This deliverable outlines the design and plan related to the PLAYHIST experiment, which focuses on creating engaging learning experiences at the FHW through the use of gamification technologies. It includes the experiment description and the technical requirements for the experiment implementation. Finally, it describes the ethics and privacy considerations.
Project acronym    EXPERIMEDIA

Full title    Experiments in live social and networked media experiences

Grant agreement number    287966

Funding scheme    Large-scale Integrating Project (IP)

Work programme topic    Objective ICT-2011.1.6 Future Internet Research and Experimentation (FIRE)

Project start date    2011-10-01

Project duration    36 months

Activity 14    Experimentation

Workpackage 4.14    EX14 PLAYHIST

Deliverable lead organisation    TECNALIA

Authors    Rosa Peral, Sara Sillaurren, Pablo Aguirrezabal (TECNALIA)

Reviewers    Magnus Eriksson (Interactive)

Version    1.0

Status    Final

Dissemination level    PU: Public

Due date    PM27 (2013-12-31)

Delivery date    2014-02-05
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1. Executive Summary

This document summarizes the work carried out by TECNALIA regarding the design of the PLAYHIST experiment. It includes both the requirements for the experiment planning, execution and analysis, and the connection with the EXPERIMEDIA software components and FHW facilities. First of all, after an introduction, a detailed description of the experiment is given, followed by the Ethics and Privacy section, where PLAYHIST considerations related to these matters are described. The Experiment Design section includes the system architecture and the interaction among the different experiment technical assets. Last section of the document includes the experiment planning.
2. Introduction

Games are powerful educational tools that have been used successfully by cultural heritage organisations. Such an approach integrates art and education into a game-like structure, through which end-users absorb information via non-traditional routes, which stimulates fun-loving but mentally challenging brain processes. The success of games such as Revolution and the Virtual Egyptian Temple, which are structured around a cultural heritage context, reveals the potential of these technologies to engage and motivate at a level which goes well beyond that of leisure-time activities.

The goal of the PLAYHIST experiment, that will take place at the FHW Hellenic Cosmos venue, is 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.

"Hellenic Cosmos", the Cultural Centre of the Foundation of the Hellenic World, is an ultra-modern Cultural Centre and Museum that stands out for its innovative programmes. In a multifunctional area, visitors experience Hellenic history and culture, while at the same time it is a venue of cultural creation and expression.

Through the use of state-of-the-art technology like the Tholos, the semi-spherical Virtual Reality theatre where FHW's digital productions are presented, the examination of Hellenic history becomes a truly remarkable experience. Audiovisual and interactive media provide a new way for the dissemination of historical information, where the audience participates actively. In the virtual Reality projection, the museum educator controls the system, thus specifying what the Tholos system will render and project to the visitors, while at the same time commenting on it. As a sole exception to this, visitors are able to participate in electronic polls which determine the path that the Educator will follow altering in this way the flow of the presentation in real time.

PLAYHIST 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.
3. Experiment Description

The goal of the PLAYHIST experiment is to enhance visitor experience in history learning by using gamification technology combined with 3D avatars. This will be done by developing a 3D interactive and collaborative serious game that will take advantage of the documentation, exhibitions and 3D content already developed at the FHW (Foundation for the Hellenic World) and the technological features provided by the EXPERIMEDIA facility as the 3DCC module for avatar creation.

The PLAYHIST experiment outcome is to enhance visitor learning experiences related to the Historical and Cultural Centre by offering a new way of interacting with cultural content (integrating both digital and real content) from the exhibitions in the FHW. Additional research will be conducted on the integration of 3DCC avatar models with 3D commercial engines (e.g. Unity) for game production.

During the PLAYHIST experiment an interactive and collaborative serious game will be developed, by reusing and adapting 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.

The next figure shows the integration of the PLAYHIST experiment with the EXPERIMEDIA components and the FHW facilities:

![Figure 1. PLAYHIST experiment integration in EXPERIMEDIA](image)
3.1. **Learning Objectives**

The experimenters' aim to carry out the experiment is to investigate the following issues:

- The feasibility of using gamification model to communicate historical information along with the improvement on the Quality of Learning (QoL) for the visitors of a history museum as FHW. The analysis of the QoL can provide the feasibility of using a gaming model to improve the learning experience of the FHW visitors. The idea of the learning object is to demonstrate and measure the engagement of the visitor being an active part of the interactive experience showed in the FHW, in the way of a 3D personalized avatar.
- The feasibility of connecting the EXPERIMEDIA modules with Unity 3D engine including the avatar creation and real time animation modules. ECC, 3DCC and PCC\(^1\) could be used them for future game and interactive application development with new and rich functionalities.
- The feasibility of cluster rendering with Unity in a cutting edge facility as the Tholos. This is the most difficult of the objectives as a lot of programming is involved. Unity development team is currently developing the cluster rendering function although there is no finish date committed and it is possible not to have it ready for the experiment execution.

