

Personalizing interactive digital storytelling in archaeological museums: the CHES project

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Abstract. The aim of this paper is to present the state-of-the art research project in digital storytelling for museums titled CHES (Cultural Heritage Experiences through Socio-personal interactions and Storytelling). The goal of CHES is to research, implement and evaluate an innovative conceptual and technological framework that will enable both the experiencing of personalised interactive stories for visitors of cultural sites and the authoring of narrative structures by the cultural content experts. We believe that the new modality of extended museum visit that CHES proposes will make cultural heritage sites more attractive and effectively conveyed to audiences (especially to “digital natives”) and will provide new means to leverage and exploit the existing digital libraries that have been developed since several years in the cultural heritage world.

Keywords: archaeological museums, interactive digital storytelling, mobile devices, personalization.

1 Introduction

Archaeological museums can be uninteresting to many people because they do not connect to the personal narratives that visitors carry with them and, implicitly or explicitly, constantly re-build. Indeed, memory institutions need to sustain, not to say reinforce, their attractiveness and the interest of their visitors if they do not want to find themselves standing still “on the conveyer belt of history” (Serota 1996). They must make cultural heritage more engaging, especially for the young generations of “digital natives”. A challenge for cultural heritage sites is to capitalise on the pervasive use of such media, while also facing the competition from the leisure-based entertainment industry, which attracts visitors through spectacular exhibits and events with experiential, but also even educational and cultural qualities. However, digital cultural heritage content and assets can be expensive, technically difficult to make, and hard to renew.

This is where novel research kicks in. Recent investigations in interactive digital storytelling, personalization and adaptivity, and mixed reality, coupled with mobility-enabling systems, promise to make not only cultural heritage sites more attractive but also to provide new means to convey cultural knowledge, interpretation, and analysis more effectively to audiences. Moreover, novel digital technologies will provide opportunities to leverage and exploit, in new forms of cultural interactive experiences, the existing digital libraries that have been developed since several years in the cultural heritage world.

The aim of our paper is to present the on-going EU funded project CHES (Cultural Heritage Experiences through Socio-personal interactions and Storytelling - www.chessexperience.eu). The principal objective of CHES is to research, implement and evaluate an innovative conceptual and technological framework that will enable both the experiencing of personalised interactive stories for visitors of cultural sites, and the authoring of narrative structures by the cultural content experts.

2 A story of storytelling

2.1 Storytelling, from oral to interactive

Storytelling is defined as the production of a narrative that communicates experiences in an oral form (Villaseñor 2007). As any communication process, it is an action that reproduces but also produces culture. This means two things. On the one hand, it contributes to re-experiencing one's own heritage, thus reinforcing identity and the feeling of belonging to a community (Abrahamson 1998). In this sense, storytelling fulfils also a moral role since, through their underlying messages, stories transmit cultural values and sanction what beliefs and behaviours are allowed or not (Bruner 1990). On the other hand, because storytelling is a general human capacity (Schank 1995) and because it deals with personal emotions and experiences, it helps to overcome cultural distances and to be able to understand other ways of living and thinking (Bruner and Turner 1986).

Storytelling constitutes the expression of an experience but also an experience in itself (Johnsson 2006). This implies face-to-face communication, and therefore an interaction between the storyteller and the audience. Thus, storytelling is *per se* an interactive performance, in which the teller adjusts the vocalization, wording, physical movements, gestures, and pace of the story to better meet the needs of the responsive audience (Bull and Kajder 2004). Telling a story is not limited to just oral communication, but also involves the creation of an atmosphere through senses, in which all told events are emphasised one after the other (Bailey 1999). In order to tell a story and to catch the audience's attention, the story teller does not only relate the events, but also makes the audience feel emotions along the narration (Bates 1994). This is where empathy comes into play. Enriching a story, catching the audience's attention and stimulating the senses contribute to create a moving story, making it memorable (Peterson and McCabe 1984).

