An interactive system for storage, analysis, query and visualization of archaeological pottery

Ana L. Martínez-Carrillo[1] Arturo Ruiz-Rodríguez [1], Francisco Mozas-Martínez [2] and José Manuel Valderrama- Zafra [2]

[1] Andalusian Center of Iberian Archaeology, University of Jaén. Spain.
[2] Department of Graphic Engineering, Design and Projects, University of Jaén. Spain.

Abstract

In this contribution is shown an interactive system for the storage, analysis, query and visualization of archaeological pottery. This system has been developed inside the CATA project (Archaeological Wheel Pottery of Andalusia), which main aim is the creation of a reference array of pottery vessels accessible through Internet. This collection is orientated to digitalize, protect and disseminate a sample of pottery vessels documented in archaeological interventions in Andalusia. The access is available to the general public as well as researches.

This article illustrates the different steps in the design of the database, the query system, and multimedia applications oriented to the spreading of the information concerning to the archaeological treatment of ceramics.

Key words: Archaeological pottery, reference collection, Internet access

1 Introduction

Due to the large volume of ceramic material found in archaeological explorations, this material directly contributes to a great amount of our historical understanding. The study and analysis of ceramics constitutes one of the most frequent activities of the archaeologist's work. A common task is the classification of thousands of ceramic sherds which are discovered. This classification contributes to the possibility of deducing forms, functions and chronologies of the vessel fragments.

The study of archaeological pottery is a continuity of methlogies used since the founding of this discipline. Although diverse procedures have been defined in the past for the classification and categorization of pottery as of yet no unified methodology exists.

This article will define a computer system that stores and classifies vessels and sherds found in archaeological interventions. The CATA project (Archaeological Wheel Pottery of Andalusia in its acronyms in Spanish) is an automated implementation for classifying and categorizing the above mentioned artefacts. The system's principal objective is the creation of a referencing framework for Andalusian pottery which dates from the Iberian, Roman and Medieval periods. The three fundamental functionalities of the system are geographical referencing of artefacts, cross-section time analysis and functional categorization of artefacts.

This article is based on the following points: the creation of protocols for the study of archaeological pottery, the design and the structure of the system, and the availability of the information in Internet.

2 Protocols for the study of archaeological pottery

The first step in creating the CATA methodology was the definition of the protocols required for the analysis and study of pottery vessels found in

Andalusia. These protocols are valid and applicable to different historical periods. It is important to ensure that all the differing groups working (specialist archaeologists in Iberian, roman and medieval periods and members of the regional government) are on board with the solution proposed.

The second step was to define the key variables which synthesis the description and definition of vessels and sherds. The four most important variables are based on the work of Orton, Tyers and Vinci [1]: date, distribution, functionality and state of preservation.

CATA adds an additional variable to the above:

- Measurement variables:

Measurements are based on a raster or vector image that is the drawing of the pottery vessel. The following sub-classification of measurements is used:

Basic measurements: vessel diameter, height, volume and weight.

Complementary measurements: these measurements define and numerically specify the most significant parts of the morphology of a vessel (rim, handle and base).

The above numerical information is obtained from the measurements related to vessel image. They can be inserted manually or semi automatically. Recent developed software called Profile Analysis Tool (PAT) oriented towards the drawing of shapes, including a utility that allows semi-automatic measurements of the pottery vessel drawing .[2]

- Qualitative variables

Qualitative variables are related to the manufacturing process of the vessel. Therefore inside this range of variables include aspects regarding the shaped of the vessel, type of oven treatment, chemical composition of the clay used and additives added to the clay. Included in the qualitative observations is the description of the morphology of the vessel distinguishing rims, handles and bases, surface treatment and decorative aspects, and chemical analysis.

- Preservation variables

The preservation variables are related to the physical state of the vessel (complete or fragmented), alterations suffered by the artefact, and the manufacturing treatments used to create the vessel (used propose to restoration and conservation of a pottery vessel).

- Contextual variables

Finally, variables have been added to describe the context in which the artefact was found. A pottery vessel or fragment is associated with a temporal and spatial context. The identification of the artefact context will allow correct dating, deduction of functionality, and the application of geographical significance. In this sense the work of Shepard [3] marks an inflection point in the study of archaeological pottery taking account different aspects as the chronology, the storage and distribution and the technological development. These variables identify and characterize the areas in which the ceramic fragments have been documented.

