Playhist: Play and Learn History.
Learning with a Historical Game vs An Interactive Film

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Abstract. Through PLAYHIST experiment we want to prove that "Learning by playing" concept is valid for history museums and cultural centers on the terms of Cultural Heritage. Our main purpose with this project is the transformation of an interactive film about Ancient Greece into an interactive and collaborative serious game over the environment of Tholos (a 3D, dome shaped Virtual Reality theatre/museum with 130 seats) in the Foundation of the Hellenic World of Athens (Greece). With this approach shift we want to demonstrate that introducing gamification concept in historical contents improve visitor's learning way in this fields.

Another challenge of the project is the development and integration of a broad range of software to provide experimenters with powerful instrumented capabilities right across the Future Media Internet landscape. These capabilities have been collected into five areas: experiment, social, audio visual, pervasive and 3D contents.

And finally, the metrics that we use for testing that "learning by playing" -in the context of a cultural center or a history museum provides a better understanding of an historical subject- are Quality of Experience and Quality of Learning. These metrics will be gathered by the components of the project and different questionnaires.

Keywords: Future Media Internet, Virtual Reality, Game Based Learning, Cultural Heritage, Human Factors, Experimentation.

1   Introduction

PLAYHIST experiment, devoted to use gaming technology, is framed in the FP7 EXPERIMEDIA PROJECT (University of Southampton IT Innovation Centre, 2013).

The goal of PLAYHIST experiment is to investigate an approach to enhance visitor experience in history learning by using a 3D interactive and collaborative serious game that will engage visitors with new ways of interactive group activities. The experiment will be carried out by taking advantage of the technological features provided by the EXPERIMEDIA Project facility, as well as of the spaces, equipment and contents available at the Foundation of the Hellenic World (FHW).

One of the main tasks of history museums and cultural centers is the preservation and dissemination of historical resources. The connection between visitors and that environment (museums and cultural centers) should be accessible, interesting and with an up-to-date ways of communication, with one which the users are used to them. With this objective the key is the introduction of new technologies in the sense of, explain, teach and cause interest on the visitor.

Nowadays, we need new paradigms for training and education that make a transformation to the one that we have. The use of video games in the educational setting has been in existence for a significant period. Numerous empirical studies suggest that there is significant educational value to their use (Lamb; Annetta 2013).

2   Background

There are a several fields in which serious games are taking an important role and different approach of the influence on learning. It is assumed that serious games influences learning in 2 ways, by changing cognitive processes and by affecting motivation (Wouters, 2013). These two are basic for enhance the concept or 'learning by playing'. The application fields are countless and very different from one another. For example: virtual lab simulations in the Strength of Materials Lab (Barham, 2012), Green Building design principles and LEED concepts (Dib, 2012), e-health (Wattana-soontorn, 2014), etc.

Although the widespread use of gaming for leisure purposes has been well documented, the use of games to support cultural heritage purposes, such as historical teaching and learning, or for enhancing museum visits, has been less well considered. The state-of-the-art in serious game technology is identical to that of the state-of-the-art in entertainment games technology. As a result the field of serious heritage games concerns itself with recent advances in computer games, real-time computer graphics, virtual and augmented reality and artificial intelligence. On the other hand, the main strengths of serious gaming applications may be generalised as being in the areas of communication, visual expression of information, collaboration mechanisms, interactivity and entertainment (Anderson, 2009).

We can summarize some of the keys after the research on what gamification can add to cultural heritage. First of all the efficacy of game-based approaches over traditional learning, the second one is the importance of play. It is demonstrated the link between less free play and higher anxiety in children. And the last one is the social interaction: collective awareness platforms, social software uptake and emphasis upon peer learning, use of mobile devices, augmented reality (Coventry University, 2013).

Because of the last advances in the smartphones field, there are very interesting developments for using apps in museums. MuseUs application stimulates the visitor to look at cultural heritage elements in a different way, permitting the construction of personal narratives while creating a personal exposition (Coenen, 2013).

