Starting from the map of the current profile of the coast we have modified it, adding the eroded part. The territory has been modeled with the height map technique that allows us to define the Digital Elevation Model or, in other words, the height of the land proportionally to the gray level of a picture.
The texture of the ground has been distributed on a polygonal surface using a planar projection. Several images of sand, grass and rocks has been used to realize it. These have been disposed according to the morphology of the ground. Two different textures have been employed: one for the entire model and another one more detailed for the temple area. The alpha channel is employed to make the texture borders smoother.
The simulation of natural elements is an important and actual topic in the computer graphics field and also for the Virtual Heritage applications. The problem is to get a realistic effect in real time. The rendering technologies of the videogames graphics engines allow us to achieve this important objective. The complex surfaces like that one of the sea have always been an hard topic for Computer Graphics. Reflection, transparency, refraction, combined with the motion of the waves, represent a huge work-load for the graphics card. The method that we have employed allows us to obtain a very realistic result without requiring top-notch hardware resources.
The first element of the environment that we have modelled is the sky, and for its realization six textures with the cube mapping technique have been employed. The sea has been modelled using 3 different textures on a semi-transparent planar surface. The first one is an animated texture that simulates the waves, the second one is also animated and is used for Bump-Mapping and the third one simulates the reflection of the sky with the Environment Mapped Bump-Mapping. The different textures have been merged thanks to the Multi-texturing technology.
Finally a directional light has been used to simulate the specular reflection of the sunlight on the sea.

3. A WALK-THROUGH APPLICATION TO ENJOY THE RECONSTRUCTION OF THE HERA TEMPLE

After the modelling phase we have started to make the application interactive. Our first step in this direction has been the implementation of a walk through application in which the user can explore the area around the temple through a first person point of view. This application can be enjoyed on a Virtual Reality system based on the passive stereoscopy that allows the users to perceive the depth of the scene wearing a pair of polarized glasses. It has been used both on a front projected screen with an audience of ten-twenty people and on a retro-projected screen that allows the user to stay in front of the screen without projecting its shadow over the screen.

4. MOVING TOWARDS AN EDUTAINMENT APPLICATION

After the realization of the walkthrough application we have started to approach the main aim of our research, which is the development of an edutainment application in which the user interaction is not limited to the exploration of the archaeological site.
The application is inspired to an episode of the Herakle's life in which the user plays this legendary hero during his arrival at Kroton, and relives the events that drive him to make and consecrate a temple to Hera at Lakinion promontory (Capo Colonna), near the city. This approach allows us to improve the exploitation of the archaeological site of Capo Colonna, giving to the user the possibility to acquire the historical and cultural context related to the Lacinian's Heraion and the relations between the myths of Herakle and the territory of Kroton.
The mythological tale that inspires the application has been reported by Ovid. He narrates that Herakle, coming back from Spain after his 10th fatigue, arrives in Brettia (today Calabria) with the herd of oxen which he has stolen from Geryon. Herakle is a guest of Lakinion and Kroton chiefs of the local tribes. Lacinio tries to steal the herd of oxen, but Herakle, fighting against Lacinio, kills Kroton by mistake. Kroton is buried on the bank of the river Esaro and Herakle, to expiate his guilt, builds a Temple dedicated to Hera.
The story board of our application is based on the following steps:

- An Initial video sequence in which Pythagoras explains the historical background of the events.
- A Game sequence in which the user impersonates Herakle while he is conducting the oxen, defending them against the attacks of the beasts.
- A Video sequence that introduces the user to the next step.
- A Game sequence in which Herakle fights against Lacinio.
- A video with the ending of the tale.

The first step in the development of the application is to model the characters (Herakle, Pythagoras, Lacinio, Kroton, the oxen and the beasts) and to animate them. The 3D models of the characters have been realized in 3D Studio

accordingly to the historical and mythological facts. Eracle, for instance, has been modelled wearing a head of lion, the oxen with the red skin, etc. Several animations of each character (like walking, jumping, fighting) have been created with Character Studio, a software that allows modeller to create animation for humans and animals without particular efforts. The most complicated step in the creations of the characters has been the porting of the animations from Character Studio in Virtools which is the Toolkit that we have used to develop our application. Virtools easily allows the programmers to define the behaviour of a character through the construction of a functional scheme with some building blocks that represent the various behaviour functionalities. Some examples of these functionalities are the so called "object keep on floor" that allows the character to follow terrains variations and "object sliding" that prevents the character to penetrate inside other objects. Other functionalities can be used to improve the aesthetic of the application like shadow casting.
With an advanced use of the behaviour functionalities of Virtools, also the fighting and other game sequences have been implemented.