Storytelling is considered the first, most essential form of human learning (Bruner 1990). It has been defined as an imaginative form of discourse, which guides the listener to a process of meaning-making in the openness of an "imaginative state" (Bruner 1990). Not only this definition is close to the constructivist theories of learning, but it has been demonstrated that stories are more easily remembered than raw facts because they contain an underlying structure and can be linked with prior experiences (Pozo, Asensio et al. 1989). Moreover, social theories of learning (Vigotsky 1978) emphasise the importance of interaction between participants. Storytelling complies with it, especially if the audience is encouraged to participate (Villaseñor 2007). Storytelling also stimulates other cognitive factors that contribute to learning (Egan 1989) such as attention (by the correct pace in the story that keeps the listener engaged) and empathy (emotional identification provides a cognitive anchorage, a frame of reference to make sense of and to ground the new information to be added).

The advent of the written word and its systematization with print transformed the oral tradition of storytelling into a literary form of art. The basic rules of oral storytelling are the same: it needs to have a clear purpose, contain strong characters that evolve, depict an atmosphere, and tell a story that is emotionally compelling, timeless and raises questions (Norris 2011). However, while it has the advantage that it includes images and it can be taken anywhere, it has lost its interactive character and the contact with the human narrator.

The next step in the historical development of storytelling is the cinema. Again, movies apply all the rules of traditional storytelling but enhance the creation of an atmosphere thanks to the audiovisual dimension and introduce new ways to develop the narration beyond Freytag's narrative model¹, thanks to the connotative and denotative power of images. Unlike books, movies are not ubiquitous, but they recuperate the social (although passive) aspect of storytelling, since a community (the audience) gathers to watch the film.

¹ Gustav Freytag (1816-1895), German novelist, defined the narrative structure as: exposition – rising action – climax – resolution.

² The concept of "persona" comes from the Human-Computer Interaction field and corresponds to detailed descriptions of

During the 90s, the use of computers opened a new field called digital storytelling, which has been defined as the combination of narrative with digital content (images, sound, and video) to create a short movie, typically with a strong emotional component. Because of this multimedia component, digital storytelling allows many of the elements of traditional storytelling to be integrated and to address different learning styles (Springer, Kajder et al. 2004). This is especially true in the case of Interactive Digital Storytelling, which appeared some ten years later with the introduction of interactivity. This new form combines participation, as occurs in computer games, with automatic story generation and narration. User interaction is strongly related with the paradigm adopted to create the story. Plot-based approaches are primarily concerned with the importance of narrative structure, and their main focus is to ensure that a certain level of coherence and dramatic tension is provided, much as it is in more traditional storytelling media. In a plot-based approach (Spierling, Braun et al. 2002), plot generation and visualization are treated separately, and well-defined stages of authoring, planning, and user interference are present (Holmquist, Helander et al. 2000).

In character-based approaches (Young 2000), the storyline usually results from the real-time interaction between virtual autonomous agents and the user (Balet, Duysens et al. 2008). Much previous research has focused on the application of various Artificial Intelligence techniques to imbue automated characters with personality, desires, and goals (Sgouros 1999). In spite of the several potential advantages of this approach to communicate / experience historical events or other societies (Danks, Goodchild et al. 2007), some authors consider that interactivity and storytelling do not fit together because the user's actions interfere with the plot and the coherent development of the story is lost, which can be especially negative for highly structured processes such as learning (Crawford 2005).

2.2 Storytelling and Archaeology

As member of the historical knowledge domain, Archaeology is deeply related with narration: it does not constitute a goal (as it happened with chronicles) nor it is used as a source (as it happens with History), but it still constitutes the main communication means (Ginzburg 1989). In the tradition of cultural materialism, the product of research corresponded to a chronological, sequential narration about what had happened in broad regions or countries (Trigger 1989). Later, the European processual functionalism and the Nord-American "New Archaeology" attempted to transfer the current scientific paradigm to Archaeology. As a consequence, they established the anthropological explanation of the material remains as their main goal (Trigger 1989), and even attempted to adopt a formal language such as the one used in logic or mathematics.

The postmodernism turn of the 60s, and the consequent theories such as post-colonialism, post-industrialism and feminism, drew attention to the subjectivity involved in interpretation processes and questioned the meta-narratives that until then had sanctioned the production of scientific, objective knowledge (Villaseñor 2007). For post-modernism there is no such thing as the truth nor universal laws constitute a scientific goal; instead, multiple opinions and perceptions are welcome to understand and represent reality. This opens the way to re-engage with storytelling. Post-modern archaeology recuperated it within the framework of micro-history, understood as subjective interpretation of researchers or as personal stories "told" by those who lived the facts.