3.2. **Experiment Procedure**

The objective of the PLAYHIST experiment is to assess the effects of using gamification in Quality of Learning (QoL) and QoE. The hypothesis that will be tested is that learning by playing provides a better understanding of an historical subject. To achieve this 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. They 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\(^2\). 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 pertaining to Group B will be randomly subdivided into two groups:

- **Group B.1**: 3D characters will be previously created and each player will choose one of them.
- **Group B.2**: 3D characters can be created using the avatar creation function of 3DCC module resembling the real person.

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\(^1\) To be decided  
\(^2\) [http://unity3d.com/](http://unity3d.com/)
PLAYHIST experiment will also test, for both B groups, the influence in QoE and QoL, of an expert’s help through an avatar. A person from the museum 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 module. This person will not be seen by the visitors, as the motion capture will be done in another room, but he/she will have in a display the full vision of the game running.

These visitors will play the serious game in the Tholos dome using a mobile device like a tablet, for character moving, performing actions or interacting with other players. At the same time, the complete 3D scene will be showed on the screen, and optionally, a person from the museum will be able to select different views, interact with the players, etc.

The game tasks could be designed in such a way that the players will have to obtain information from the exhibition to be able to answer questions, choose options, etc. This functionality will integrate the real world and the virtual one, achieving a better understanding of the relation between the exhibited content and the information showed in the venue.

The metrics that will be evaluated in the PLAYHIST experiment are:

- QoL: understanding of an historical subject. Comparison of Group A and Bs
- QoL: influence of degree of engagement in the serious game. Comparison of Group B.1, B.2
- QoE: user satisfaction. Comparison of Group A and Bs
- QoS: the number of rendered virtual scenes presented per second, delay between real time motion capture and character animation visualization.

Data to compare the results of different groups will be gathered by users filling in two questionnaires:

- Q.1 The first one will be related to their Quality of Experience (QoE)
- Q.2 The second one will contain questions about the historical data reflected in the interactive film or the serious game, providing information about the QoL

At the same time, some data about QoL or QoE will be automatically registered from the game through the ECC module. At least initially, we will only use the ECC module to gather these data, not the Babylon component from PCC, until the game design is more advanced and the PCC features deeply studied.

As there will be 4 or 6 users per test run, Tecnalia will also suggest the option to do short interviews immediately after the visitors have tried the game. This way, Tecnalia could get them to describe their experience more freely than in the questionnaires and get more information about what they would like to be improved. Tecnalia will get ideas that can be implemented in the second or in future runs.
3.2.1. Usage Description

Alice, Sophia, John and Arthur are a group of middle aged tourists from the UK, visiting the Hellenic Cosmos exhibitions. When they enter the main building to attend one of the interactive films in the Tholos, they are offered a new interactive activity recently developed for the film they want to view. They are explained it consists in a collective serious game aiming to get a more engaging and productive experience for history learning. Alice and John refuse to take part in the activity, but Sophia and Arthur, accept to participate in the game.

While Alice and John are conducted to the Tholos for watching the interactive film, Sophia and Arthur enter in an adjoining room where personnel from the museum explain them the serious game and the way of playing it. They also meet other persons who are going to take part in the experience.

First of all, each visitor is given a tablet to interact and play the serious game. They are given the possibility of choosing an avatar from the collection of 3D available characters or customizing one of them with their own face. Sophia, who wants to try this functionality, puts herself in front of a webcam, where her face is scanned and integrated in the 3D avatar she has chosen.

Once the group has received the instructions for the serious game, and after the interactive film has finished, they enter the Tholos to play.

Each participant takes the role of one of the historical characters and, using the tablet and headsets, moves around the scene and interacts with places and historical characters to achieve a set of tasks. The serious game plot has been developed for better learning of the historical moment represented and is totally aligned with the interactive film. Players can get clues and information to solve the different questions or problems proposed, from the characters they find or the places they visit. They compete among each other to get the maximum score before the serious game finishes.

Sophia gets involved very quickly, and using her tablet, she moves around the scene and gets a lot of information for solving the questions. She can see her competitors avatars in different places of the 3D scene projected in the Tholos screen, while she can see her achievements and tasks to do in her own tablet.

Arthur has been playing for a while but he looks a bit lost, so he asks for help using the tablet. A person from the museum is supervising the experiment in another room. He can see what each player is doing and gets an alert of Arthur asking for help. He decides to appear in the serious game, and standing in front of the Kinect, he starts doing signs, waving… to recall Arthur’s attention and showing in the virtual world the direction Arthur must take. He can also interact with Arthur by typing instructions or via voice.

After twenty minutes, the serious game ends and the players get their score and the final ranking. The best player wins a prize from the museum.
Before leaving the Hellenic Cosmos, Alice, Sophia, John and Arthur are asked to fill in a questionnaire about their experience in the museum, and a second one about the historical content they have received.

The end.

3.3. Background
The base of the information structure used by PLAYHIST experiment will be interactive 3D scenery provided by the FHW venue. At this point the 3D models for testing are being provided in OSG format. Tecnalia is doing the conversion processes needed to import these OSG models into Unity graphic engine.

