# A Virtual Navigation in a Reconstruction of the Town of Otranto in the Middle Ages for Playing and Education

Lucio Tommaso De Paolis, Giovanni Aloisio
Department of Innovation Engineering
University of Salento
Lecce, Italy
lucio.depaolis@unisalento.it
giovanni.aloisio@unisalento.it

Maria G. Celentano, Luigi Oliva, Pietro Vecchio
Scuola Superiore ISUFI
University of Salento
Lecce, Italy
mariagrazia.celentano@unisalento.it
luigi.oliva@isufi.unile.it
pietro.vecchio@unisalento.it

**Abstract— The aim of the MediaEvo Project is to develop a multi-sensory platform for the edutainment in Cultural Heritage towards integration of human sciences and new data processing technologies, for the realization of a digital didactic game oriented to the knowledge of medieval history and society. The developing of the project has enhanced interactions among historical, pedagogical and ICT researches, by means of the definition of a virtual immersive platform for playing and educating and has permitted to investigate some navigation and interaction modalities among players for education purposes. In this paper we present some results of the MediaEvo Project that has led the researchers to use the reconstruction of the city of Otranto in the Middle Ages in order to determine the conditions for testing more elements of interaction in a virtual environment and a multisensory mediation in which merge objects, subjects and experiential context. With the aim to make interaction easier for users without any experience of navigation in a virtual world and more efficient for trained users, we use the Wiimote and the Balance Board of Nintendo in order to increase the sense of immersion in the virtual environment.**

***Keywords - simulation; edutainment; Virtual Cultural Heritage; navigation; virtual treasure hunt***

## I. INTRODUCTION

Edutainment, a neologism created from the combination of the words education and entertainment, refers to any form of entertainment aimed at an educational role. The videogame is one of the most exciting and immediate media of the edutainment applications because the game enables a type of multisensory and immersive relationship of the user through its interactive interface; moreover, the cyberspace of the videogame is a privileged point of sharing and socializing among players.

Edutainment is an up-and-coming field that combines education with entertainment aspects; thus, it enhances the learning environment and makes it much more engaging and fun-filled.

One of the most important applications of edutainment is undoubtedly the reconstruction of 3D environments aimed at the study of cultural heritage; the use of Virtual Reality in this field makes it possible to examine the three-dimensional high-resolution environments reconstructed by using information retrieved from the archaeological and historical studies and to navigate in these in order to test new methodologies or to practically evaluate the assessment. Virtual Reality (VR) technology makes it also possible to create applications for edutainment purposes for the general public and to integrate different learning approaches.

The building of three-dimensional renderings is an efficient way of storing information, a means to communicate a large amount of visual information and a tool for constructing collaborative worlds with a combination of different media and methods. By recreating or simulating something concerning an ancient culture, virtual heritage applications are a bridge between people of the ancient culture and modern users.

One of the best uses of the virtual models is that of creating a mental tool to help students learn about things and explore ancient cultures and places that no longer exist or that might be too dangerous or too expensive to visit. In addition, it allows students to interact in a new way, using many possibilities for collaboration. A very effective way to use VR to teach students about ancient cultures is to make them enter the virtual environment as a shared social space and allow them to play as members of that society.

The development technologies of video games are today driven by strong and ever-increasing request, but there are very few investments related to teaching usage of such technologies, they are still restricted to the entertainment context. Several VR applications in Cultural Heritage have been developed, but only very few of these with an edutainment aim.

The Human-Computer Interaction (HCI) technology is concerned with methodologies and methods for designing new interfaces and interaction techniques, for evaluating and comparing interfaces and developing descriptive and predictive models and theories of interaction.

The HCIs improve interactions between users and computers by making computers more usable and receptive to the user's needs.

Researches in HCI field focus on the developing of new design methodologies and new hardware devices and on exploring new paradigms and theories for the interaction. The end point in the interface design would then lead to a paradigm in which the interaction with computers becomes similar to the one between human beings.

This paper presents some results of the MediaEvo Project that has led the researchers to use the reconstruction of the city of Otranto in the Middle Ages in order to determine the conditions for testing more elements of interaction in a virtual environment and to develop a multi-channel and multi-sensory platform for the edutainment in Cultural Heritage.