3   Design system architecture of CATA

3.1. Digital media for Cultural Heritage

The use of new media in the service of cultural heritage is a fast growing field, known variously as virtual or digital heritage. New Heritage, under this denomination, broadens the definition of the field to address the complexity of cultural heritage such

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[1] Orton, Clive; Tyers, Paul; Vince, Alan. *Pottery in archaeology*. Cambridge University Press, Cambridge (United Kingdom). 1993.

[2] Lettner, Martin; Mara, Hubert; Müller, Andreas; Sablatnig, Robert; Singer, Marianne and Krenn, Martin "PAT: Profile Analysis Tool for the Documentation of Archaeological Finds", in R. Sablatnig, j. Hamsley, P. Kammerer, E. Zolda and J. Stockinger (Eds.), *1st EVA Vienna Conference*, pp. 83-90, Vienna, Austria, August 2006.

[3]Shepard, Anna O. *Ceramics for the archaeologist*. Carnegie Institution of Washington,Washington D.C. 1956.

as the related social, political and economic issues.[4]

Cultural Heritage applications are now characterized by their massive utilisation of digital media[5]. This has been employed to document sites, artefacts and restorations. Up to recently, such documentation is mostly based on pictures, reports, and analysis. In this sense several works are focused on the documentation, analysis and preservation of the cultural heritage using digital media in this aims.

In this case, has been used on one hand a database system for storage, insert and search information purposes, and on the other hand an Internet interface for the visualization of the information.

3.2 CATA Database: table schema and design

Data archaeology is a skilled human task, in which the knowledge sought depends on the goals of the analyst, cannot be specified in advance, and emerges only through an interactive process of data segmentation and analysis.

Data from archaeological excavation is suitable for computerization although they bring challenges typical of working in non-scientific subjective areas. Meaning and significance within data are established on-site and afterwards by a heuristic process of discussion and contestation, a process at odds with the rigorous demands of database design.

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[4] Yehuda E. Kalay, Thomas Kvan, Janice Affleck. *New heritage: new media and cultural heritage*. Routledge, 2007.

[5] Lahanier, Christian , Aitken, Genevieve; Pascal , Cotte; P illay, Ruven; Pitzalis, Denis. Digital capture of archive, objects and paintings for research and conservation. In Proceedings of EVA 2004.

[6] Kadar, Manuella. "Data connection and manipulation of archaeological database created in visual enviroment". *Proceedings of the International Conference on Theory and Applications of Mathematics and Informatics* - ICTAMI 2004, Thessaloniki, Greece. 2004.

A common and powerful method for organizing data for computerization is the relational data model. Relational databases have a very well-known and proven underlying mathematical theory, that makes possible automatic query optimization, schema generation from high-level models and many other features that are now vital for mission-critical Information Systems development and operations [6]

The database engine selected for the CATA system is MySQL due to the facilities given for Web design and the easy implementation with programming language such PHP.

In this case has been differentiated between two main levels: a high level, the settlement; and an artefact level represented by the pottery vessels. The systematization of the documentation has been made using a database for storing and searching different type of data (numerical values, text, images and videos).

Once the above mentioned variables were defined and clarified, the next step was to create the table schemas using these variables and define the relation amongst tables.
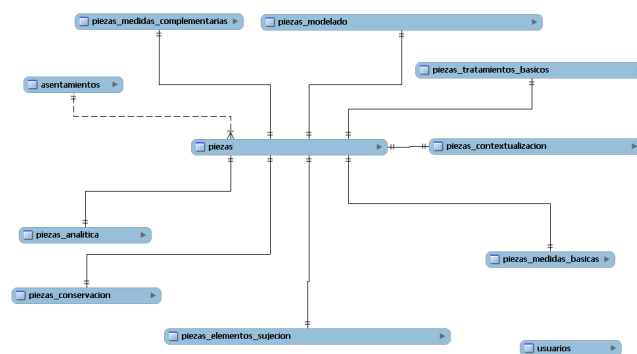

Figure 1. Tables schema

The settelement represents the high level of the tables schema. The information concenrning to the settelements includes the name of the site, the code and the geographical coordinates.

The following level in the database system is the level for describing the ceramic vessels. Vessel table: acts as a bridge between the settlements table

and all information concerning sherds and vessels (quantitative and qualitative tables).

In this case the table "Vessels" is created to connect all the information, that has been divided in the following tables:

- Measurement table: stores the numeric values of a vessel.

- Treatment table: stores the type of manufacture and the surface treatment.

- Analysis table: sytore different types of chemical analysis that could be made in a pottery vessel.