Although nowadays a clear distinction between facts and stories, between proof and opinion, still persists in Archaeology, an engaging text that aims to engage or convince the reader needs to have a balance between validity, reliability, and a human or emotional component (Villaseñor 2007). This is even more compelling in an educative context, and is the reason why several Social Sciences choose storytelling as the main way to communicate with non-expert audiences (Nash 1990; Bedford 2001). The specific problem of Archaeology is to find a communication formula that integrates different representation formats (descriptions, maps, pictures...), multicausality, time and space scales, etc. Some authors developed interactive storytelling projects with a multimedia approach (Tringham

2004), but they remained isolated attempts until the spreading of low-cost Virtual Reality and serious games (Roussou 2001; Pietroni, Forte et al. 2006; Kee, Beheshti et al. 2008; Gonzalez-Tennant 2010).

2.3 Storytelling in museums

Museums are storytellers (Bedford 2001; Johnsson 2006). Starting from the premise that the meaning of archaeological objects is not immediately accessible to non-expert audiences, museums propose one or more interpretations of objects, which are usually presented through a combination of different mediators sequentially located within the space of the gallery. The 19th century museum proposed a monolithic, authoritative perspective, based on a chronological and geographical arrangement, and on labels (Wyman, Smith et al. 2011). As a consequence, storytelling was implicit, mainly related to the objects' historical context, and therefore only accessible to experts. The transformation of the museological practices during the second half 20th century (the so called New Museology) has transformed exhibitions, which now present different points of view (mainly related to the social and cultural context); are based on other arrangements (e.g. thematic); and include different tools for different audience sectors to build their own interpretations or even share authorship with the museum (Fisher, Twiss-Garrity et al. 2008).

The adoption of a more explicit storytelling approach to exhibition design contributes to making collections more accessible and engaging for different kinds of audiences: it creates a relaxed environment that raises self-confidence (Johnsson 2006); establishes a universal way of communication; and because it invites the audience to fill in the blanks with their own experiences, it helps to set emotional connections, which are deeper than intellectual understanding (Bedford 2001; Springer, Kajder et al. 2004). Moreover, traditional storytelling has recently been introduced by museums as another means to contextualise objects in two ways: as specific events in the museum's family or school programmes (e.g. National Archaeological Museum of Athens), and by including in exhibitions personal stories related to historical events (e.g. the Imperial War Museum North). This has three consequences (Fisher, Twiss-Garrity et al. 2008; Hooper-Greenhill 1999): firstly, objects become closer and more relevant for visitors; secondly, social minorities see themselves represented in the museum; finally, it helps the majority culture to overcome the self-centred, reductionist perspective of the world.

At present, museums are trying to develop their exhibitions so that the experience adapts to the different interests and needs of visitors, with the ideal goal to make it fully personalised and interactive. They are also aware of the need to have more powerful tools to support their function as creators of narrative experiences. The challenge of supporting interactive storytelling in Cultural Heritage has been at the core of several previous projects, such as Art-E-fact (Spierling and Iurgel 2003), NICE (Bernsen and Dybkjr 2005), INSTEP (Danks, Goodchild et al. 2007), Brighton Fishing Museum (Danks 2008), or INSCAPE (www.inscapers.com). However, while the results of interactive digital storytelling projects have been successful when applied to games, films, or multimedia, their potential to enhance storytelling in museums is less clear. Museums comprise a distinctive setting for storytelling, not only because they need to integrate digital media with physical artefacts and settings (Benford, Bowers et al. 2001), but also because they are very often experienced by groups.

3 The CHESS Project

CHESS proposes to enrich the museum visit through personalised interactive storytelling experiences on two axes: a) by personalizing and (dynamically) adapting information about cultural artefacts to each individual or group of individual visitors, and b) by (re) injecting the sense of discovery and wonder in the visitor's experience. The driving force of the project is its experience-oriented, user-centred approach, which aims at ensuring that its users' needs are perfectly addressed, thus maximising the acceptance of a highly innovative system and its potential for use in pragmatic situations. CHESS targets two levels of end-users:

1. **Visitors** are people experiencing an interactive story created with the CHESSE authoring tool. They are invited to join in the available adventures when entering the museum or from home. When on-site, they participate through their mobile phone, receiving information from the system according to the plot, their position, their personal profile, but also contributing information in response to the system's solicitations.
2. **Authors** are non computer-experts (e.g., content providers, curators, and museum staff) in charge of creating cultural interactive experiences for visitors. They use the CHESSE authoring tool to create narrative structures that use existing digital content, support several devices and multiple visitors, and adapt to the visitors' profile, progress within the experience, and interactions.