3   Experimedia Project and Components

3.1   EXPERIMEDIA Project

EXPERIMEDIA is a collaborative project aiming to accelerate research, development and exploitation of innovative Future Media Internet products and services through a socio-technical location that support experimentation in the real world which explore new forms of social interaction and experience in online and real world communities.

The experiments are made in three main venues that EXPERIMEDIA has as the place where individuals and communities go for experiences, learning and social interaction: Schladming (an Austrian alpine resort), CAR (a high performance athletic training facility in Barcelona) and FHW (a Greek cultural Centre and museum for Hellenic culture and history).

3.2   EXPERIMEDIA Project Components

One of the key of PLAYHIST is that we have to use some of the components that EXPERIMEDIA Project has developed. We have to interact with them for different purposes over the work in this project. These components are divided into five areas:

- Experiment Content Component (ECC): monitor, and derives experimental data from an experiment.
- Social Content Component (SCC): publishes, gathers, analyses, manages and monitors data generated on social networks during an experiment.
- Audio Visual Content Component (AVCC): supports the experimenter in the audiovisual content lifecycle.
- Pervasive Content Component (PCC): offers ubiquitous computing based functionality, such as augmented reality, location awareness and live games creation.
- 3D Cotent Component (3DCC): supports experimenters in acquiring and manipulating 3D information from depth sensing devides (e.g. the Kinect), avatar editing and avatar interactive motion.

4   PLAYHIST System Architecture

This experiment will reuse and adapt the 3D content from the FHW 3D Model Repository, related to one of the interactive movies projected at the FHW. This game will allow visitors to act and interact as a historical character in a 3D environment recreating one of the historical moments depicted in the FHW. Visitors will be proposed with a mission or set of tasks that must be developed to achieve a specific goal, in an engaging and collaborative experience enhancing the learning process and therefore achieving a better historical knowledge.

Initially, the idea was to use actual Tholos render machines. However later we had to consider different kind of architecture because of the problems we found with the os linux version installed in the machines of the Tholos, too old for our Unity3D base solution. Finally the architecture chosen is the one that we can see in the following image (Figure 1). We are going to use a single main machine with three graphic exists which will be responsible for rendering the game on the Tholos and also taking the role of the server to manage all the interactions between the clients and the expert.
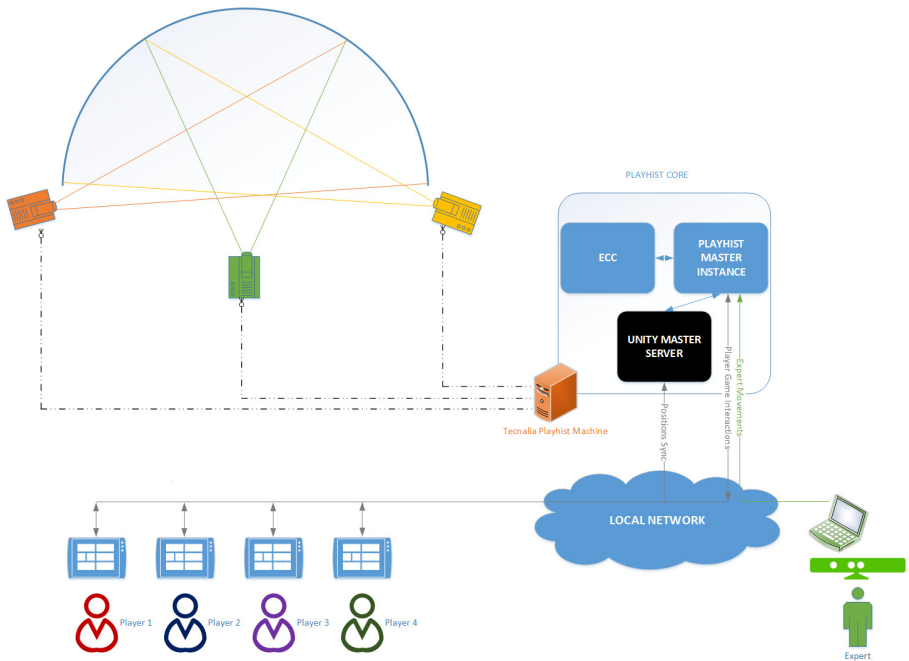