In the following is reported the virtual reconstruction of the town of Otranto in the Middle Ages, the interaction modalities and rules of the navigation in the virtual town and has been also tested the possibility to navigate in a complex virtual environment by means of the Nintendo Wiimote and Balance Board [1] and the idea of the use of the Augmented Reality technology in a treasure hunt.

## II. Previous Works on the Navigation within Virtual Environments

The techniques for navigation within virtual environments have covered a broad kind of approaches ranging from directly manipulating the environment with gestures of the hands, to indirectly navigating using hand-held widgets, to identifying some body gestures and to recognizing speech commands. Perhaps the most prevalent style of navigation control for virtual environments is directly manipulating the environment with gestures or movements of part of the user's body.

Some developed systems are based on a head-directed navigation technique in which the orientation of the users head determines the direction and speed of navigation [2]. This technique has the advantage of requiring no additional hardware besides a head tracker, but has the disadvantage that casual head motions when viewing a scene can be misinterpreted as navigation commands. In addition, a severe drawback of this and other head-based techniques is that it is impossible to perform the common and desirable real-world operation of moving in one direction while looking in another.

Another direct body-based navigation technique is found in some systems that use sensors to measure the tilt of the user's spine or the orientation of the user's torso in order to determine the direction of the motion and to enable the decoupling of the user's head orientation from their direction of movement [3].

Another category of techniques for motion control is based on speech recognition. Speech allows a user to indicate parameters of navigation and can often be used in conjunction with gestures to provide rich, natural immersive navigation controls [4]. Speech controls should play a role in virtual environment navigation, but it is also critical to support an effective navigation based on speech-free techniques.

In the last few years, systems based on locomotion interfaces and on control navigation by walking in place for the navigation in a virtual environment have also been developed.

String Walker [5]is a locomotion interface that uses eight strings actuated by motor-pulley mechanisms mounted on a turntable in order to cancel the displacement of the walker. String Walker enables users to maintain their positions while walking in various directions in virtual environments because, when the shoes move, the strings pull them in the opposite direction and cancel the step. The position of the walker is fixed in the real world by this computer-controlled tension of the strings that can pull the shoes in any direction, so the walker can perform a variety of gaits, including side-walking or backward walking

The CirculaFloor [6] locomotion interface uses a group of movable floors that employ a holonomic mechanism in order to achieve omni-directional motion. The circulation of the floors enables users to walk in arbitrary directions in a virtual environment while their positions are maintained. The CirculaFloor creates an infinite omni-directional surface using a set of movable tiles that provide a sufficient area for walking and a precision tracing of the foot position is not required. This method has the potential to create an uneven surface by mounting an up-and-down mechanism on each tile.

Powered Shoes [7] employs roller skates actuated by motors and flexible shafts and supports omni-directional walking, but the walker cannot perform a variety of gaits. Powered Shoes is a revolutionary advance for entertainment and simulation applications, because it provides the proprioceptive feedback of walking.

## III. Improving knowledge through the virtual representation

Evolution in research methodology corresponds to a general debate on communication and education closely linked to the characteristics of a changing perception of teaching, oscillating between experimental impulses and conservative attitudes.

The improvement in technological capabilities enriches the possibilities for research and protection and enhances the value of cultural heritage, thus halting their demise.

Firstly, the increased speed of communication and data exchange within the research community offers the dimension of real time interconnectivity.

Secondly, the overall amount of information originating from both qualitative and quantitative exploration with the support of technologically advanced equipment, compared with that of a few decades ago, leads to the possibility of an extremely detailed description of reality.

The ancient town, as an information unit made up of ontological entities [8], can be defined as a cultural unit code which locates and describes the process of territorialisation of human society. It represents the space-time relation between man and environment at a certain time [9]. Apart from this assertion of uniqueness of space and time the educational purpose of the work requires a perceivable synthesis of culture, civilization and place referred to a perceivable and sufficiently extended phase of civilization [10].

Until recently, "historic vision" was limited to only a few professionals, scholars and researchers, who shared the interpretation codes for extracting the ancient landscape from the actual one. In this new stream of experimentation, geared towards interaction and edutainment, the researcher becomes part of a larger system through which to study and interpret space. In a virtual interactive town, the possibilities of information exchange increase dramatically, moving from static reconstruction to simulation.

