Vilars AR Project. Testing the Augmented Reality Paradigm in an archaeological site

ARES VIDAL, ENRIC TARTERA, NATÀLIA ALONSO, CARLES AGUILÓ, EMILI JUNYENT, JESÚS LORÉS

Universitat de Lleida

ABSTRACT

In this paper we will present our interdisciplinary research of new paradigms in Human Computer – Interaction and cultural heritage applied to an archaeological site, Els Vilars. Particularly our interest is in how to apply augmented reality systems to provide location and position dependent multimedia content to the visitors of an archaeological site: Els Vilars d'Arbeca (Lleida, Spain), a fortress inhabited during the First Iron Age and the Iberian Period (from 750 to 325 BC).

This project pretends to create an augmented reality (AR) system applied to the site visit, where the visitors will be able to observe virtual reconstructions from different visitable points with a portable visualization device (a tablet pc) and also to interact with other offered multimedia contents, taking into account the users' plurality.

So then, we pretend to use the AR device as a way to discover the archaeological site and enjoy an interactive visit, that is, as an initiator to archaeological heritage. In this paper we will show all the creation process, the methods based in the user centred design, the first results, the conclusions derived from them and the new results succeeded in the second execution phase.

INTRODUCTION: VISUALIZING HERITAGE

The time when archaeology gathered knowledge without taking care of its socialization is, fortunately, past. Nowadays archaeology and its study object have to revert into society in order to improve its knowledge and to increase social sensibization about archaeological compounds and their importance as cultural goods to consume.

All the actual diffusing efforts with archaeological remains are originated by the selfsame characteristics of this kind of heritage: its complexity comes from its triple fragmentation[1]. The archaeological remains are only a little part of a wider physical past, they only represent a little sample of a more complex world, in other words, they cannot show the economical, political, social and cultural complexity of any community, and, finally, they are interpreted from a different cultural, political and social background, with other cultural values and thoughts. In consequence, the archaeological heritage is difficult to visualize and to understand for the whole public and that phenomenon can generate social undervalue or, at least, indifference.

Taking into account this situation, one of the tasks we are developing on this domain is the Vilars ARProject[2], a result of the collaboration between the *Grup d'Investigació Prehistòrica* (GIP) and the *Grup de Recer4ca Interacció Persona Ordinador* (GRIHO), both from the University of Lleida. Our main aim in this *project* will be *to teach in order to learn and value.*

So, to put into practice the project, we will solve the visualization problems using virtual resources to make the remains understandable and emphasise the use of didactic but rigorous contents to succeed in people aprehenticeship, a basic item to sensibizate. The contents will combine virtual resources with other supports, such as text, audio and images, promoting the interaction between the user and the site.

To accomplish this aim we will promote the user role during the whole process of creation and evaluation. The user, as the project addressee, has to be present actively, because his opinion will help us to understand his interests, his knowledge and his problems to understand and enjoy a visit to an archaeological site. So he will help the project to render a really usable product.

1. TESTING AR

Augmented Reality is a Human-Computer Interaction (HCI) paradigm. It consists in combining Virtual Reality with the real world in order to allow the acquisition of computer-generated information, usually Virtual Reality, in a non-immersed way (YAMANE, L.; LORÉS, J., 2004, p. 63). So its basic aim is to increase the data available from the real world, improving its perception and offering a kind of information not available to the human eye.

1 The Archaeological Heritage's fragmented nature has been profoundly treaten by some authors with different perspectives, such as Gonzalo Ruiz Zapatero (RUIZ ZAPATERO, G., 1998, 9-11) or Felipe Criado (CRIADO, 1996).

2 The project is also explained and shown in the website http://www.griho.net/vilars.

The contribution of Augmented Reality to prepare the Archaeological Heritage for the visit is based on the fact that AR can be used to complete the fragmented state of the AH, using different strategies. First of all, the architecture can be virtually reconstructed and presented in a transparent layer close to its remains. Next, explaining contents can be attached to this virtual information. And finally, interactive activities can guide the visitor through the contents in an enjoyable experience.
The fact of the matter is surely that the combination of physical and virtual reality aloud to recreate in its wholeness the archaeological fragmentary remains and complete the information to transmit, making it more understandable for the user without renouncing to the leading role of Archaeological Heritage.