To support this approach, a user-centred design philosophy is followed throughout the entire course of the project, both in the design and the evaluation phases. The main tenets include:

- An **iterative process** of design – development – evaluation, which begins with a comprehensive analysis of the needs, wants, and limitations of the end-users. For every step of the project, a multi-tiered **evaluation** methodology has been set, in order to test the validity of the design, either in real world experiments or through the organisation of **user workshops**.
- A **participatory design** methodology, implemented with a small group of end-users (both museum curators and representative groups of visitors) who, either as partners in the consortium or through a user group actively participate in the planning and design of the scenarios from the outset.
- The development of both a **personalised and an adaptive** system, which delivers personalised narrative experiences for each visitor. The modelling of a visitor profile starts with its assignment to a specific pre-defined **persona**² thanks to techniques such as the CHESSE Visitor Survey (a brief questionnaire aimed at gathering information from the visitor). Additionally, CHESSE may make use of “automatic” extraction of users' profiles from social networking sites. During the visit, the system will be able to recognise the change in interests and needs over time and dynamically adapt to the visitor throughout the entire visit.

The CHESSE consortium comprises seven organisations from four different countries, which provide all the necessary competencies throughout three complementary categories of partners:

Name	Country	Type	Field	Main role
Diginext (DXT)	France	Industrial	Simulation and VR	Coordination, Authoring Tool & Distributed Framework
University of Athens (UoA)	Greece	Research	Computer Science	Story Model, Personalization & Adaptation, User-centred design and scenarios
University of Nottingham (UNOTT)	UK	Research	HCI	Evaluation
Fraunhofer Institute of Technology (IGD)	Germany	Research	Visual Computing	Experiencing systems
Real Fusio (RF)	France	Industrial	Interactive visualisation	Dissemination, Multimedia Assets automated simplification
Acropolis Museum (AM)	Greece	Cultural	Archaeological Museum	Content development

² The concept of “persona” comes from the Human-Computer Interaction field and corresponds to detailed descriptions of imaginary people built out of well-understood, highly specified data about real people, which are used as a design tool, in order to create a set of representative profiles (or archetypes) for users.

Cité de l'espace (CITE)	France	Cultural	Science Museum	Content development
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Table 1: The CHESS Consortium

The different nature of the cultural partners (an archaeological museum and a science centre) provides an interesting test bed for the implementation of interactive digital storytelling in different contexts. Cité de l'espace is a science centre displaying educational models with a high degree of interaction, and it expects that CHESS provides a coherent link between exhibits. The Acropolis Museum (AM), on the other hand, displays originals aimed at contemplation, with a low degree of interaction, and expects from CHESS an explicit interpretation of objects.

4 Development of the CHESS project at the Acropolis Museum

The Acropolis Museum (<http://www.theacropolismuseum.gr>) is an archaeological museum devoted to the archaeological findings of the Acropolis of Athens, from the Greek Bronze Age to Roman times. The first museum was built in 1865 at the top of the Acropolis hill but, in spite of several enlargements (1888, 1946-47), it continued to be insufficient to accommodate the findings from the excavations and, later, the increasing amount of visitors.



Fig. 1 The Acropolis Museum

The new Acropolis Museum (figure 1), built by architects Bernard Tschumi and Michael Photiadis, opened to the public on June 21, 2009. It is located 280 meters, as the crow flies, from the Parthenon, by the south-eastern slope of the Acropolis hill. The building lies on the archaeological site of Makrygianni, which contains architectural remains from the Roman and early Byzantine Athens. Today, the new Acropolis Museum has a total area of 25,000 m², and nearly 4,000 objects are exhibited over an area of 14,000 m², ten times more than that of the old museum on the Acropolis hill.



Fig. 2 The Archaic Gallery

Thanks to the architectural design and to the presence of Archaeologists-Hosts³, the museum tells a spatial, chronological, and artistic story. The journey starts at the slopes of the hill and its sanctuaries (on the ascending wide glass-floored gallery after the ground floor lobby) and arrives at the Parthenon (on the second floor), through the Archaic Gallery (on the first floor), where visitors can wander amongst the architectural and sculptural remains of the period spanning from the 7th century B.C. to the Persian Wars (480/79 BC). The flexibility of its museographical design, as well as the diversity of historical facts and approaches behind the objects, makes the Archaic Gallery the perfect context to develop the CHESS project (figure 2).