Simulation permits the construction of a platform that adds the definition of game rules and plots to interaction and immersion. The final goal of the definition of the historic landscape is a cybernetic world that will create infinite possible simulations, not necessarily bonded to physical reality, based on the algorithms that encode the understanding of ancient situations [11].

At present, many experiences of interactive reconstruction take place on the net or have been presented during the course of international conferences. These primarily concern the elaboration of algorithmic models in order to better comprehend and reconstruct the sites, technological applications for Augmented Reality on cultural heritage and ontological systems and data management.

Other applications facilitate access to and reading of the cultural patrimony both within the museum and online, for example:

- The reconstruction of the site of Faragola (Foggia) by the University of Foggia, undertaken as part of the Itinera Time Machine Project, fits within the trend of an experiential relationship within an archaeological context [12];
- Appia Antica Project, 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 [13];
- Virtual Rome Project [14];
- Ancient Rome on Google Earth [15];
- Medieval Dublin [16];
- Nu.M.E. Project, a virtual museum concerned with the city of Bologna [17].

On a strongly interactive level and related specifically to multichannel edutainment, examples of applications utilizing Virtual Collaborative Environments are:

- City Cluster [18];
- The Quest Atlantis Project [19];
- Integrated Technologies of Robotics and Virtual Environment in Archaeology Project [20].

## IV. The MediaEvo Project: Learning about the Middle Ages in Otranto

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 [21], [22].

The framework has features of strategy games, in which the decision-making capacities of a user have a big impact on the result, which in our case is the achievement of a learning target. The idea is to create competition between the players, during the learning process.

The game is intended as a means 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 easternmost tip of the Italian peninsula, in Puglia, in the so-called Italy's heel. Due to its geographical position, Otranto was like a bridge between East and West and it played an important connective role in the Middle Ages from a historical and cultural point of view. For these reasons many publications and lectures have looked at and partly explained the ancient role of this town by focusing on the historical happenings and on the development of urban institutions within it [23].

Otranto was a Byzantine and a Gothic centre, later ruled by the Normans, Swabians, the Anjou and the Aragonese. After a long siege, on 14 August 1480 the town was caught and the inhabitants were massacred by the Turkish army. This mix of history can be seen in the enigmatic mosaic of the Cathedral, a Romanesque church built during the Norman domination in the 10th century on the axis that joined Rome to Byzantium. The mosaic, done by the monk Pantaleone in the 12th century, covers almost the entire floor of the Cathedral, for over 16 metres; its size is nothing compared to the complexity of images and references that mixes Biblical narration from the Old and New Testaments with some pagan elements and others of Eastern derivation.

The implementation of an 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, hence, 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 capabilities 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 their learning.

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

The use of digital entertainment and performance media, then, can enhance the communication of cultural heritage and history in order to increase our knowledge of such a relevant part of our history.

Given the knowledge we have of the town in the Middle Ages, it may be almost impossible to carry out a full reconstruction, what could be experienced in the game is the immersion in a virtual environment that can easily enhance the communication of historical research and understanding of the birth and life of cultural heritage.

During its definition, the platform that has been planned for educational purposes has proved to be useful for testing researchers' hypotheses about the ancient town and its everyday life.

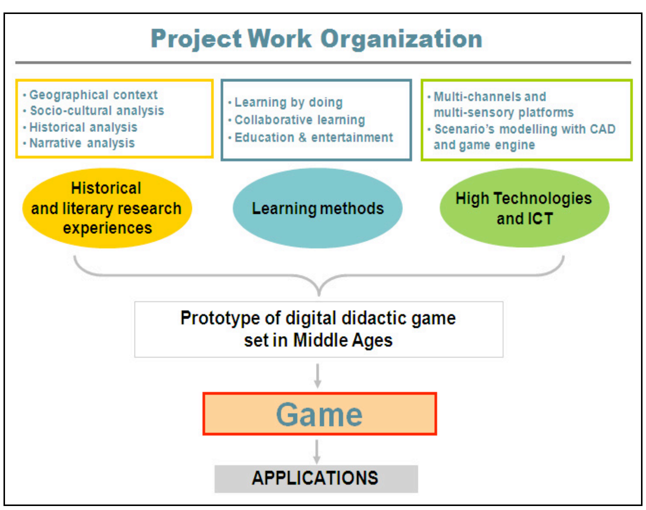


Figure 1. Scheme of project work organization for MediaEvo Project

At the end of project, other application fields have been tested on the game: new peripherals for motion and interaction, virtual treasure hunts, Augmented Reality and evaluation of the scheme for territorial marketing and touristic promotion.