5. CONCLUSIONS AND FUTURE WORKS

The results obtained with this work demonstrate that the rendering engines, used in videogames, allow us to obtain an excellent graphical quality and a greater level of realism compared to the other approaches used in the field of the cultural heritage applications. The advantages of the videogames engines are not only limited to the visualization performance, but also regard the possibility to implement interactive elements that satisfy the requirements of an application in which the game and didactic aspects have to be reconciled. Therefore the reconstruction of the archaeological site assumes a role of remarkable importance. It must be realized in a careful way, to allow the application to run at an acceptable frame rate and to guarantee a good graphical quality. For this aim the use of models composed by few polygons, a proper choice of the textures to enrich the details of the objects and the use of techniques like shadow maps are essential.
In the future we are planning to organize some tests with various focus groups in which the effectiveness of these techniques and, particularly, of the edutainment approach will be evaluated.

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FIGURES

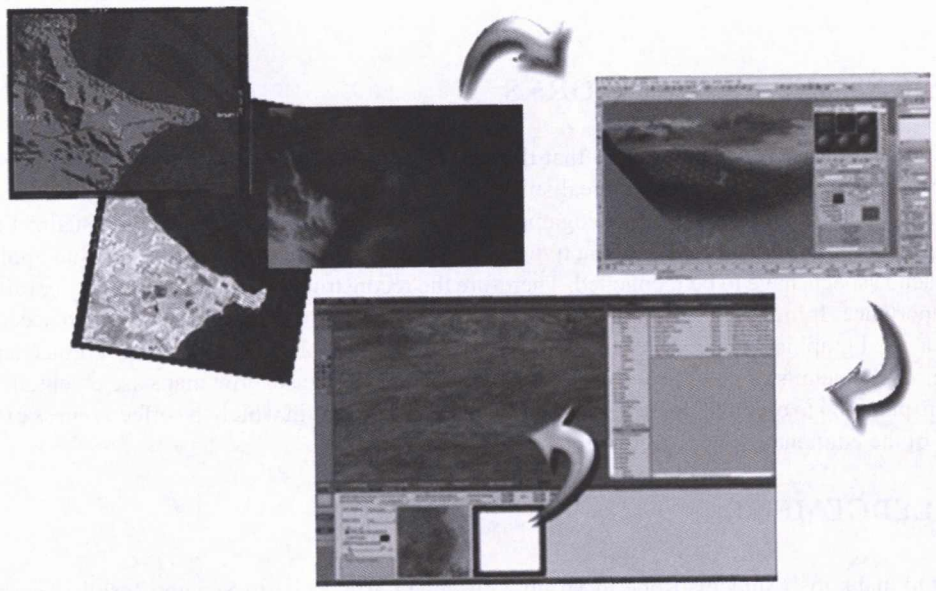

Fig. 1 – In this picture it is possible to observe the phases of the realization of the 3D territory model. The first picture represents the present day morphology of the Crotonese coast (satellite view). On the lower picture there is the 3D territory model enriched by texture (step 1), as a simple polygonal surface (step 2), in wireframe mode (step 3). At the bottom we can see the detail difference between the textures used to improve the terrain quality in proximity of the archaeological site