In November 2013, we visited the FHW in Athens to evaluate the technical constraints and the different interactive films in order to choose the most suitable one for the experiment. After analysing the available productions, Tecnalia and the FHW have agreed to use the Ancient Miletus scenery.

For the election, the learning content of the Ancient Miletus production has also be taken into account, bearing in mind the gamification strategies that will have to be applied for the game development provided not every historical information is suitable of being delivered through gamification.

In this sense, Tecnalia will also count on the historians and experts knowledge on the contents of both the interactive film and the own FHW. Tecnalia people and content experts will have to work very closely to get a good accuracy on the final gamification experiment and will count on their knowledge to "gamify" the chosen interactive film. In this sense, FHW staff will provide Tecnalia with the high level educational goals of Ancient Miletus scenery.

Before beginning to use the 3D model, Tecnalia and FHW will sign a confidentiality agreement, in order not to use the 3D models for other purpose than the PLAYHIST experiment inside the EXPERIMEDIA project.

3.4. Assumptions and Preconditions
Following assumptions and preconditions have to be met in order to drive the PLAYHIST experiment:

- Mobile or Internet access support must be provided in the experimental area.
- FHW partner should be able to provide 3D scenery for the experiment in a common format like OSG or OBJ. Actually some test have been done under OSG format, but the steps to get a compatible format for Unity engine are quite long and time-consuming.
  For the final model, Tecnalia will study other ways to transform the 3D model provided by FHW, looking inside the OSG export possibilities to Collada or FBX format.
- Mobile client must provide interfaces for the user interaction, rating and game mechanics.
• Availability of historians and content experts from FHW to help and validate Tecnalia decisions about the interactive film gamification. A very close work among both teams will be done in order to get the best accuracy of the presented contents.

• The recruiting of the focus group will have to be decided in the terms of Ethics & Privacy of this document, and depending on the availability of visitors. FHW will be in charge of providing the participants following Tecnalia specifications.

• If 3DCC avatar creation module is updated in order to be used inside an Android app, player will be able to use the tablet's webcam to capture their face. If not, player will have to use a PC and webcam solution to capture their face in a previous game step.

3.5. Parameters
In our case, the different parameters would be the definition of the 3D avatars associated to the user. In one case, the avatar would be a standard one, from the avatar library of 3DCC component. On the other case, the avatar should be a standard one with the digitalized face of the own user.

The third case, would be a new play element on the experiment developed, with a 3D avatar moving (digitalised from a person from FHW staff), to help the users in the experiment development.

Other parameter to be had into account is the mentioned in the previous point about the 3D models formats to be provided by FHW. Actually the 3D models are being provided in OSG format, but the pipeline to get the Unity3D compatible models is quite hard, and can have some texture mistakes (and others). Tecnalia and FHW will have to test some other types and transformations, in order the final 3D model can be as faithful as original one (Collada or FBX).

Tecnalia will test different size of tablets for the experiment in order to decide which size works better for game playing. These tests will be done in Tecnalia in order to decide the most suitable size for the experiment run in the FHW. The tablets in study are Nexus 7 2013 (already in the market) and Nexus 10 (to be delivered by the end of the year in Europe), or equivalent.

3.6. Constraints
The partner of the EXPERIMEDIA PLAYHIST experiment have visited the FHW venue once before the deliverable D4.14.1 is delivered, from the 27/11/2013 to 29/11/2013 to analyse the capabilities and constraints of the venue in regards to the experiment. Tecnalia has identified the PLAYHIST experiment should be conducted, subject to the following restrictions:

• No modification of exhibits: the physical exhibits should not be modified or altered in any way. The rendering cluster should not be modified, as it is a critical point in the running exhibition on FHW venue. One clarification has been done in Tecnalia’s visit to FHW: only executable files could be recorded in the main cluster of the exhibition, but these executable files should not alter or modify the computer configuration in any case.

• If Tecnalia decide to use FHW render cluster machines, the executable files should be GNU/Linux compatible because this cluster uses 6 Alienware machines with Debian v5 GNU/Linux installed.
• Apart from no changing cluster machines configuration, these machines cannot have external internet connection, just connectivity in the local network. The experiment will run on June 2014. Tecnalia personal will be present to conduct the experiment and even can train FHW staff to conduct the experiment in a longer period of time.

• Other constraint will be the number of test users available in the experiment conduction time. With a greater number of test users Tecnalia will be able to generate more precise data analysis and QoS and QoL will have a more representative demographic sample on test users. At the current stage, Tecnalia cannot estimate the precise number of test user of the PLAYHIST experiment, but we will promote targeted activities (together with the FHW venue), to ensure the quantity and quality of the test user base. And estimated number of visitors recruited for the experiment would be among 20 and 40 people, depending on the FHW recruiting. Tecnalia will project a two-day experimentation, with 2 or 3 experimentation times (depending on the Tholos availability). The visitors recruited will not be children, but adult people with basic-medium knowledge of English and some technological knowledge about mobile devices, as tablets.