The scheme of the MediaEvo Project work organization is reported in Fig. 1.

## V. Reconstruction of the Virtual Town

For reconstructing the natural place and its surroundings a Digital Terrain Model (DTM) of the site was produced using ESRI ArcGIS and imported in the game engine Torque Game Engine of GarageGames. Characters and animation are made using 3ds Max.

Figure 2. The reconstruction of defensive wall and its surroundings.

Architectural contents were modelled using the Torque Constructor editor of the Torque 3D engine. The first dwelling consists of a unit cell surrounded by a rectangular court, this is considered the initial settlement model for all ancient towns; the second one is the terraced house unit. Composing and varying those units on the particular scheme leads to the reconstruction of the urban medieval space in the game. The modular elementary residential units have been designed according to the local medieval unit system. They have been used as bricks for composing the urban landscape in which monuments, infrastructures and playing are located. In Fig. 2 the reconstruction of the defensive wall and its surroundings is shown.

Torque Constructor has proved to be an efficient tool for the direct implementation of basic 3D graphics models but we found some difficulties in modelling complex buildings because of the lack of many useful features implemented in professional 3D software. For this reason, the reconstruction of big monuments has been carried out using a CAM in order to obtain a more accurate definition of the architectural structures. All the models have been imported into the Torque 3D engine.

St. Peter's Church was found to be useful for testing the importing system both for its characteristic modularity and for its historical relevance as a single byzantine building located in a medieval context.

In Fig. 3 is shown the internal and external reconstruction of the Otranto Cathedral.

Figure 3. The reconstruction of the Otranto Cathedral.

Other parts, walls and external structures such as towers or gates, complete the original landscape for the game.

For the context of edutainment for cultural heritage, in this issue various virtual interactions into the Torque Game Engine platform have been produced.

A new algorithm has been implemented to realize a preliminary Artificial Intelligence with the ability to establish stable textual or vocal connections between the different virtual players placed in the game mission.

Interactions have been placed into some checkpoints of the Torque virtual environment; these checkpoints make it possible to trigger particular audio or/and video events during the navigation of the game player.

It is also possible to implement the interactions in the Torque platform, allowing developers to bind appropriate actions to a given event. Each event manages a particular action in the game mission and in this sense the events can be used for controlling textual or multimedia mode.

It is possible to control the movements of each game player in the game mission in the collisions with game objects placed in the virtual environment.

## VI. Interaction Modalities and Rules

In Fig. 4 is shown a diagram of interactions of the avatar-player. There are 2 levels, as it is described below:

### A. *Level I. Educational*

When the game starts, the player sees a multimedia presentation (a videoclip developed by experts in medieval history/art) with a short introduction to the history of Otranto; s/he can then choose the possible destinations (Cathedral, St. Peter's Church, Castle and Town Walls) and see the corresponding videoclips or skip the presentation and start the application. Here s/he goes to the second level.

### B. *Level II. Interaction and surfing*

This is an interactive level where the player enters the virtual world. S/he will meet a guide and could choose to navigate with him/her - surfing with a guide (level II.1) - or free surfing without the guide (level II.2).