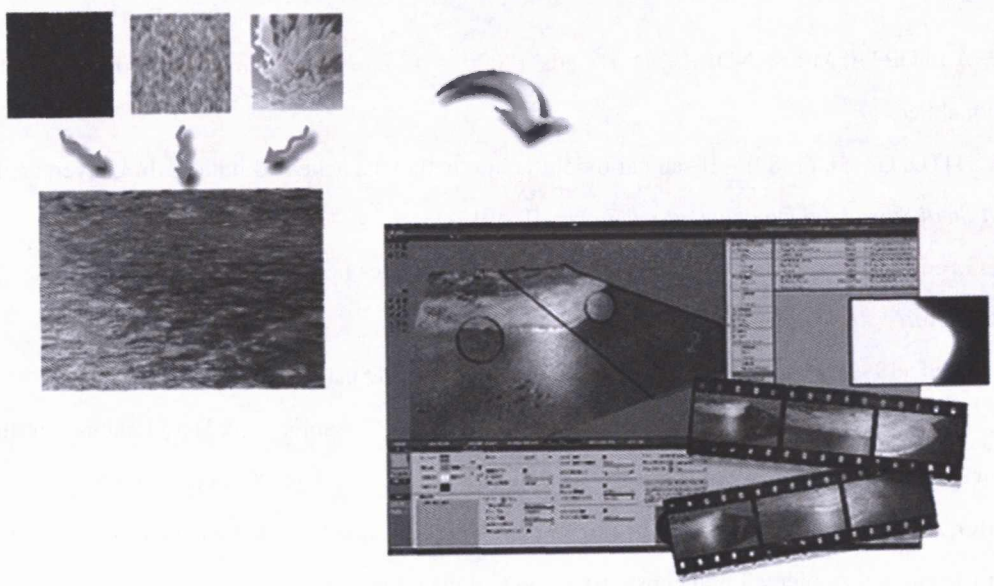

Fig. 2 – On the left we have three different textures used to model the semi-transparent sea surface. On the right the photorealistic effect resulting at the end of modelling process is shown. In fact in the zones marked by number "1" the alpha channel has not been employed and we can perceive a sharp visual change near the intersection zone between the sea and the coast. In the zones marked by number "2" the alpha channel has been employed and we can see the gradual shift from a transparent colour to a more intense one as the sea goes deeper.

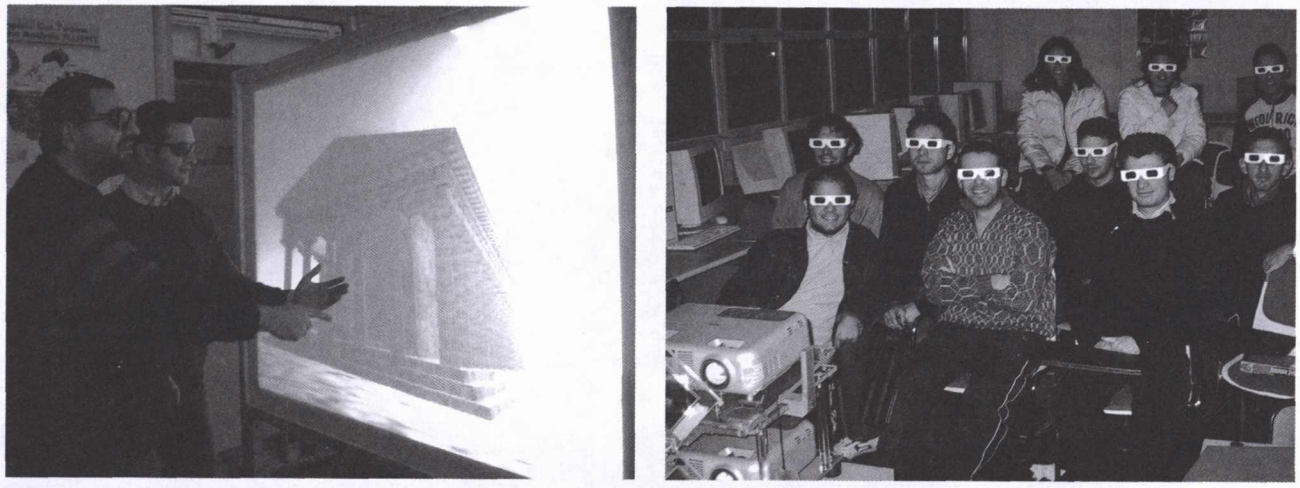

Fig. 3 – The passive stereoscopic system employed with the walkthrough application. It has been used both in retro-projection (left figure) and in front-projection (right figure).

Fig. 4 – Some screenshots of the applications showing the quality obtained with the natural elements (sea, sky and vegetation), the reconstruction of the temple, Eracle with the oxen in a game sequence, Pythagoras while narrates the introduction of the tale.