• There will be a physical constraint about the number of visitors at the same time in the experiment, due to the number of tablets provided by Tecnalia. In any case, the possibility of the visitors bringing their own Android devices will be studied.

• The game instructions will be in English textual, due to the constraint Tecnalia doesn't know in advance who is using the game. The possibility of a Greek textual translation will be had into account (provided the Greek translation by FHW staff).

• If the 3D interactive film is not related to a current exposition in FHW, Tecnalia won't have the possibility of use that visitor's previous knowledge to compare it at the game playing stage. Efstathia from FHW has communicated Tecnalia that in May-June the running exhibition will be one related to Folklore. Yet to be decided if it can be related to the game in the experiment.

FHW venue has two main projection systems currently working: the "Dome" and the cave. Both systems have been studied, with the main objective to use the Dome if Unity3D allows us to use at runtime a visualization solution through the computer cluster system installed at FHW (even if it doesn't, the projection will be done on the central projector of the Dome).
4. Methodology

The methodology chosen for the PLAYHIST experiment is focused on developing an experiment for a gamified learning experience, based on the 3D contents provided by the 3D model repository. For this purpose, the experiment activities are logically structured in four workpackages, as defined for the Activity 4 of the EXPERIMEDIA Project:

- At the first stage, WP 4.14.1, the experiment design will be achieved, defining the experimental method, the resources needed and the functional definition of the experiment (it will also be taken into account the EXPERIMEDIA components connection).
- After this, a second stage of implementation will be developed in WP4.14.2. At this point, the connection of the ECC and 3DCC components with the PLAYHIST developments will also be achieved.
- WP4.14.3 will include the experiment execution in FHW, with all the needed monitorization and associated data collection. This stage will implement a new paradigm of engaging around cultural heritage resources, where entertainment can go along with education and information about the European civilizations’ achievements.
- At the last stage, WP4.14.4, the analysis of data collected in the previous workpackage will be performed and a set of best practices in the use of educational serious games for education and appreciation of the Hellenic history and tradition will be defined.

4.1. Value Impact Assessment

The experiment will be conducted in accordance with the EXPERIMEDIA meta-methods put forward in Deliverable 2.1.1, “First EXPERIMEDIA methodology”, specifically the Value Impact Assessment (VIA). The VIA framework is organised into three phases, designed to incrementally move towards industrialisation and large-scale trials. Phase 1 is really targeted to a very small number of users, and due to the characteristics and technical constraints of the PLAYHIST experiment, where only a small number of participants will be able to take part on it, we will focus on this stage aiming at studying the opportunities and risks behind the experiment. The main research question is whether the PLAYHIST approach to using serious games for illustrating and explaining facts about major historic events could make it into the market as an additional attraction for History museums or as an additional educational resource for primary and high schools.

The experiment is ultimately intended to evaluate the impact of the PLAYHIST proposal for venues like the FHW. The expected impact of the PLAYHIST experiment for the involved stakeholders is depicted in the following table:

<table>
<thead>
<tr>
<th>Stakeholder</th>
<th>PLAYHIST impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Visitors</td>
<td>Improvement of visitor experience.</td>
</tr>
<tr>
<td></td>
<td>Enhancing of the learning experience.</td>
</tr>
<tr>
<td></td>
<td>Improve the overall experience of the audience through their interaction with a serious game, in two facets: engagement and learning.</td>
</tr>
</tbody>
</table>
Visitors will enjoy new education experiences aimed at improving the understanding of historic events, relying on serious games. Motivate visitors to go deeper into the historical core concepts, especially for scholars and children. Students take control of their own learning and are engaged participants rather than passive observers.

<table>
<thead>
<tr>
<th>Venue management</th>
<th>Capacity to attract more visitors and offer better experience by offering a new additional service to the ones currently available to their visitors. Examine the suitability of gamification for improving visitors’ experience, in two facets: engagement and learning. Achieve FHW’s mission: the preservation and dissemination of Hellenic history and tradition, the creation of an awareness of the universal dimension of Hellenism and the promotion of its contribution to cultural evolution.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Museum staff</td>
<td>Capacity to participate in a new type of collective experience interacting with visitors in an innovative way through a virtual 3D character. Possibility to be another actor in the serious game, participating in the live reconstructions or animations.</td>
</tr>
<tr>
<td>Content providers</td>
<td>Availability of an additional outlet for the multimedia contents they produce, which will be usable to provide historically-meaningful explanations to the situations arisen during the serious game. Availability of a new tool for 3D characters development for interactive applications and serious games as a result of the integration of 3DCC module and a widely used 3D engine as Unity.</td>
</tr>
</tbody>
</table>

The steps to ensure the impacts will start with the experiment at Hellenic Cosmos venue, in two phases. The first one will be a Value Opportunity Validation phase and will be small scale experimentation. This first phase will provide queues as to whether the approach could be industrialized, i.e. to whether this experimental setting could be a new service provided by Hellenic Cosmos for its paying customers.

