A Game-Based 3D Simulation of Otranto in the Middle Ages

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Abstract— In educational sense, the Virtual Reality shows its value when the user can actively participate in the creation and development of his knowledge. According to the MediaEvo Project and with the multiplayer educational game realized, the paper shows that the Entertainment Games Platforms can also be used to develop platforms for multi-channel and multi-sensory cultural edutainment. Herein we present the process for collecting and processing data, the methodology and the tools used in the work and the multi-playing and Artificial Intelligence models implemented in the project. At the moment the MediaEvo Project is working in progress.

Keywords: 3D Game; Edutainment; Virtual Cultural Heritage

I. INTRODUCTION

There is a worldwide interest in the using of Virtual Reality (VR) technology in Cultural Heritage in order to recreate historical sites and events for such purposes as education, special project commissions and showcase features at visitor centers.

The power of VR lies with its ability to open up places and things not normally accessible to people and to allow them to explore objects and experience events that could not normally be explored without alterations of scale or time. The user can actively participate to create new knowledge through the discovery, the doing and by interaction with other users and objects in the environment.

The use of VR has defined new fields inside traditional research contexts. Today we consider virtual archaeology, virtual architecture or urbanism and so on as defined disciplines specialized in enhanced virtual representation or reconstruction as a distinctive methodology of approach.

One of the best uses of the virtual model is that of creating a mental tool to help students to learn about ancient cultures and to interact in a new way, using many possibilities for collaboration, in a shared social space.

By recreating or simulating something about an ancient culture, virtual heritage applications are a bridge between the people of the ancient culture and the modern user.

There are many experiences of historical environment reconstruction, the most successful are available on the web or have been presented in the international conferences. Some of them relate to the elaboration of models or algorithms for better represent and reconstruct important sites, others explore Augmented Reality applications for Cultural Heritage, others test ontological systems for data managing and sharing.

Virtual Rome is an Open Source web VR project, based on geospecific data, 3d models and multimedia contents for the interpretation, reconstruction and 3d exploration of the archaeological and potential landscape of ancient Rome. The purpose is the creation of a three-dimensional on line 3D environment, embedded into a web-browser [1].

The Appia Antica Project regards activities, technologies and digital solutions connected with an interdisciplinary approach, with the goal to realize a digital archive of the monuments of the park, employing many different technologies for 3D representation of the landscape and integrating instruments for topographic relief and methodologies of surveying on site according to the level of detail required [2].

The experimentation of Virtual Collaborative Environments (CVEs), multichannel and interactive platforms is lead in City Cluster that introduces players to a virtual tour of different cities [3].

Quest Atlantis Project provides virtual archaeological training [4]; Integrated Technologies of Robotics and Virtual Environment in Archaeology Project points both on education and on research [5].

II. THE MEDIAEVO PROJECT

The MediaEvo Project aims to develop a multi-channel and multi-sensory platform in Cultural Heritage and to test new data processing technologies for the realization of a digital didactic game oriented to the knowledge of medieval history and society [6].

The game is intended as a mean to experience a loyal representation of the possible scenarios (environments, characters and social roles) in the historic-geographical context of Otranto during Frederick Age (XIII century).

We chose Otranto as an example town; Otranto is located in the south of Italy. Due to its geographical position (in the extreme East of Italy), Otranto was like a bridge between East and West. The implementation of the edutainment platform is strongly influenced by the definition of the scenery that is the world in which the framework is placed with the related learning objects and learning path, the
characters, the scene’s objects, the logic and so the rules of the game, the audio content, the texts and anything related to its use.

The framework will have features of strategy games, in which the decision capacities of a user have a big impact on the result, which in our case is the achievement of a learning target. Nevertheless the strategy and tactics are in general opposed by unforeseeable factors (provided by the game) connected with the edutainment modules, in order to provide a higher level of participation, which is expressed in terms of the ease with which it is learnt. The idea is to provide a competition between the players, during the learning.

The system, on the basis of a well defined learning target and eventually based on knowledge of the user, will continuously propose a learning path (learning path composed of a sequence of learning objects), in order to allow the achievement of particular learning results.

III. THE STEPS OF RECONSTRUCTION

The ancient town of Otranto preserves relevant elements that witness Middle Ages culture but also the former and latter ones. This could increase the pedagogical purposes and place the project in a more complex, complete, “time machine” perspective.

In 1227, when the Emperor Frederick II of Swabia, entered the town with his wife and court, Otranto was a cultural melting pot. Even if there were two official languages, Latin and Byzantine Greek, walking in the town it wasn’t uncommon to hear people talking in Hebrew, Armenian, Vareg, French, Provençal, German, Arabic, etc. [7].

All those elements can be reflected in a big deal of situations that are useful for educational purposes. In other terms we could say that Otranto, as it is represented in the game, becomes a compact, interactive, little encyclopedia of Middle Ages civilization.

A. Data acquisition

The general information we first collect are actual Digital Terrain Models (DTM), thematic, technical, hydrogeological, nautical charts. On local side, surveys and metering operations produced maps of street organization, urban limits and fortifications, monuments and materials, referenced to absolute coordinates.

Information coming from archaeology (published or available in archives) has been inserted in topographic charts, distinguishing the different historical period [8], [9].