Fig.3 Visitor personas at the AM

The project started with the definition of the end-user requirements. This was achieved thanks to an ethnographic research (involving observation and interviews with visitors and the museum staff), which provided the basis for two tasks. Firstly, the initial definition of personas: 26 relevant variables were established, from which 6 archetypical profiles (5 for visitors and 1 for authors) were distilled (figure 3). The second task was the creation of a **scenario**⁴ describing the four phases of a visit (preparation, arrival, tour of the Archaic Gallery, subsequent activities) by the persona "Natalie Schmidt". This helped understand the use of the system in context and highlight the critical design issues. In the Human-Computer Interaction field, scenarios are later broken down into a more detailed, visual, step-by-step description of the visiting experience. In the case of CHESS, these storyboards are based on the notion of **trajectories**⁵ (Benford, Giannachi et al. 2009). The Acropolis Museum offers a particular challenge for the implementation of the CHESS system, which is the harmonious integration of high-tech interaction with the contemplation of archaeological originals.

³ Archaeologists-Hosts are members of the museum staff, who amongst other tasks, are available daily at the exhibition areas to answer visitors' questions about the exhibits.

⁴ Scenarios are commonly used in the design of interactive computer systems and correspond to informal narratives that describe human activities or tasks and that are intended to provide some structure to guide the work of design. Since they are often presented from the perspective of representative users of a system, they can be linked with the concept of persona.

⁵ Trajectories are a series of diagrams representing interleaved paths, each of which expresses an individual's journey through an experience that may extend over multiple spaces, timescales, place participants in various roles, and employ a variety of interfaces.



Fig.4 Storytelling phases

The proposed storytelling model for CHES attempts to capture and structure the knowledge behind the way humans are creating the stories, and how these stories may eventually be presented to the visitors. Five major phases have been identified in this process, corresponding to the making of a movie or the setting up of a play (figure 4).

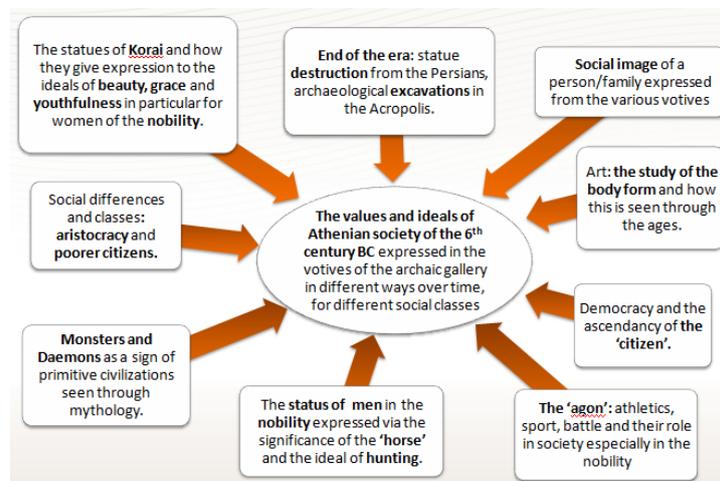


Fig.5 The main archaeological themes for the CHES stories

The first step is the definition of the story concepts, which in the case of the AM correspond to all the possible subjects and perspectives related to the central message conveyed by the exhibits of the Archaic Gallery (figure 5). This knowledge was organised in five specific chapters⁶, each of which was developed by internal and external researchers, archaeologists who collected and wrote the basic scientific materials (images and texts). Then, a selection of information is extracted by story authors, including a novelist, who collaboratively write the story script while tailoring it to the characteristics of each persona. In this scripting phase, the basic archaeological knowledge is transformed into emerging stories, with characters, plot, climax and roles.