In a second phase, after the experiment (and possibly the EXPERIMEDIA project) has finished, the system could remain in Hellenic Cosmos for further VIA tests. The user base would grow accordingly, as it would be easily replicable in other FHW venues provided the necessary network infrastructure existed. Therefore, further experiments in order to nail the uncertainties are easily possible and affordable.

TECNALIA is aware that some of these impacts mentioned above are difficult to quantify and verify in a direct and explicit fashion due to their indirect nature. Most of those impacts are medium to long-term impacts and will therefore be difficult to evaluate during or immediately after the one-year lifetime of the experiment. That said, some steps can be mentioned on how to bring about these impacts:

- Adherence to targets and proclaimed solutions and best practices within the network
- Awareness raising in the wider community of potential users, with promotion actions and dissemination
• Creation, maintenance and animation of user communities, so that a sufficient sample of the immediate impact of the project becomes available.

As explained in Deliverable 2.1.1, “First EXPERIMEDIA methodology”, VIA focuses on defining, measuring and assessing business release value at specific milestones during the lifetime of an experiment. The business release value was first defined in terms of key performance indicators derived from Quality of Service (QoS) and Quality of Experience (QoE) metrics. The PLAYHIST experiment will assess these three dimensions as explained below.

4.1.1. Quality of Service Metrics

QoS data typically reflects direct, objective measurements of physical characteristics of the environment of an experiment or the performance characteristics of software or hardware components. The most important aspects identified thus far are:

• The responsiveness of the interfaces offered during the gaming stage. This will be a function of the memory and computing power of the mobile devices.

• The responsiveness of the communication with the different pieces of software lodged remotely in the EXPERIMEDIA facility. The critical point is the following one: [3DCC] The latencies in the communication with the expert element during the gaming stage, which might be a delay between real time motion capture and character animation visualization.

• The battery consumption of the participants’ tactile mobile devices. The obvious requirement is to be up for the whole duration of the three stages, regardless of how much the users interact with the mobile application.

• The frame rate in the different game interfaces.

4.1.2. Quality of Experience Metrics

QoE reporting is the subjective perception of an individual within a specific usage context considering cognitional, affective and emotional dimensions, so QoE could only be measured by a user self-reporting on their experience. We have two types of participants in our experiment. The ones attending the normal interactive film will fill in a questionnaire at the end of the projection with questions related to level of entertainment, quality of the content, level of interactivity, etc.

In the case of participants playing the game, with the aim of understanding the experiential aspect of the PLAYHIST experiment, QoE data will include both quantitative and qualitative measures:

• On the one hand, the software will keep track of all the movements and actions of the participants during the game. Likewise, the application running on the tactile mobile devices will be providing stats about how and when the participants use its different features and interfaces (as areas of virtual world visited or not, times in areas, number of times a player tries a test/mini-game, scores from mini-games and combined scores, how long they played for).
On the other hand, the mobile application will provide brief questionnaires to gather opinions about the PLAYHIST approach and to rate different features of the experience: educational value, level of entertainment, convenience of the interfaces, quality and completeness of the contents, preferences for certain types of contents, etc. Those ratings will be matched against anonymous information about the participants’ educational background and interest in specific topics.

4.1.3. Quality of Learning Metrics

QoL in PLAYHIST experiment is defined to reflect the amount of knowledge gained by the visitor in the gaming experience. Typically QoL is referred to how the learner (in this case the visitor) constructs meaning out of experience (the game in our case). Data gathered in the experiment will mainly include quantitative measures, but not forgetting the qualitative ones (mainly provided by the visitors’ own attitude and motivation):

- On the one hand, and from the quantitative point of view, the game playing should enhance and facilitate the interpretative process on the Ancient Greek life of a city. Because of the gamification it should be easier and more pleasant to interact with the content. There will be defined metrics to measure the visitor’s increase of knowledge and understanding of an historical subject. For example, one of the metrics could be the comparison between time on each mini-game and knowledge gained at that step. The game itself can directly provide some of the metrics based on the answers or elections done by each player while playing.
- On the other hand, QoL will measure the experience of learning by playing. In other words, some questions should be posed, as:
  - does the visitor consider gaming is a good way to learn?
  - does the use of historical game playing increase the motivation to learn or the visitor’s attitude towards the contents showed?
  - was the game playing interesting?
  - would the experience incline the visitor to explore further in the domain?

4.2. Privacy Impact Assessment

Experiments conducted using the EXPERIMEDIA facility take into account ethical concerns, mainly relating to the protection of personal data and the privacy of the users involved in such experiments,

The PLAYHIST experiment will be conducted in accordance with EXPERIMEDIA’s ethical and data protection procedures and will follow the measures defined by the EXPERIMEDIA’s Ethical Advisory Board and Data Protection Coordinator. In this sense, the design and execution of the experiment will respect the ethical principles and guidelines defined in the EXPERIMEDIA deliverables D5.1.1 EAB and DPB Operating Procedures and D5.1.2 Ethical and regulatory framework for social and networked media- and also will follow the privacy impact assessment methodology defined in the deliverable D2.1.1 First EXPERIMEDIA Methodology.
Therefore, the experiment fully acknowledges the existing legislation in the area of privacy and personal data protection, which has been a focal point of the European Community actions since Directive 95/46/EC of the European Parliament and of the Council of 24 October 1995, on the protection of individuals with regard to the processing of personal data and the free movement of these data.