2. THE EARLY IRON AGE FORTRESS OF ELS VILARS D'ARBECA (CATALONIA, SPAIN)

Concerning the fortress of Els Vilars d'Arbeca, this archaeological site is located in the Western Catalan Plain, which is placed in the northeast of the Iberian Peninsula, in the heart of a flat landscape entoured by the best cultivable lands and a course of water, renouncing to the natural defences offered by the situation on the top of a hill[3].
It was continuously inhabited from the beginning of the eighth century to the last quarter of the fourth century. Nowadays, the site offers a large and non-interrupted stratigraphical sequence and it covers the formation ages of the Iberian culture. Actually, Els Vilars d'Arbeca has an exceptional importance for the knowledge of fortification systems in the Early Iron Age, in the Iberian Peninsula as well as in Europe. The fortress combines in its defensive system a wall, twelve towers, a barrier of standing stones and a ditch.
On the other hand, It is extremely significant the early appearance of iron metallurgy in Vilars in the 8th century and the presence of horses' foetus burials inside the houses. This second phenomenon shows the existence of a horse cattle breeding in Els Vilars and it would have a symbolic power role during the Iron Age and the Ancient Iberian Period.
All the research made in Els Vilars is useful to explain social and political transformations during the rising and the consolidation of Iberian aristocracy (in the 6th century). This actual quantity of disposable information about Els Vilars is the result of almost twenty years of excavations and research from the University of Lleida. It is an interdisciplinary scientific project that connects the historical and the archaeological reconstruction of the fortress, its paleoeconomic and paleoecological study, and its patrimonial recovery. As an important monumental site, the Catalan Government has declared Els Vilars "*Bé Cultural d'Interés Nacional*" (the highest legal category of cultural heritage in Spain) and nowadays it is supported by a Directive Plan, with the purpose of putting the site in value and arranging it for visitors, setting up adequate infrastructures and adding a management model for the involved institutions.
To sum up, this archaeological site offers the ideoneus framework for transmitting archaeological and historical knowledge to the public.

3. THE VILARS AR PROJECT[4]

According to the principles explained before and the characteristics of the archaeological site we started the Vilars AR Project, which has a main purpose: to explore and to evaluate AR Paradigm possibilities in order to improve diffusing strategies according to Archaeological Heritage, with the objective of generating an interactive visit to Els Vilars fortress, using the AR Paradigm, for individual or reduced groups, holding a portable device, following a predetermined route and containing interactive contents.

3.1 METHODS

The methodological basis of the whole project is the Usability Engineering Process Model and it consists in including the user participation in the whole process, above all in the design and evaluation of prototypes in order to render a product usable and accessible.
In this sense the evaluation methods must be basic and we have used four different models. First, we have prepared different possible scenarios on paper (as story boards) and video support which reflects possible situations with potential public, such as how they managed to found out about Els Vilars, what they knew about the site before their visit, how they can use the AR device, etc. We have used these scenarios to analyse and solve the existing problems and to explain the project in different phases of the evaluation.

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3 **This archaelogical site has originated a huge amount of bibliography and we do not pretend to totally quote it here, but it is worth to mention the last synthesis papers published (ALONSO, N. *et al.*, 1998, p. 355-372; ALONSO, N. *et al.*, 2001, p. 161-173; ALONSO, N., *et al.*, 2003, p. 233-274) and the website (http://www.vilars2000.com) in order to give the reader the opportunity to better know the site.**

4 **To better understand the theoretical principles and the methodological basis of the project there are several papers published until now (GRANOLLERS, T., *et al.*, 2003, p. 265-269; VIDAL, A., *et al.*, cop. 2005; YAMANE, *et al.*, 2004, p. 62-69) and a website (http://www.griho.net/vilars).**

We also made questionnaires to improve our knowledge about users' profiles. The questions proposed were centred on the users characteristics and once the prototyping tasks began, we gradually introduced questions related to navigation, contents and design to evaluate the results. At the same time, we made Focus Groups to hear and discuss all the criticisms and the proposals not included in the questionnaires.
The last method used was the Heuristic Evaluation, consisting in the observation of the interaction between a user and a prototype. This method was always preceded by a brief explanation of the project.

3.2 OBJECTIVES: USABILITY, CONTENTS AND EXPERIENCE

Bearing in mind that this was the first phase of the project we delimited the objectives of the resultant prototype, so it consisted in a prepared visit to significant elements from Els Vilars fortress assisted by an AR device. To sum up, the defensive system: the wall, the towers, the standing stones barrier and the ditch.
All in all, the aims of this prototype focus on three basic elements*: usability, contents and experience*. From these aspects we have stated the essential needs of the project.

3.3 INFORMATION ARCHITECTURE AND MEDIA

Nevertheless, we made a structure for the information architecture that could be useful at any other Cultural site. Taking into account the topographic nature of the site we have divided it in ten zones of interest. Each zone has a central point of view from where the visitor observes the area. In each zone of interest there are different observed locations depending on the view direction. Inside this observed location the visitor can see several elements of interest (for instance, the wall). And each element of interest can introduce the public to some related subjects and abstract themes. This organization laid the foundations for the navigation structure, having in each zone a first introduction display followed by a zone of interest presentation display. Afterwards, there were the elements of interest displays and the subjects explained in each element.
We have had to adapt the prototype to the hardware and the software available. In this case, the platform used is a Tablet PC because its dimensions offer more graphic possibilities than other devices, such as a pocket PC, and it is also useful with audio. Concerning the software we have chosen the multimedia-authoring tool, Macromedia Director.

