

GAME EMBRACE SIEGECRAFT IN "PROTECT THE WALLS!"

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Abstract

Demonstrated during the Digital Heritage Expo in Granada, Protect the Walls! is an educational project that deals with the technology and tactics of siege of the 4th century BC. It was conceived as a serious game in order to facilitate enjoyment by younger persons, while maintaining its scientific validity and historical reliability. It is a multi-sensory stereoscopic experience aimed at transmitting cultural content not in a descriptive manner but looking for emotional involvement by the public. During the game experience, the user gets to know the ancient war machines and the strategies of attack and defense in a siege, the architectural characteristics of the towers and the city walls of Paestum (once called Poseidonia). The dramatic storytelling of Protect the Walls! is also developed through a short but spectacular introductory movie, completely realized in CG. The game runs in a VR environment and requires gesture based interaction to be played.

Keywords

Serious Game, Virtual Archaeology, 3D Graphics, Natural Interaction, Crowd Simulation

1. Innovation

The topic of innovation is a key theme for Protect the Walls!

It covers several aspects of this really challenging project. The most obvious among these is probably the choice of the context for the fruition of the application. In fact, the visitor has the privilege to relive the Macedonian siege to the ancient walls of Poseidonia being in the very same place where the siege was suffered in 332 BC by Lucanians people, that is inside the fortified walls of the actual city of Paestum.

This strong element of contextualization has the power to amplify the evocative effect of the reconstruction, strengthening the emotional and immersive component in the whole experience for the viewer and creating a powerful connection between the place and the visitor.

Another strong factor of innovation in Protect the Walls! is the attempt to spread historical/scientific information within a game of pure action: an Arcade game, we could say (Anderson, McLoughlin, Liarokapis, Peters, Petridis, & de Freitas, 2010). The player is motivated to hold these information as they're provided in the form of hints that are essential to his survival during the experience of the game (Salovey & Sluyter, 1997; Antinucci, 2004).

Also in terms of communication and languages, the project aspires to be highly innovative.

The narrative contents in the introductory video are entirely built upon "voice-off" dialogues with a strong cinematographic flavor attached to them, joined with a theatrical staging due to a persistent still shot on an open field that operates just as an animated theatrical backdrop.

Even from a strictly technical point of view, Protect the Walls! contains a number of innovative aspects. The game, that requires gesture - based interaction in order to play it, makes the most of the crowd animation tools to create, animate and characterize the army of the besiegers. Enemy soldiers perform their actions taking them randomly from a broad range of possible actions previously set by the 3D animators. They are capable of making decisions and behave accordingly to them during the simulation.

Also, during the gameplay of Protect the Walls!, real-time graphics and pre-rendered sequences are combined in order to provide a believable crowd simulation, without weighing too much on the performance of the hardware resources dedicated to the task of the application execution. In this way, the game experience can be conducted in a fluid and engaging fashion.



Fig. 1: Screenshot from the introduction movie. Soldiers coming out from the forest, seen from the tower



Fig. 2: Screenshot from the introduction movie. Soldiers in the battlefield using the ancient war machines



Fig. 3: Screenshot from the introduction movie. The soldiers loading an Oxybeles



Fig. 4: Last frame from introduction movie. The enemies start the attack against the wall

2. Concept

Protect the Walls! is a serious game (Clark, 1970) that deals with the technology and tactics of siege of the 4th century BC, the war machines and the strategies of attack and defense, the architectural characteristics of the towers and the city walls of Paestum, functional to face an enemy attack at that time.

It has been realized in 2015 by E.V.O.CA. s.r.l. in collaboration with CNR, Institute of Technologies Applied to Cultural Heritage (ITABC) and Institute of Sciences and Technologies of Cognition (ISTC), with the historical and archaeological support of Fondazione Paestum, Salerno University; it has been financed by Arcus S.p.A.