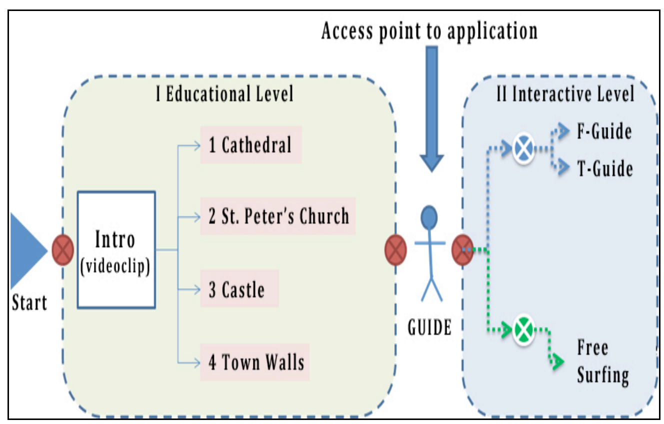


Figure 4. Access and interaction levels of the avatar-player

In the definition of the interaction with the 3D environment in the case of level II.1, two possible scenarios were created and, therefore, two possible tasks for the avatar-guide:

*a) 1st choice: Facilitator Guide (F-Guide)*

The guide is a facilitator and gives the player suggestions to follow a specific navigation path. The player can start multiple paths with the F-Guide and select among four different Interest Points (IPs): the Cathedral (IP1), St. Peter's Church (IP2), the Castle (IP3) and the Town Walls (IP4). Fig. 5 shows the Interest Points of the game.

In the journey from the starting point (Ø) to the selected

IP, the guide will not be available for other players accessing the game. These players can wait for the guide or start free surfing without a guide.

*b) 2nd choice: Tele-Transportation Guide (T-Guide)*

The player can ask the guide to be tele-transported to some points of interest. This option is a learning strategy to turn the player's attention to specific educational objectives.

All interest points have the option to locate the T-Guide with the task to tele-transport the player to another IP. It is possible a case in which the player, without the help of a guide, can freely surf the virtual environment; in this case the only helping tools are some "road signs" located at the road intersections to direct the player to the Points of Interest.

All the possible interactions between the player and the IPs are planned and properly designed.

The main interactions are:

- Surfing inside the IP;
- Surfing outside (all around) the IP;
- Asking the guardian of the IP to recount its history;
- Asking the guardian of the IP to view the educational/information library associated with the IP;
- Asking the guardian to benefit from tele-transportation to another IP.

There are also "intermediate Interest Points" (IIPs), such as the workshop, the blacksmith shop, the olive tree grove, etc. These IIP will provide more multimedia educational contents for the player (videos, texts, audio files, images).

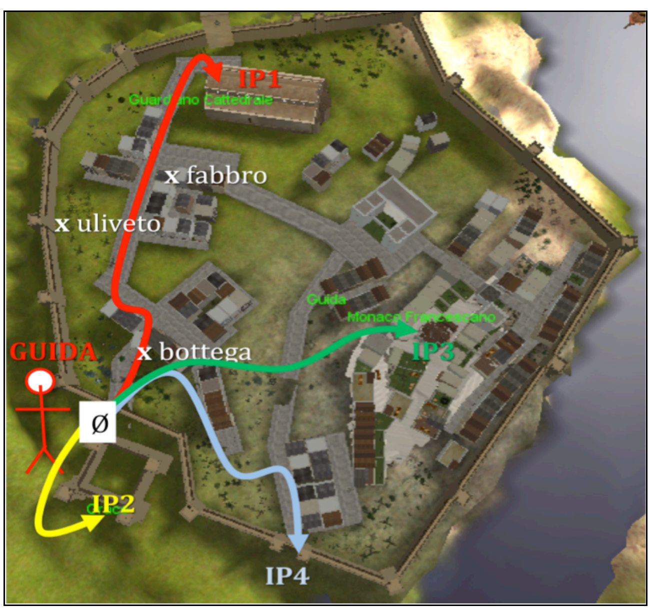


Figure 5. The Interest Points in the MediaEvo game

## VII. Players and Artificial Intelligence

Inside MediaEvo Project there has also been implemented a module to manage the Interactions with Artificial Intelligence (AI) [24].

The artificial intelligence is necessary to establish a connection with some characters in the virtual game and to 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 environment.

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 reconfigurable database of instructions has been generated.

The configurable database has direct access to the AI Interactive module. The result of the proposed approach is shown in Fig. 6.


Figure 6. The GUI implemented.

The AI Interactive Module has been realized according to the guidelines of the scripts implemented in Torque Game Engine [25].