⁶ The chapters are: 1. Introduction to the Archaic Period; 2. Description of the Archaic Acropolis (virtual reconstruction); 3. Gods and heroes; 4. Animals and monsters; 5. The world of Humans

During the staging phase, story authors are supported by museologists to associate script pieces with exhibits, paths and hotspots in the physical space of the exhibition. In the case of a given museum setting, where the exhibition arrangement is purposefully meaningful, the placement of the story into the physical environment is necessarily concurrent with the previous phase⁷. Next, in the editing phase, authors do the actual montage of the story, i.e. they select (or prescribe when not already available) all the multimedia digital resources and applications that will be employed to realise the defined script. Such resources are generated during the producing phase (including audiovisual material, games, quizzes, AR models, and applications) and are imported into the CHESS library by museum experts or they are generated and contributed by specialised teams of producers (multimedia creation teams). A sophisticated Authoring Tool is being designed and implemented for this purpose, to support authors during all the authoring phases described above.

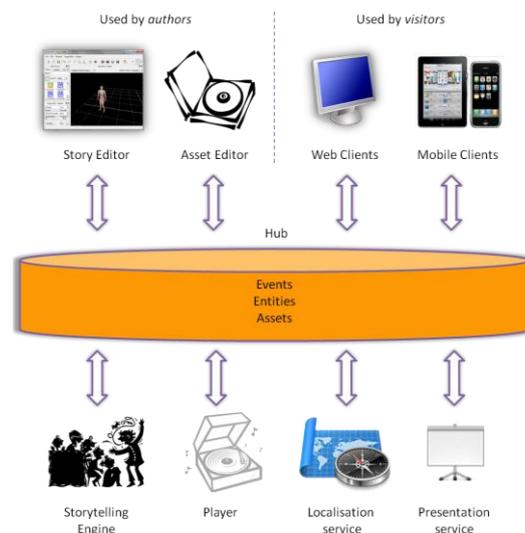


Fig. 6 CHESS components and architecture

Finally, in the experiencing phase, the authored stories will be adaptively provided to visitors through web-based and mobile experiencing systems, thanks to several co-operating engines (storytelling, profiling, personalization) and services (location tracking, multimedia presentation and interaction), depicted in figure 6 (Vayanou, Ioannidis et al. 2012).

5 Innovative aspects and potential advantages

The CHESS project draws from the storytelling tradition: it is an interactive and multimedia application; its contents will be orally told by a narrator (with written version for audio-impaired users); and its development is based in the movie production model.

From an archaeological point of view, CHESS can be classified as a combination of post-modern and traditional approach because either different historical characters or a scientist (depending on the theme) will tell (personal) stories about the past, to help visitors understand the ideals and values of other societies. On the other hand, the combination of hypertext, multimedia and interactivity fits the narrative basis of Archaeology as well as its multiple representation formats, and allows a flexible non-linear communication (including chronological, thematic and object-oriented approaches), which is not possible with traditional (non-virtual) dissemination means.

⁷ For example, apart from the most popular exhibits, stories always try to include the less explored exhibits in the Archaic Gallery.

Previous projects of interactive storytelling in museums (Tselios, Papadimitriou et al. 2008; Ardito, Lanzilotti et al. 2011) emphasise the importance of the context and propose a series of dimensions for design and evaluation. These proposals provide general guidelines for one device in a single context. Yet, such experiences are essentially hybrid in structure and involve multiple spaces (real and virtual), interfaces, and user roles (participants, spectators, bystanders). This is why CHESSE proposes the use of trajectories as the most comprehensive and coherent approach and has been developing this formerly analytical tool through its adaptation, extension and implementation in cultural heritage environments as an early stage designing tool.

In this respect, what is currently missing in the cultural heritage field is a set of tools that assist different authors to bridge the gap between scientific databases and educational interpretations for audiences. Several ICT tools (e.g. Matthew, ARCO or INSCAPE) have been developed but they present several limitations: while some are constrained to the simple exhibition of a particular set of objects and do not allow building narrative-driven interpretations, in other cases, a certain level of programming skills is required. The CHESSE Authoring Tool not only addresses these issues but also integrates two other central aspects: on the one hand, it takes into account the specific needs and constraints of the different authors (through the participatory design method); and on the other hand, it includes the users' profiles and trajectories during the authoring phase.

The personalisation methods currently used in the Cultural Heritage field require that users explicitly give feedback by specifying keywords, providing ratings or answering questions about their interests. In the case of museum visiting, the smoothness of the experience is undermined by the need to fill in data about one's self. This is why CHESSE aims at developing a dynamic system, which will adapt to the visitor throughout the entire visit and beyond. This is done thanks to the combination of several profiling methods, namely an engaging mini-interview that may be completed before the visit; the extraction of users' preferences and interests from their existing social networking profiles (if they consent); and finally, implicit methods of personalization (i.e. behaviour during the visit), to suitably and dynamically adapt the visit.