The walls of Poseidonia (the Greek name of Paestum) knew the war closely, over the centuries. However today we keep a vague memory of only one episode, when the city became the base of military operations of Alexander the Molossian, king of Epirus. Shortly after 335 BC, Alexander, uncle of Alexander the Great, moved against the Samnites from Poseidonia. He conquered the city after a deadly siege that, in this application, we are preparing to relive, between dream and historical sources. It is an educational project involving the user in a multi-sensory experience.

The issue is developed through a short but spectacular movie followed by a game using gesture-based interaction, suitable for a diverse audience, particularly young people (primary and secondary schools), given the constant presence, in Paestum, of groups of students.

The installation is located on the ground floor of tower n. 27, located along the city walls of Paestum. The projection, in stereoscopy, takes place indoor, in a dark space, on a large screen (about 4x 2,30 m) on the wall directly facing the battlefield. Thus, it is configured as a large virtual window that brings the visitors directly in touch with the real environment of the site, allowing them to better understand the ancient space. The purpose of the project is to transmit educational contents, scientifically correct and plausible, not in a descriptive manner but, instead, arousing a strong conceptual and emotional involvement in the public, through a dramatic storytelling in first person. Visitors, in fact, are brought inside the action and live the scene of the siege, using the war machines (gastrophetes, oxybeles, tortoise,

mobile tower, catapults and so on) and choosing the best defence strategies. The scene has been rebuilt in computer graphics according to the suggestions given by the archaeologists and experts of poliorceticism.

Also the "soundscape" is rendered in a realistic manner, in dolby 5.1 surround, and with the noise of weapons, voices, clamours, rumblings, producing an immersive impact.

3. Introduction Movie

The introduction movie, lasting 6 minutes and 30 seconds, aims at creating the historical background, showing various weapons and tactics of siege and defense in the IV century BC with a spectacular 3D reconstruction of both environmental and movement of armies (crowd animation).

The story starts with the dialogue between two soldiers that, at dawn, are guarding over the city walls and suddenly they see, at a distance, a cloud of dust raising from the forest. They give the alarm, immediately the captain of the guard and the general arrive and evaluate the situation. Once the enemies have come out from the forest (fig.1), occupying the battlefield and preparing their weapons (fig.2-3), the captain and the general are able to dictate strategies of counteroffensive, from the top of the tower. Then the battle starts (fig.4).

The voices of famous cinema actors have been used to obtain the best emotional impact. The visitor is then asked to enter in the game and play the role of a soldier fighting on the wall, defending the city of Paestum.

4. Serious Game

The serious game has been developed in Unity 3D. The field of view and the space of the game are constant: the user is on the top of the tower and sees himself represented by an "avatar", through a fixed camera that frames the scene. As mentioned the user plays the role of the defender of the town of Poseidonia-Paestum. From the top of the tower, he must contrast the advance of the besiegers throwing arrows, stones and flaming objects from the field below against the walls. To do this, the player needs to alternate and combine, in a strategic way, two behaviors: defense and attack.

The battlements (about 2,40m high from the floor of the tower) allow the player to hide and



Fig. 5: Screenshot from the serious game. Defence action of the player

protect from arrows, stones and burning objects launched by the enemies (fig.5).

In the short pause between the enemy attacks, the player has to come out and run to activate the war machines (oxybeles and lithobolos) placed on the tower, launching the counterattack (fig.6). This is not easy because the enemy attacks are increasingly pressing and the time interval between one and other is very short.

The player, after operating the war machines, must therefore quickly return behind the battlement, so moving very quickly between the open and the protected space. To make the game harder the two war machines at the user's disposal, appear alternately for few seconds between the battlements, on the left or right side of the screen, and they suddenly disappear (alternately again) after a variable time; in this way the user cannot be sure about the direction he has to move to attack.

Some weapons are more lethal than others. The most lethal one (*lithobolos*) can kill a greater number of enemies but it is more difficult to operate (especially because it takes more time to load the stone). When the weapon appears an automatic animation shows its loading and the subsequent player's action is directly the launch.