The algorithm to manage the Artificial Intelligence that can be divided into two main modules:

- The AIT Server Management Code;
- The AIT GUI Management Code.

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

Figure 7. The opening of a multimedia clip video.

The game has been designed for enabling multi-playing in order to provide the real-time ability to interact with other game sessions localized in different places of the reconstructed virtual environment.

In the MediaEvo platform are available some multimedia elements; in particular, it is possible to insert audio elements and to run video clips when the player reaches some checkpoint.

In Fig. 7 is shown the opening of a multimedia clip video when the character reaches the S.Peter's church. In addition it is visualized a virtual radar in order to know the positions of the other players in the virtual environment.

## VIII. Testing Input Peripherals: the Nintendo Wiimote and Balance Board

In recent years some systems based on the control of the navigation in a virtual environment by walking have been also developed.

We present an application of navigation and interaction in a virtual environment using the Wiimote (word obtained as a combination of "Wii" and "Remote") and the Balance Board of Nintendo [26].

The aim is to make interaction easier for users without any experience of navigation in a virtual world and more efficient for trained users; for this reason we need to use some intuitive input devices oriented to its purpose and that can increase the sense of immersion.

Wii is the last console produced by Nintendo; it was released in October 2006 and, according to official data of 2010, has surpassed 70 million units sold. The reasons for this success can be undoubtedly found in the new approach that the gaming console gives the user in terms of interaction that effectively makes it usable and enjoyable by a large part of users. The secret of this usability is the innovative interaction system; the Wiimote replaces the traditional gamepad controller type (with cross directional stick and several buttons) with a common object: the remote control.

The Wiimote is provided with an infrared camera that can sense the infrared LED of a special bar (Sensor Bar) and it can interpret, by means of a built-in accelerometer, the movements of translation, rotation and tilt.

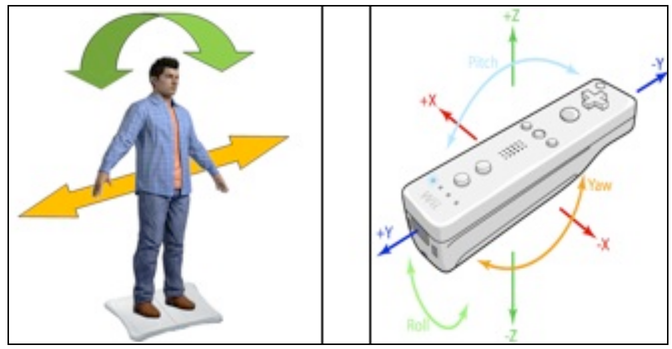


Figure 8. Interaction modalities of Wiimote and Balance Board.

The Wiimote has been equipped with a series of accessories that increase its potential, such as the Balance Board, that, by means of four pressure sensors at each corner, is able to interpret the movements of the body in order to control the actions of the user in a videogame.

Because we walk on our feet, controlling walking in Virtual Reality could be felt as more natural when done with the feet rather than with other modes of input. For this reason we used the Nintendo Balance Board as an input device for navigation that offers a new and accessible way to gain input. It is a low-cost interface that transmits the sensor data via Bluetooth to the computer and enables the calculation of the direction the user is leaning to.

Fig. 8 shows the interaction modalities of Wiimote and Balance Board.

In addition, in order to implement the control of different views and to change the point of view of the user, in our application we use the Nintendo Wiimote and the interaction by means of this device has the aim to simulate the use of the mouse.

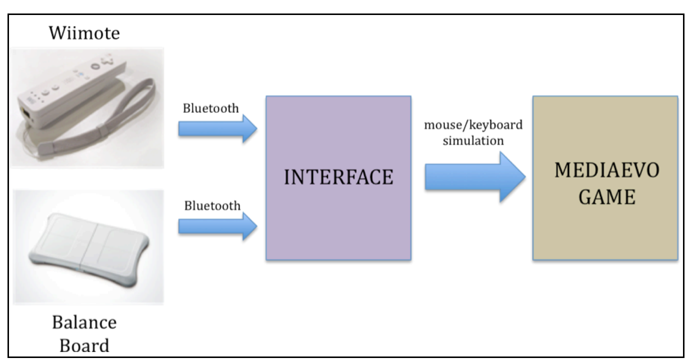


Figure 9. Use of Wiimote and Balance Board in the MediaEvo game.