4. THE PROTOTYPE

As regards to the results, at the end of this first phase of the project we have obtained a Tablet PC device, which includes: a Macromedia Director presentation of one Zone of Interest (the Defensive System) with an audiovisual introduction, virtual representations of the defensive system evolution, Subjects Related to each element of interest, General themes, a glossary and user's evaluation in paper, video and photographic support.
To explore adaptivity, we took into account the heterogeneous nature of the public, so, for the time being, we have considered two user profiles. The first one is the family profile, which is thought for reduced family groups. Its level of difficulty is according to the children's age (8-10 years old). It is characterized by a narrative style of contents explained by a representative character of the fortress in first person. The other profile is for adults, in terms of individual or reduced groups, with no previous knowledge needed and in a descriptive-explanatory style of contents in third person.
Not only do we have to explore adaptivity with the users' profiles, but also with the languages of the visitor. So then, we prepared all the contents in two languages: Spanish and Catalan. At least, we have the intention of adding the English and the French version soon.

5. EVALUATING THE PROTOTYPE

Concerning usability we observed that the users succeed in navigating through the contents and the graphic design and the multimedia contents were appreciated by the most part of the public. Finally, the users recognized and understand the relation between the contents displayed on the device and the archaeological scene around them. As Weak Points, everybody agreed that the Tablet PC chosen for the project is too heavy and his display, unless is thought for outdoor use, has lack of visibility. One of the most important problems was the interaction on the family visit, the presentation of the contents was not attractive enough for children and their parents had to make an extra effort, not only by carrying the device, but also staying at their same height to allow them to see the display.
As far as contents are concerned, they were considered extremely attractive but, the text turned out to be too long and complex and the users had not enough criteria to select the most interesting things for them. Finally, it must be asserted that there was also a lack of interaction in the visit because the contents were extremely linear.
Even so, it must be acknowledged that the experience was positive because people enjoyed the visit. Unfortunately, the device became more interesting than the archaeological site. This means that he device was not "transparent" enough for the visit.
To sum up, we want to recall that the weak points on the evaluation refer to specific problems, while strong points refer

to general aims of the project and its success. It appears that the user's valuation is positive but not fully effective because the device takes the leading role at the expense of the heritage enjoyment. Of course, any future strategy must bear in mind all these evaluation results in order to correct the problems and improve the user's enjoyment.

6. FUTURE STRATEGIES

In the case of usability, the device has to be improved by solving visibility and transportation problems. The lack of visibility will surely be attached to the research of new devices, so we have to look at the characteristics of the new Tablet PC generation. To solve the carrying of the device we will create a sort of frontal knapsack, which will allow both hands of the user to be free.

Another important and immediate aim to develop is the location system, in order to reduce navigation and facilitate the transit between different Zones of Interest. In this sense, the first prototype didn't have any location system at its disposal. Nowadays, we are trying to solve this item by attempting different strategies. The first is the use of a GPS device with an electronic compass, but for the moment the margin of error is excessive. The second and most likely solution is the use of sensors.

As far as contents are concerned, we must identify the main concepts so that we can transmit and discard the rest. This means that we have to choose a main message to transmit, we have to decide what the real essence of Els Vilars is: is it an impregnable fortress? Is it an agricultural community? The truth of the matter is surely that the basic concept chosen must have a connection with the present visitors. To put the whole matter in a nutshell, the user must feel identified with the inhabitants of Els Vilars. So, one of the first strategies we have started to develop is that: taking into account several diffusing principles we have chosen a main message. That is, Vilars as a centre of power. This message will stimulate emotion and comprehension, two basic elements to feel identified with the explained story. At the same time it is a scientific message derived from our research, it is rigorous and true. It is also a good slogan to attract people to the site, it is a message understandable for every body, because power is present in everyone's life and it can be useful as a starting point to explain any other subject.

Once we have succeeded in that, we will be able to develop the other Zones of Interest, following the new strategy and presenting them in a really interactive manner. So we must increase audio and graphic resources at the expense of text, because the device must be a support for the dialogue between the user and the site.

In this sense, we have also started to develop new virtual resources in order to add another zone of interest to the visit, in this case, the southern district.

This dialogue could be based on enigma-games. The idea would be to present different common situations of the past inhabitants of Els Vilars and to state problems that have to be solved by the user to continue the visit. For the moment we have started to work with enigma-games related to the defensive system, stating one problem for each defensive structure that have to be solved from the outer point, the ditch, to the inner point, the towers, in order to transmit people the difficulty of approach to the fortress for a foreign person. The enigma-games are simply questions illustrated, to easily to solve and they are proceeded by a brief element of interest introduction. In all this new design the text disappears except for the solution games, and all the contents will be presented by audio, virtual and illustrated elements.