If the player remains always protected and never attacks, he won't kill enemies, allowing

them to move forward, damaging the walls and the towers, up to break into the city. In fact, when the enemy stones impact the walls and the battlements they compromise progressively the stone blocks until they fall. Thus the defensive structures will be destroyed and the player will find himself in the open space without good protection.

After the battlements have been compromised and are no longer a sure defense, the player can still shelter himself crouching behind the wall at the base of the battlements, but his movements are clumsy and slow.

During the game the level of his energy is shown, it changes according to the wounds he received. If the user is wounded, his movements become progressively slower and slower and so it becomes more and more difficult to defend and attack. He can also die before the time is over. Beside, during the game the amount of killed enemies is shown.

The besieged and the player, are guided and encouraged by the voices of the general and the captain of the guard. This condition enhances the emotional strength of the game and allows to transfer in dramatized form some important information about the techniques of battle, the use of weapons and their danger.



Fig. 6: Screenshot from the serious game. Attack action of the player using the war machine on the tower

5. Gesture-Based Interaction

The interaction of the visitor is based on body movements not using "symbolic" gestures but natural and spontaneous ones, similar to those ones we would perform in the real world to play the same actions (running away, hiding behind the battlements, come out at the right moment, touch a lever to activate the war machine, etc.) (Varela, Thompson, & Rosch, 1991). The avatar moves inheriting the same user's gestures as they are captured by the Kinect sensor. The active user must enter in the interactive area, in front of the projection, a space about 3.5 meters wide and 2 meters long. Kinect 2.0 sensor allows to capture and track the user's movements transforming them in inputs that generate events within the virtual scenario. Running between the defense and the attack positions, the player moves along a horizontal axis, parallel to the wall projection. As a reference, this ideal line has been traced on the floor with an adhesive paper. No movements on the depth axis are required. Only one player at a time is allowed to interact, to avoid collisions between people. However the public may attend in group, easily alternating in the active experience

Each game cycle lasts 2 minutes, to encourage the fast alternation of people and thus favoring a logic of team. The player collects more points if he takes a major risks without being killed. If the user is particularly able, he can extend his time winning 30 seconds more and he will enjoy the spectacular event of the burning mobile tower in the battlefield.

6. Score

The game can be played individually or in teams. When the time is over the score of that game is shown and compared with the maximum score ever obtained and also with the best score obtained within the team with whom the user is sharing the experience. In the case of a team, the scores of all the players are summed to get the overall score.

The score is shown in a dedicated layout, where also additional educational information are provided about the ancient war machines, their constructive techniques, their evolution and their influence on the war strategies (fig.7).

7. Graphic Development

The enjoyment of the spectacular installation within the walls of Paestum is divided into two



Fig. 7: Example of Score

phases, both important and designed with the aim to enhance each other. The first phase is represented by the vision of the introductory movie (consisting of pre-rendered 3d content), the second is represented by the game experience; this is done through gesture-based interaction. The paradigm of natural interaction has the task of allowing the player to avoid all the traditional game interfaces (mouse, keyboard, joystick, game controller, etc.) to gain the control on the experience of the game only thanks to the movements of his body (Pietroni & Antinucci, 2010; Featherstone & Burrows, 1995).

From a technical point of view, several challenges have been faced to get to the realization of the pre-rendered introductory movie. The authors have used 3D tools which are usually employed in the field of architectural visualization and photorealistic rendering, with the aim to focus on the depth of the image and the overall impact of the graphic.

Moreover, the scientific implications of the project required an accurate 3D reconstruction of war machines and weapons on the basis of diagrams and drawings given by the experts of poliorceticon and siege techniques (Cipriani, Greco, & Pontrandolfo, 2015).