Fig. 9 shows the use of Wiimote and Balance Board in the MediaEvo game.

Since the frequency of communication between the Wii console and the Wiimote/Balance Board is that of the standard Bluetooth, these devices can be used as tools to interact with any computer equipped with the same technology. Appropriate libraries have been realized in order to allow the interfacing between these devices and a computer.

A software layer that allows the Balance Board and the Wiimote to be used as input devices for any application that runs on a computer has been realized. The aim is to make it possible to receive signals and commands from the Wiimote and the Balance Board and to translate these into commands for the computer in order to emulate the keyboard and the mouse.

The application, created to provide a new system of interaction in the virtual world of the MediaEvo Project, can be coupled to any application of navigation in a virtual world.

The modalities of interaction provided by the application involve the use of the Wiimote and Balance Board simultaneously. In particular, the user is able to move the avatar in the virtual environment by tipping the scales in the direction in which he wants to obtain the move; an imbalance in forward or reverse leads to a movement forward or backward of the virtual character, while the lateral imbalance corresponds to the so-called "strafe" in video games, where the movement is made on the horizontal axis while maintaining a fixed pointing direction of the gaze.

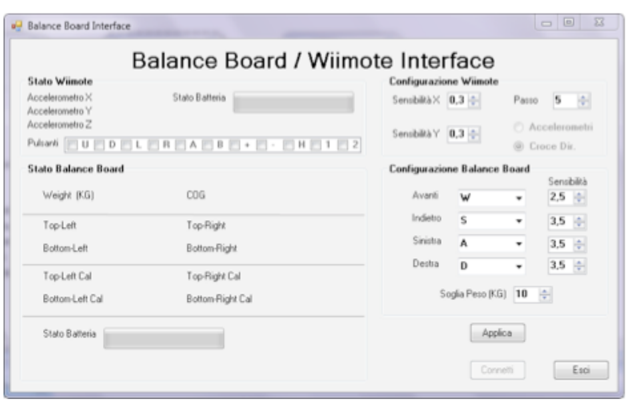


Figure 10. Configuration interface of the Wiimote and Balance Board.

To run the application, it is first necessary to configure the keys able to emulate any type of movement, to set the sensitivity of the Balance Board and then to connect the device; the information on the data received from the device are displayed in real time.

The interface that visualize the data received from the Wiimote and Balance Board is divided into two main sections: the left panels contain the control with all the data received via Bluetooth from the devices, whereas in the right side it is possible to set the associations among the command given to the device and the equivalent command simulated from the computer, the levels of sensitivity and threshold beyond which the interactions occur.

For these operations the software uses two open-source libraries in C# and the WiimoteLib InputSimulator; the WiimoteLib is a library for interfacing the Nintendo Wiimote and other devices (such as the Balance Board) in an environment .NET [27]. The purpose of this library within the application is to simulate the use of a mouse and a keyboard starting from the properly interpreted and translated inputs received from the Wiimote and Balance Board.

Regarding the interaction by means of the Wiimote, the aim is to simulate the mouse using two modalities of interaction.

"Mode 1" uses the movement on the X and Y axes of the accelerometer to move the mouse (and, in the 3D environment, the user’s point of view) on the longitudinal and latitudinal axes; the value provided by the accelerometer is compared with the sensitivity set during configuration.

"Mode 2", that is the default mode, allows to move the mouse (and, then, the user’s point of view) using the direction arrows of the Wiimote.

Fig. 10 shows the configuration interface of the Wiimote and Balance Board devices.

Figure 11. Navigation in the MediaEvo virtual environment.

Fig. 11 shows a user during the navigation in the MediaEvo virtual environment using the Wiimote and the Balance Board.

## IX. Virtual Treasure Hunt

Within the MediaEvo Project it has been also developed a "virtual treasure hunt" placed in the old town of Otranto using an iPhone as a device to find and read the clues of the game.

The Augmented Reality [28] has been used as an edutainment-oriented technology for geo-locating the points of interest (POI) and the visualization of useful and interesting data that are overlapped on the video stream of the iPhone camera.