The main ethical issues concerning the PLAYHIST experiment have been outlined below, following the questionnaire format produced by the EXPERIMEDIA project.

Before going into the details, we recall here the principles of data collection adopted for the PLAYHIST experiment:

- Demographic data as gender, group of age, nationality or educational background will be collected to do a proper assessment of QoE and QoS with statistical information.
- Participant's name and id number will be only collected and used for the tablet device assignment and the informed consent for the participation in the experiment.
- Participant image will be captured directly on the tablet and erased after experiment/game ends.

4.2.1. Participants / Recruitment

There will be three types of participants in the PLAYHIST experiment: visitors, expert and administrator. The requirements for them will be as follows:

- Visitors need not have any specific background to participate in the experiment apart from an average level of English and familiarity with tactile mobile devices (tablets). They will only participate in one experimentation session which will typically last between 20 and 30 minutes (including preparation, gaming and delivery of questionnaires).
- The role of expert may be played by invited historians, FHW guides and experts or by some of the experimenters. Nevertheless, knowing the difficulties faced by the people from the FHW to involve real experts in their embedded, it is expected that this role will be played by one of the experimenters in some of the sessions (at least the initial ones).
- The administrator will always be a member of the experimentation team.

Both experts and administrators may participate in several sessions to support different groups of visitors.

The core of the experimentation will be done in the Hellenic Cosmos (the venue provided by the Foundation of the Hellenic World in Athens), but this will be supplemented with trials in the Tecnalia offices in Vitoria (Spain), both ex ante (to get early feedback and thereby fix defects in the software or in the experiment design itself) and ex post (to gather further evidence for the evaluation or to assess questions that remain unanswered).

In late November 2013, Tecnalia personnel had a meeting with representatives of the FHW and CERTH in FHW offices and the Hellenic Cosmos, with the purpose of getting to know the venue and discuss early questions relevant for the realisation of the PLAYHIST experiment. Besides taking note of the technology and the spaces available, Tecnalia could check that most of
the visitors to the Hellenic Cosmos are children who come with teachers and/or their parents, so it would be rather difficult to gather a sufficient number of volunteers to run the group experiences proposed in the experiment while complying with the decision of the EXPERIMEDIA consortium to avoid involvement of minors. Therefore, both partners agreed to be FHW personnel the ones in charge to recruit the adult volunteers (previous confirmation from Tecnalia of the dates of the initial test and experiment, with a month in advance).

The recruiting procedures will not consider any payments to the participants, and it will be made sure that participants do not feel pressured in any way by the experimenters or peers.

4.2.2. Informed Consent
All the participants in the PLAYHIST experiment will be informed about the purpose of the experiment and all the aspects around the usage of the corresponding systems and interfaces to ensure that they understand the experiment and are willing to participate. This communication will be done in written and signed during the recruiting process. Translation of the informed consent agreement into Greek will be available if FHW staff provides to Tecnalia the Greek translation of the document, in order to facilitate the understanding of the document. The terms will be reminded before the activation of the interfaces; the users will have to agree on them by ticking a checkbox upon start-up.

4.2.3. Confidentiality
Key features of the PLAYHIST experiences are enabled by having a detailed record of the actions made by participants during the gaming stage. Some demographic information (e.g. age and educational background) will be used to assess some QoE and QoL parameters, but names, home addresses, telephone numbers, e-mail addresses and other pieces of information that might serve to identify a given individual will not be needed. The experiment will be self-contained inasmuch as the aforementioned records will not be linked to any other data.

One major measure to protect the participants against any uses of the data beyond the mere experimentation goals will be to ensure that the records of actions and responses are totally anonymous, for which the data will be linked to the participants' nicknames in the game (which are uniquely stored during the game process), not to any personal data that may serve to identify a given individual. The 3D avatars created at the beginning of the game stage (the ones with the visitor's face) will be used only during the experimentation session, and deleted immediately afterwards along with any data cached or stored by the PLAYHIST software in the participants' devices. To cover possible cases of unattended switch-off, any cached data surviving from previous experimentations will be deleted automatically upon start-up of a new one.

Data collected or logged during the experiment will only be available to the experimenters and to whoever else should be granted access according to the rules and terms of the EXPERIMEDIA project. Any data stored out of the EXPERIMEDIA facility will be kept in computers belonging to the experimenters' research group of Tecnalia. The Spanish Agency for Data Protection has been informed about the terms of this experiment. We are waiting for reply.
In principle, the experimenters’ group will keep the fully-anonymized data indefinitely, only for research purposes. There is no commercial intention behind the collection of this data, so no third parties will ever be allowed to access the data, and no transfers will be permitted.
5. **Experiment Design**

This section will describe the initial design proposed, explaining all the different parts of the experiment, including the EXPERIMEDIA baseline components, the ones initially considered (3DCC and of course ECC) and one extra component that has been suggested and recommended to be able to integrate PLAYHIST experiment (PCC).