Particular attention was paid to the definition of vegetation and landscape. They were generated

in Autodesk 3DS Max and rendered in VRay render engine by Chaos Group. Given the massive presence of elements of vegetation, scattering techniques have been used randomly on the territory, using extensive controls on the probability distribution of the plant species and the variations in color and shape, essential to obtaining harmonic and natural results in terms of visual perception.

Another rather critical aspect has been the need to represent simultaneously several hundreds of soldiers besiegers encamped outside the city walls. This kind of requirement inevitably implies two important problems to solve for the creators of the digital ecosystem: 1) a technical problem, represented by the huge deployment of moving geometries to be rendered in a single frame of animation, 2) an expressive problem, represented by the need to diversify, misalign, randomize the actions and appearance of such a multitude of individuals, in order to get a believable and convincing crowd, free of identifiable patterns and systematic repetitions.

The system used to generate the crowd of besiegers inside the introductory movie allows to generate mass scenes of all kinds, from the organic ones (humans, birds, fishes ..) to the inorganic ones, using artificial intelligence. This system, called Golaem Crowd, works inside

Autodesk Maya and uses a number of motion clips (cyclic and not cyclic movements) created from a reference avatar and take advantage of a particle as a base to associate each character of the crowd.

The animator creates separately such movements, and a number of various objects (for example, weapons and clothing in case of a humanoid crowd) that fits in the hierarchy of the avatar. For each object, the artist creates a number of morphological and chromatic variants (working on textures and shaders) in order to assign and link them to the reference avatar.

Once developed these elements, it is necessary to give instructions to the software, to deploy, more or less randomly, in the desired space a population of heterogeneous characters.

For this purpose, a panel is used for the management of assets, the backbone of the system. Through it, in fact, the animator may determine the percentage with which an object related to our avatar will be more or less inside the crowd, the material (or the series of materials) to be associated with each part and in to what extent, the size of the bounding box relative to the area of action of the avatar from standstill, useful to avoid interpenetration among characters when everything is animated.

Subsequently, the motion clips are associated with the avatar thanks to a behavior management tool. Thanks to this tool it is possible to establish if the animations should be cyclic or not. It is also possible to modify their speed, decide in how much time breaking them to play new ones, decide if each animation has to be performed in parallel or alternatively to another, if the crowd needs to produce group actions, or if it will reach a target in the scene by walking or flying. In addition, it is possible to induce or finish an animation of one or more characters through the work of a trigger.

Once verified that everything works properly, the creation of a cache file is required so that the rendering engine, V-Ray in this case, will not have to load materials and objects in each frame. That's an operation that could be crucial to streamline the final rendering time.

The setting of stereoscopy in the introductory video was carried out aiming at a 3D effect balanced and not too "tiring" for the viewer. Close attention was paid to the management of parallel cameras within the different 3D packages, making sure that the stages of import/export of the

stereo cameras did not produce changes of view or unwanted offset.

8. Conclusions

During the initial stages of *Protect the Walls!*, the development team decided that the game was meant to be a "real" video game, aiming directly to the main category of this sector: the action video game (sometimes called "shooter"). A video game where sensorimotor capabilities are primarily engaged: fast, accurate perceptions and reactions.

And because we wanted also to get the greatest emotional impact, we made so that actions were true body actions (jump, run, grab, etc.) and not symbolic actions such as those that are made with joystick or similar devices, and that the perceptions were also the closest possible to real world perceptions.

We achieved this using a very big screen and a three-dimensional vision system. In this way the player is absorbed in something that approximates really closely the real world. Under these conditions, the effect on motivation is very high.

The motivation is so important because *Protect the Walls!* is a project addressed primarily to school children. They have a dedicated environment just inside the ancient walls of Paestum, where they participate in a team video game focused on defending the besieged city of Paestum from a deadly enemy attack.

In this way, they discover what weapons were used in the past and what were the techniques of offense and defense and, hopefully, this very close and very motivating encounter will help them to get more familiar with the ancient world.

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