With regard to the visit experience, some museums contemplate the possibility that visitors prepare their visit in advance at the museum's website or send to their email address the tasks completed at the exhibition's kiosks (e.g. at the Victoria & Albert Museum). CHESSE moves beyond these fragmentary activities by seamlessly extending the visit experience in time thanks to the production of personalised narrative-driven cultural "adventures". On the one hand, visitors will be able to start their personalised visit from home and include the surrounding archaeological sites. On the other hand, visitors will be able to easily record and upload the most interesting moments of their visit, so that they can continue an individual or "shared" exploration through different social networks.



Fig. 7 Simulation of the Augmented Reality system at the Acropolis Museum

From the point of view of learning, personalisation and real time adaptivity should benefit learning by tailoring contents and formats to visitors' interests and skills, and by adapting the experience to the visit conditions. Seemingly, it has been demonstrated in other studies (Economou and Pujol 2007) that interactivity (control over the system, activities) fosters engagement, memorization and restructuring of previous concepts. On the other hand, the indoor location capacity and the Augmented Reality experiencing system (fields in which CHESS will contribute by testing a scalable localisation system using hybridisation techniques) are aimed at enhancing the direct interpretation and exploration of exhibits by visitors, with the possibility to see coloured reconstructions and contextual information on the spot (figure 7). Also, the possibility of experiencing different stories is likely to stimulate re-visiting. Finally, the creation of an extended experience (with pre and post-visit online activities) should increase learning, thanks to the previous establishment of conceptual anchors (Pozo, Asensio et al. 1989) and the subsequent reinforcement of the message.

6 Future work

In order to successfully achieve the aforementioned innovations and to verify the potential advantages of the application for archaeological museums, CHESS has developed a comprehensive evaluation framework, which can be generalised for use with novel digital cultural storytelling experiences at large. Originally the concept of a museum was "museum centric". In the last decade, the focus seems to have shifted to "visitor centric". But neither one nor the other holds; visitors are not empty vessels just like museums are not empty buildings. Therefore, the balanced museum recognises that museums and visitors equally construct the museum experience. Evaluation can be used as a process and a tool to explore the balanced museum's programs, especially when these involve innovative digital technologies.

CHESS will use a "User experience (UX) evaluation" approach, which allows assessing the quality of the experience, that is, whether visitors engage with the digital cultural experience through the high-level interactive narrative activities performed as intended by the designers and cultural content authors. It is non-trivial to evaluate user experience holistically and come up with solid results, since user experience is subjective, context-dependent and dynamic over time (Law, Roto et al. 2009). For example, in the case of CHESS, studying user experience must examine a plethora of parameters in addition to the user's profile and demographics, interests, location, visit situation etc. These parameters are high-level constructs of user experience that can be used as the basis for studying it and may include, for example, affective response, immersion, cognitive or conceptual change, perception of value, and inspiration. The effect of particular technological choices (e.g., adaptivity, transparent "user modelling" methods via social networks, the mobile Augmented Reality features, etc.) will also be examined in this task. This kind of evaluation can only be carried out with real users in the context of the environments where the experiences are to take place.

7 Conclusions

CHESS proposes to create narrative-driven cultural "adventures" through hybrid structures, which adapt continuously to visitors, extend over space and time, and involve users in multiple roles and with different interfaces. To achieve this, CHESS integrates interdisciplinary research in personalization and adaptivity, digital storytelling, interaction methodologies, and narrative-oriented mobile and mixed reality technologies, with a sound theoretical basis in the museological, cognitive, learning, and leisure sciences. This tightly integrated framework is applied and tested with two renowned cultural sites, the New Acropolis Museum in Athens (Greece) and the Cité de l'espace in Toulouse (France).

With regards to previous projects in the field of digital interactive storytelling for cultural heritage settings, the CHES project introduces several novelties (adoption of a user-centred approach, personalization through the use of personas, real time adaptivity through the use of localization systems, use of trajectories in the design phase, extension of the visit in space and time). We expect to demonstrate that these will positively contribute to enhance the dissemination of archaeology in museums.

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