The best way of summing up is by saying that *the visit must be a discovery and not a story*. It must be a really interactive experience where the visitor feels that he/she is forming part of a discovery adventure.

As far as experience is concerned, we have to increase the enjoyment of the visit by improving the interaction and using new strategies for the contents presentation. So at this moment we are developing a new prototype simpler, with fewer contents in text and more audiovisual items. That is, the new prototype will be more linear in the information architecture but it will also be more interactive in the use of contents by the visitor. Following this strategy, the visit in AR must be a lure to attract people to the site and gain their attention.

It would be reasonable to assume that, in consequence, the success of this experience will stimulate the use of other archaeological diffusion resources.

In our own experience we have also decided to change technologies. We used Macromedia Director in the first prototype because is very useful developing multimedia applications. But using Director we found some problems that advice us to use it in next versions. We have seen that is too difficult to make changes in the contents and it is almost impossible to use databases. So we have decided to change the technology and to use XML and a dynamic web interface, because it is easy to make contents that have a different look and feel depending on the device used to query the contents, the contents and the interface are completely separated and it is also easy to convert the contents into paper by using pdf.

CONCLUSION

We can conclude by saying that we have seen that Augmented Reality can be an effective and interesting tool to visit and enjoy the archaeological heritage, because is able to transmit a complete vision of its fragmentary past without renouncing to the own remains. The user-centred design can be considered a good tool to understand better the user's needs and interests, and at the same time it will help us to detect and correct problems.

But we already have a long distance to cover to finish this project with success. We have to increase adaptivity with the user profiles, not only oriented to age and knowledge if also to handicaps. We have also to improve the systematic collection of evaluation data. We have to develop the other zones of interests and their respective virtual resources. And finally it would be interesting to increase the user's freedom, choosing the time he/she wants to spend on the visit and better adapting the contents to transmit to his/her interests.
So we will keep on doing further steps to succeed in this project.

REFERENCES

ALONSO, N. *et al.* (1998) – Poder, símbolo y territorio: el caso de la fortaleza de Arbeca. In ARANEGUI, C, ed. – Actas del Congreso Internacional Los Íberos, Prícipes de Occidente. Estructuras de poder en la sociedad ibérica. Barcelona: Fundació La Caixa, p. 355-372.

ALONSO, N. *et al.* (2001) – El proyecto Vilars 2000: Investigación, recuperación y socialización del conocimiento y el patrimonio. Madrid: Universidad Complutense de Madrid (Trabajos de Prehistoria 57/2), p. 161-173.

ALONSO, N. *et al.* (2003) – Caballos y hierro. El campo frisio y la fortaleza de "Els Vilars d'Arbeca" (Lleida, España), siglos VIII-IV a. n. e. In ALONSO, N.; JUNYENT, E.; LAFUENTE, A.; LÓPEZ, J. B., ed. – Chevaux-de-frise I fortificació en la primera edat del ferro europea. Lleida: Universitat de Lleida, p. 233-274.

CRIADO BOADO, F. (1996) – Hacia un modelo integrado de investigación y gestión del Patrimonio Histórico: la cadena interpretativa como propuesta.– In Boletín del Instituto Andaluz del Patrimonio Histórico, 16: 73-8. Sevilla.

GRANOLLERS, T. *et al.* (2003) – Análisis y diseño de una visita guiada a la Fortaleza de Arbeca en realidad aumentada. In Actes del II Congrés Internacional sobre museïtzació de jaciments arqueològics. Barcelona: Ajuntament de Barcelona, p. 265-269.

RUIZ ZAPATERO, G. (1998) – Fragmentos del pasado: la presentación de sitios arqueológicos y la función social de la arqueología. In GÓNZÁLEZ MARCÉN, P, ed. – Actes del II seminari Arqueologia I Ensenyament. Barcelona: Universitat Autònoma de Barcelona (Treballs d'Arqueologia, 5), p. 7-34.

VIDAL, A. *et al.* (cop. 2005) – Vilars AR Project: presenting a prototype for the visit of an archaeological site in Augmented Reality. In 9th Workshop "Archäologie und Computer". Vienna: Stadt Archäologie.

YAMANE, L.; LORÉS, J. (2004) – Els Vilars: a Cultural Heritage Augmented Reality Device. In LÓRES, J.; NAVARRO, R., ed. – Interacción 2004, V Congreso Interacción Persona-Ordenador. Lleida: Universitat de Lleida, p. 62-69.

WEBSITES

http://www.vilars2000.com

http://www.griho.net/vilars