The working modalities of the virtual treasure hunt are shown in Fig. 12.

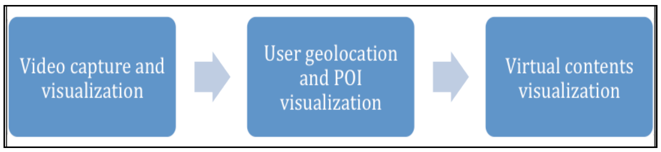


Figure 12. Working modalities of the virtual treasure hunt.

The main components of the developed application are:

- The management of the treasure hunt guides the logic of the game in every aspect and. It also has the task of interfacing with the database to retrieve the information that helps players during the treasure hunt. It is possible to obtain additional data through Internet on a specific POI.
- Augmented Reality manages the information regarding the user geo-location and the visualization of the information associated with the POI.

These components take advantage of the GPS and compass interfaces and provide the user with a map of the city in order to facilitate moving in the town and easy reaching the clues.

The user menu allows visualizing the last clue or a map where are shown the location of the player in the town and the location of the next point to be reached.

The tools that the player can use during the treasure hunt are the following:

- A radar that provides the location of the POI during the player's walk;
- A GPS signal display;
- A user menu;
- A radius that shows the distance within which the radar can detect the POIs.

In Fig. 13 is shown the graphic interface with the tools.

During the treasure hunt the player can use radar that provides the location of the POI, and a menu with the possibility to increase or decrease the distance within which the radar can detect the POIs.


Figure 13. Visualization of the POI.

Once the player is close to a POI, a marker that indicates the presence of a clue is visualized on the on the iPhone screen and superimposed on the images captured by the camera; this is a typical visualization in Augmented Reality.

Touching the marker in the screen, a brief description of the stage is shown and two new buttons appear in the toolbar:

- The first one is a link to the resources available through Internet if the POI has an associated web page;
- The second gives more detailed information (in terms of text, move or audio) to reach the next stage.

In Fig. 14 are shown some video and audio clues.

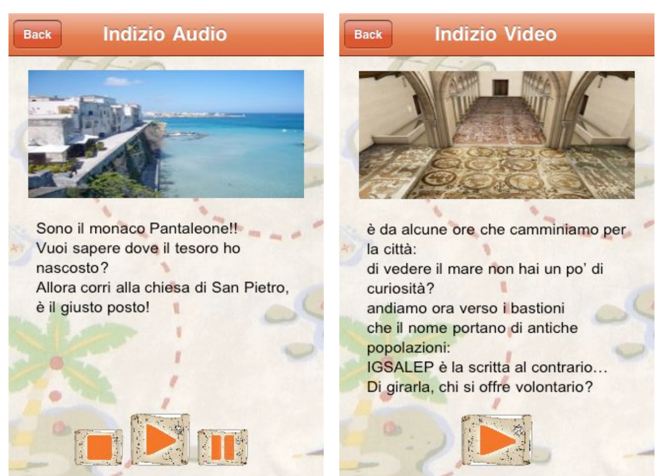


Figure 14. Visualization of video and audio clues.

## X. Conclusions and Future Work

The aim of the MediaEvo Project is the development of a multi-channel and multi-sensory platform for the edutainment in Cultural Heritage.

This paper presents some results of the project that has led the researchers to use the reconstruction of the city of Otranto in the Middle Ages in order to determine the conditions for testing more elements of interaction in a virtual environment and a multisensory mediation in which merge objects, subjects and experiential context.

Taking into account the potential of a virtual scenario, a series of properties have been defined to give the game platform an effective educational value.

By incorporating historical, technical and educational considerations, the final product presents itself as a "complete-open-interactive" environment for the acquisition of knowledge, the enhancement and safeguarding of cultural heritage.

In the MediaEvo Project has been also tested the possibility to navigate in a complex virtual environment by means of the Nintendo Wiimote and Balance Board and the idea of the use of the Augmented Reality technology in a treasure hunt.

Possible future developments could include the conversion of the application in external library, by adding specific methods and attributes to be directly integrated into other applications, and the porting of the developed application in a multi-platform language in order to be used in different development environments.

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