Fig. 1. Playhist system architecture

PLAYHIST Experiment Core represents all developments needed to create the multiplayer real-time serious game, already integrated with EXPERIMEDIA components

PLAYHIST Experiment involves three different development environments that interact with some EXPERIMEDIA components and other Hellenic Cosmos's resources. They are easily recognizable these groups in the image. First of all, we can see **visitor's environment**. Here we have Android Application which gives the interaction between the game and visitors (they can move within the 3D scenario, play mini-games, etc.). The application will include 3DCC component (University of Southampton IT Innovation Centre, 2013) for avatars creation. This way some of the players will play with a customized avatar. There is also the **expert's desktop**, this one will be useful only in one of the mini-games. Basically, this is the motion capture module which permits to the expert not being physically present in the

Hellenic Cosmos. We can see in the next image how the expert is being detected with Kinect and then his avatar in 3D scenario (Figure 2). The role of this person is to give advises to the other players about the best way to achieve the player's mission. And finally and the most important one is the **Playhist core**. This is the standalone application, the responsible of the 3D scenario rendering and of showing it through Tholo's projectors. This way all the players will know where they are located inside the game.
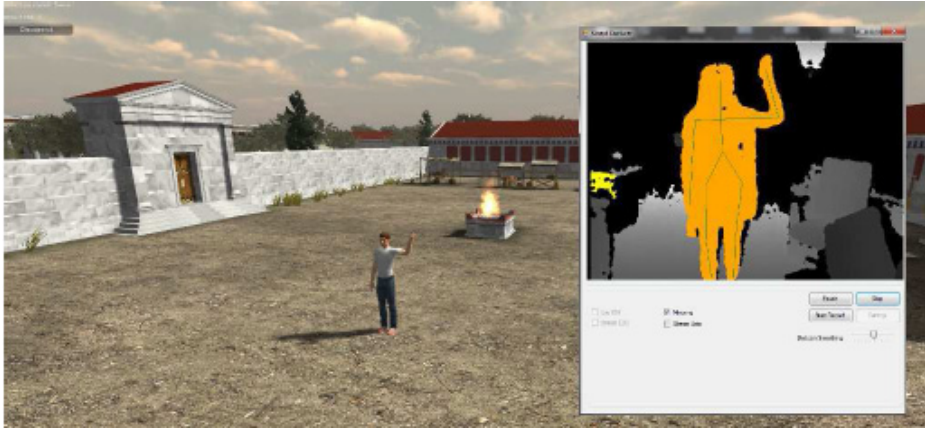

Fig. 2. Motion capture module

5   The Experiment and Metrics

5.1   PLAYHIST Experiment

The goal of PLAYHIST Experiment is to investigate an approach to enhance visitor experience in history learning by using a 3D interactive and collaborative serious game that will engage visitors with new ways of interactive group activities. The experiment will be carried out by taking advantage of the technological features provided by the EXPERIMEDIA facility, as well as of the spaces, equipment and contents available at the Foundation of the Hellenic World (FHW). This experiment will try to create a more engaging experience for the FHW visitors transforming one of the interactive projections in a multiuser game in which the participants must achieve a specific goal moving and interacting in the virtual world with a complex aim: obtaining an engaging learning experience about Hellenic history.

The PLAYHIST experiences will be organised in two stages to achieve the experiment goal:

- Visitors to the FHW will be randomly assigned to two different groups:

  1. **Group A** will be the control group and will define the baseline for subsequent comparisons. The will play with the interactive film that is already on exhibition in the venue.

2. **Group B** will be the experimental group, and they will play a 3D serious game that will be developed using Unity 3D Engine[1]. The plot of this serious game will be aligned to one of the interactive movies already exhibited in the FHW. The game will recreate an historical place where people will have to interact and complete specific tasks along the 3D scene for achieving a goal and at the same time, getting historical and cultural information.