The overall amount of data acquired and represented defines the actual state and conformation of the town (realscape) on which we are making a process of subtraction (reverse stratigraphy), in order to obtain the state on year 1227.

Unfortunately, during the last centuries, there has been a substantial loss of historical documents. The survived ones are not enough to describe efficiently the town in Middle Ages.

The first views of Otranto date to the end of XV century. They are more symbolic than realistic. Furthermore, historical maps and views have been collected and classified, together with relevant documents and plans.

B. Data interpretation

We analyzed the urban structure and the buildings for tracing the hierarchy of development and the typical of the medieval units [10].

Using comparison among similar context we acquired information from other sites where elements and structures still exists.

The final result is the simplification of the townscape and the easy recognisability of space in its attributes that are directly connected to the information we want the player to keep.

Those data contribute to define the pastscape, the plausible scenario for the game. It is a “world-in-progress”: every new acquisition coming from analysis, research or data interpretation contribute to enrich the scenario.

C. Creation of urban landscape

The historic scenario is however a static representation of a context. The final goal of interactive reconstruction is the definition of an immersive platform able to let players experience and feel the socio-cultural values of that period: the so called "mindscape" [11].

This is reached towards the creation of high representative interactive contexts:

- religious (the diocesan space: cathedral-tower bell-square and the churches);
- infrastructural (function and hierarchy of road axes, identification of the central distribution system and its links);
- defensive (fortifications, castle);
- commercial (buildings and structure devoted to exchange, commerce, distribution and collection of goods);
- intermodal (port, regional roads);
- sub-urban (expansion areas, non urban functions: monasteries, docks, fields, etc.);
- residential (neighborhood, social-economical-racial concentration and building types);
- artisan (arts and crafts);
- familiar.

![Figure 1. A 3D model of actual Otranto.](image)
D. 3D modeling and game engine

A Digital Terrain Model (DTM) that has been produced using ESRI ArcGIS, containing all historical information like sea level, rivers, etc. It has been saved in .dif format and imported in the game engine.

For building and street modeling, we first used AutoCAD, 3ds Max, Cinema 4D. Characters and animation are made using 3ds Max. In Figure 1 is shown a 3D model of actual Otranto.

Once defined a list of modular elementary residential unit, according to the local medieval unit system, we composed the urban landscape in which monuments, infrastructures and situations are located [12]. This is shown in Figure 2.

The first monument to be modelled has been St. Peter's Church, due both to its characteristic of modularity that is useful for testing the software and its historical relevance as unique byzantine building located in a medieval context [13]. This church is shown in Figure 3.

After drawing and importing the church with textures and lights we experienced problems with the non-convex objects produced by common modelling software that drove us to use only Torque dedicated applications like Torque Constructor.

IV. INTERACTION AND MULTIPLAYER GAMES

Inside MediaEvo Project has also been implemented a module to manage the Interactions with Artificial Intelligence (AI) [14].

The artificial intelligence (AI) is necessary to establish a connection with some characters in the virtual game and receive multimedia information and commands in real time.

The ability to interact with AI characters is the principal key for retrieving knowledge and experiences from the virtual reality.

In the Mediaevo Project, the component of Artificial Intelligence is based on a graphical interface, with the following specifications:

- The interface should allow the starting of the interaction by pushing a default button on the keyboard;
- The interface should provide a choice of applications to be given as instructions to the virtual character;
- The interface should display all workable interactions with a virtual character.

For this purpose, a configurable database of instructions has been generated. The configurable database has direct access to the AI Interactive module. The final result of the proposed approach is shown in Figure 4.

The AI Interactive module has been realized according to the guidelines of the scripts implemented in Torque Game Engine from Finney [15].

In Figure 5 is reported the algorithm to manage the Artificial Intelligence.

The AI Interactive algorithm can be divided into two main modules: AIT Server Management Code and AIT GUI Management Code.

When the player selects an item of the AIT Queries database, then the GUI interface establishes a communication between the player and a virtual AI character.

The selected item from the AIT Queries contains the instruction that could be imparted to the AI character.
The instruction is straight managed from the AIT GUI Management Code module that encapsulates the information into a single system call.

Finally, the system call is routed to the AIT Server Management Code module and then it is interpreted to identify the corresponding action, into the AIT Actions database.

The game is designed for enabling multi-playing. Multi-playing is the real-time ability to interact with other game sessions that are localized in different places.

At beginning of the game, a player should log as Server Multiplayer; meanwhile the clients will join in the multi-playing session when the server will be ready to communicate.

The MediaEvo Project contains some multimedia elements; in particular, it is possible to insert audio elements, which are triggered with the crossing of the player into default game areas; and it also is possible to run video clips when the player reaches some checkpoint.

In Figure 6 is shown the opening of a video with a virtual radar. In this way, it will be possible to watch the positions of all the players inside the virtual environment.

V. CONCLUSIONS AND FUTURE WORK

MediaEvo Project is a didactic game-based 3D simulation about the history of the Middle Ages. The scenario is the town of Otranto.

Using Torque Game Engine we have realized a client-server platform where different player can navigate and interact with other objects and other players.

What could be experienced in the game is the immersion in a virtual environment that can easily enhance the diffusion of historical knowledge of the medieval Mediterranean era.

The project now is still in progress.

REFERENCES