### 5.1. Requirements

With the aim of test and evaluate the proposed scenario, several requirements have been identified:

- There must be good and stable local internet connection coverage at the FHW facilities in order to avoid game interaction delays.
- Internet connections ports used in the experiment should be opened to avoid problems in the interaction of different experiment parts and devices.
- Baseline components must be ready to be integrated in multiple mobile platforms (Android, Unity3D...).
- 3DCC component must be able to extract acquired data into a Unity3D compatible data format in order to be consumed by Unity3D at runtime.
- If PCC component is finally used, it should be able to provide an agile live game interaction services.
- The venue should ensure that there are visitors to take part in the experiment.
- FHW 3D models must be supplied in a Unity3D compatible format, or at least the processes to convert these models into a compatible format should be offered.

### 5.2. System Architecture

The following figure represents a very high-level architecture diagram:
Figure 2. High-Level Architecture
With the goal of representing the concept of the experiment from a technical point of view the following diagram has been also prepared:

![Diagram](Image)

**Figure 3. Conceptual experiment representation**

### 5.2.1. Functional Building Blocks

As previously mentioned, PLAYHIST experiment will use the 3DCC and ECC EXPERIMEDIA baseline components, and it will also be studied the inclusion of PCC component, specifically its live game services exposed features. From ECC and 3DCC modules, we will use all their features.

PLAYHIST Experiment Core represents all developments needed to create the multiplayer real-time serious game, already integrated with EXPERIMEDIA components. As shown in Figure 3 visitors will be players, through a "slave" app in a tablet, of a master multiplayer game running on PLAYHIST core. Visitors use the tablets to move, engage and interact in the game, but truly, everything is monitored and managed through the PLAYHIST core, which acts like a server.

At this point, the modules which form this PLAYHIST core, can only be described from high level approach:

- **Unity3D game:** What we are going to develop really is a 3D multiplayer game, so it will be necessary to create everything you need to develop a serious game. Using Unity as 3D engine, and based on the 3D models provided by FHW, we will develop all the game logic, interactions, events, menus, tests, sync processes etc. and all this based on a historical context and a story.
• Events Interface: PLAYHIST Experiment Core will listen visitors’ interactions as game players, so we will implement a middle layer in order to centralize and manage all this kind of input and output events to convert them into remote call procedures.

• EXPERIMEDIA Interface: With the aim of integrating all the EXPERIMEDIA components with the Unity3D game itself we will develop a middleware layer which will allow us to connect all different experiment modules.

• ECC Client implementation: Inside this core module is the ECC client implementation.

In principle, ECC "server" (and its dashboard) will be deployed locally in the same machine that PLAYHIST core.

As mentioned previously, an app for tablets will be also developed, which actually will be the front end for visitors to become players. Visitors will see the game on the Dome facility and will use the tablet to move through the game, respond and interact. The tablet is constantly connected to the PLAYHIST Core. At this stage, the architecture designed, centralizes everything in the PLAYHIST core, so there will be only one ECC client implementation. Depending on the complexity of the integration of the different modules, the implementation of several ECC clients (one at the core, and others on the tablets apps) could be considered.

3DCC component will also be used independently with the aim of acquiring expert animation to help users or in the initial stages of the game if visitors want to see their face reflected in his avatar in the game. This part will also be connected to the core constantly. The expert will also have a small interface, through which he will be able to know which players are asking for support.

5.2.2. Technical Assets

The experiment will involve a series of hardware and software assets, namely:

• A PC or a server machine equipped with a high performance GPU and processor.
• 3-4 tablet devices for the visitors in order to play the game.
• Wi-Fi network connectivity with an appropriate bandwidth and stability.
• Unity3D Pro license.
• Unity Master Server.
• FHW 3D Models set (Ancient Miletus scenery).
• A visualization environment suitable for a multiplayer game. (In this case the Dome ready) A Kinect and Laptop appropriate for running 3DCC component.

• If the FHW cluster solution is finally discarded, an intermediate solution will be using a PC with several (3-6) GPU outputs to directly connect this machine to the Tholos projectors.

Beside, as already detailed above, we will make use of the following Experimedia baseline components:

• ECC v1.2
• 3DCC
• PCC, its inclusion will be studied, depends on progress and needs

5.3. Content Lifecycle

5.3.1. Content Authoring
This experiment does not involve any ad hoc content creation, since the content will be reused and imported from FHW already designed 3D models. The only content that will be "created" is the one referred to the people involved in the experiment faces capturing process, to be attached to the game avatars.