- Visitors in Group B will play the historical game. The main steps for the game progression will be:

    1. The visitors begin to configure their character using a laptop with a webcam. They will have to choose between a standard character and a personalized one. If they decide to personalize the character, they will have to take a picture of themselves and through the application get their own character with their face.
    2. The visitors get their tablets and come into the Tholos, and they will be presented the main objective of the game, a brief historical introduction to the game and the steps or mini-games to get the final objective.
    3. For each mini-game, there will be an initial brief presentation of the specific challenge, and immediately, the visitors will begin to play the mini-game. The end of each mini-game will be defined both by time ending assigned to each mini-game or by all the visitors finishing and reaching the objective, the first of both events. Depending on the level of achievement on each mini-game, the visitor will be assigned punctuation and ranked in a general list (visible on the general screen of Tholos for all the visitors).
    4. Once all the visitors have passed through all the mini-games, the winner will be considered the one who has the more points in less time.

    Besides these players, the experiment will also have a person from the museum that will be able to act and interact with the players in real time. This person will appear as one of the characters in the serious game, but the movements will be captured using the capture function of the 3DCC avatar motion capture module.

5.2   Experiment Validation: Metrics

The metrics that will be evaluated in this experiment are the following ones:

- Quality of Experience (QoE): User satisfaction. Comparison of Group A and Bs. Several data about QoE will be automatically registered from the game through the ECC module.

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[1] http://unity3d.com/

- Quality of Learning (QoL): Understanding of a historical subject. Comparison of Group A and Bs. Several data about QoE will be automatically registered from the game through the ECC module.
- Quality of Service (QoS): It will be also measured the performance of the system using some metrics like the number of rendered virtual scenes presented per second, delay between real time motion capture and character animation visualization.

We have also two types of questionnaires that will be filled by the users

- Q1: The first questionnaires will be related to their Quality of Experience (QoE).
- Q2: And the second questionnaires will contain questions about the historical date reflected in the interactive film or the serious game, providing information about the QoL.

6   Experiments Objetives

Taking into consideration the educational content and the gamification possibilities of the 3D scenery we have decide to use the production "A Journey to Ancient Miletus" (Foundation of The Hellenic World, 2013). In this production, visitors travel to city of Miletus as it was two thousand years ago. Visitors will be able to explore the virtual city learning about the most important buildings.

The main objective will be to erect a votive stele along the Sacred Way to celebrate the annual festivities in honour of Apollo called Didymeia, which included a procession starting at the Delphinion along the Sacred Way.

The player will have different type of missions during the game. All that missions are to overcome mini-games and each has an educational objective. The game is divided in three scenarios where the player has to play a mini-game to pass to the other level, considering that the most important objective is to learn the history of Miletus. The next table shows what the player will learn in each mini-game played.

Table 1. Educational objectives per each scenario

SCENARIO/MINI-GAME	EDUCATIONAL OBJECTIVES
Lion Harbour: unload goods from the boat	Learn which type of goods were sell in the Agora
North Agora: sell the goods in the Agora business	Learn about the system of exchange and the buy and sell system in the Agora of Miletus
Sacred Way: Buy and compose a votive steal to dedicate it to the god in the annual festivities in honour of Apollo	Learn about the annual festivities in honour of Apollo and the offers that people did with the votive steles.

Fig. 3. Agora Scenario

Fig. 4. Lion HarbourScenario

7   Conclusions

It is prove that serious games for cultural heritage are particularly suited with respect to the affective domain. Empathy with a game character and plot may be very helpful for understanding historical events, different cultures, other people's feelings, problems, and behaviours, on the one hand, and the beauty and value of nature, architecture, art and heritage, on the other one (Mortara, 2014).

In his paper, 'learning by playing' concept is based on the visitor's engagement through technological challenging innovation, which has been created from the development of a multiplayer online videogame. And by measuring quality of experience and learning through the project data capturing procedures is the way that we want to demonstrate the effectiveness of the new approach of learning. 3D Virtual Worlds have the potential to expand the knowledge of a foreign culture by presenting the information in a visual context. We have wanted to combine aspects of learning and fun in an immersive 3D Environment to make the communication of knowledge an entertaining experience.

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