The QoS and QoE data generated during the experiment runs should also be treated as content. QoS data will be collected by the ECC, while QoE evaluation will be based on questionnaires filled by the participants after experiment runs.

In the precise case of PLAYHIST experiment, a new concept of QoL has been introduced. The QoL data will be obtained by means of a second questionnaire that will contain questions about the historical data reflected in the interactive film or the serious game, providing the information about the QoL needed for the study.

5.3.2. Content Management
The content of the experiment will be integrated and compiled inside the PLAYHIST Core, and a small part will be compiled and deployed through the tablet app. In summary all the experiment content will be compiled and used in order to be consumed, there is no possibility on managing the content.

The previously mentioned people faces, captured through 3DCC, will be used only at runtime, so they will be created at the game/experiment beginning and removed at the end.

5.3.3. Content Delivery
As mentioned above, content will served through a mixed solution of the FHW visualization facilities (Tholos, projecting with 3 or 1 project, it has yet to be decided) and the tablet app.
6. Plan for Implementation

This sections lists the actions needed to be completed in order to carry out the experiment and a preliminary timeline for their completion.

6.1. Current Status

Until now, Tecnalia has done some test with the 3D models, provided in OSG format. It is pending to evaluate if a quicker and more automatic process can be found to obtain the OBJ models needed for Unity graphic engine (it will be tested the OSG export possibilities to Colada or FBX format, in order to simplify the process of 3D model acquisition).

The final 3D scenery has already been decided. It will be the Ancient Miletus exhibition. It is a full reconstruction of the two important Hellenistic cities of Asia Minor (Ionia), which are located in the territory of modern day Turkey. It is a harbour town with a complete Agora (with all the little shops inside and a central block for sacrifices). The harbour has two different boats. One of them could be used for the game (with old vases inside).

As mentioned in Constraints section, FHW render cluster machines cannot have external internet connection, just connectivity in the local network, so Tecnalia has already begun Unity Master Server compilation and local deployment tests. This Unity Master Server abstracts the implementation of the multiplayer thread synchronization.

6.2. Development of the System’s Components

The system’s software and hardware components have to be developed and adapted to the PLAYHIST experiment. That will include:

- Develop a system interface between 3DCC module and the Unity graphic engine development, in order to bring to the 3D model the avatars representing the visitors and the expert movement acquisition.
- Develop and EXPERIMEDIA interface for the ECC module to connect the QoS and QoE measurements that will be researched in the experiment. These measurements also need to be defined and Unity developed component need to be adapted in order to collect them.

6.3. Integrating the System with EXPERIMEDIA Baseline Components

Two EXPERIMEDIA baseline components, ECC and 3DCC are planned to be utilised in the experiment. This requires some integration effort:

- PLAYHIST core will use an ECC client implementation to send monitoring data to the ECC server component
- PLAYHIST core will implement a listen 3DCC client to retrieve visitors’ avatar data and expert movement acquisition from 3DCC principal module.

6.4. Experiment Runs

Two runs of the experiment can be planned:
• A preliminary run: to allow the experimenters to identify any potential problems in the experiment setup and to fine-tune the parameters (May 2014)
• A final run: carried out to gather the QoS, QoE and QoL measurements in an optimal setup, although this data will also be recorded during the test run. In order to do that, QoE and QoL questionnaires have to get prepared beforehand (June-July 2014)

6.5. Experiment Results Assessment and Reporting
The assessment of results will start after the preliminary run of the experiment and will continue after the final run. The gathered QoS, QoE and QoL data along with any additional experiences and findings will serve as basis for the final experiment report.

Following completion and delivery of this document, the plan for implementation of the work-plan will be completed with the following precise tasks:

• Elaborate the list of requirements for the experiment development, after the End-of-November visit to FHW
• Decide the 3D scenery for the experiment → early December 2013
• Sign the confidentiality agreement for receiving the 3D models from FHW → mid December 2013
• Receive the high level educational goals of the gamification process from the FHW → end of December 2013
• Design the gamification platform and send the proposal for the replay and debate stages to the Cultural Information Sector of the FHW for review and feedback, in order to ensure historical rigor in the PLAYHIST experiment → end of January 2014
• Submitting a paper describing the experiment and its technological basis to the 16th International Conferences and Exhibitions of Virtual Technologies and uses (Laval Virtual 2014) → early December 2013
• Implementation of gamification module and 3D avatar adaptation module → May 2014
• New visit to FHW for testing the PLAYHIST implementation → May 2014
• Definitive PLAYHIST running experiment → June-July 2014
Figure 4 contains an approximate timeline for the above tasks.

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Figure 4. Approximate experiment timeline
7. Conclusion

We have described in this document the current status and future plans for the experiment PLAYHIST based at the Foundation for the Hellenic World in Athens. The purpose of the experiment as both a mechanism for helping the EXPERIMEDIA project and as a piece of research in itself has been discussed. The project’s architectural blueprint, methodological guidelines and ethical oversight principles have all been taken into account.

This report will be followed by a progress report, including intermediate results, at the end of March.