- Preservation table: stores the description of the state of conservation of a pottery shape.

- Context table: stores the spatial and temporal context in which every vessel has been found.

Also a table to store the information regarding to the users has been created.

This system is preparing to carry out copies of segurity of every sesion, this constitutes a secure system for preservating all the stored information.

4   User Interface

The interface for Internet is oriented on the one hand to implement computerization of the ceramic registry and by another one to offer to the users an interactive access to the system.

First of all, have been defined different categories of users:

- Invited users: they can consult all the information available in the reference collection.
- Registered users, they can add and edit information in the system.

Also an administrator of the system has been planning for reviewing and validating the new approaches of the registered users.
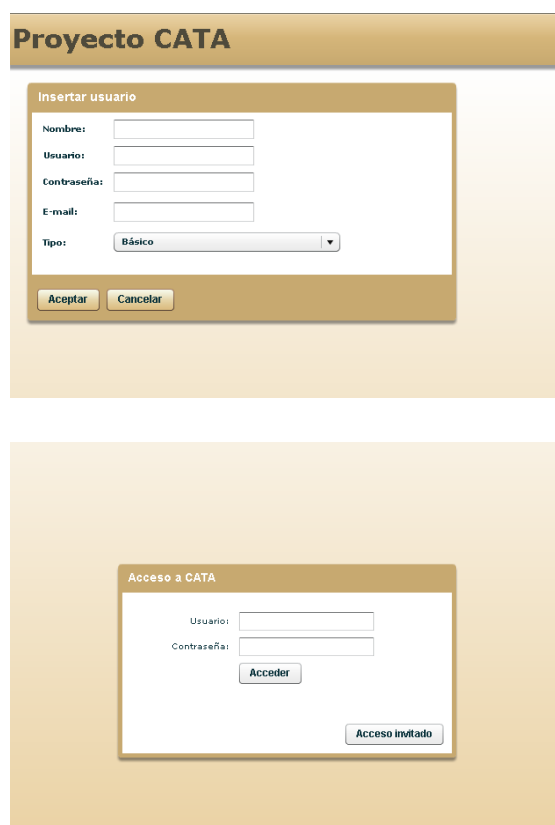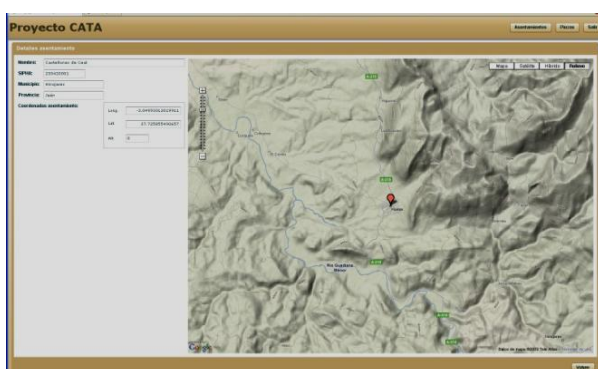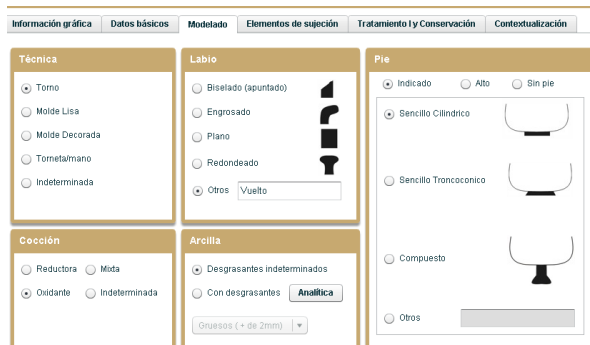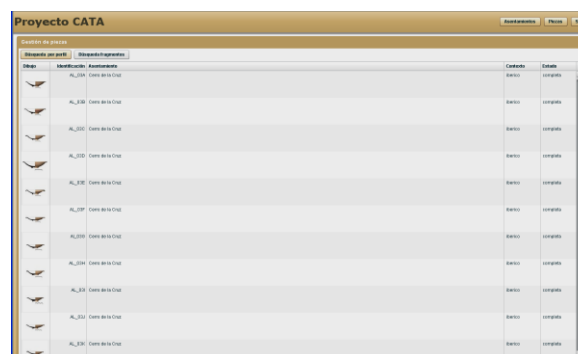

Figure 2.   Access system and register of users

Next, the information regarding to the settlements is showed, indicating the name and the location of each of them. In addition has been established a connection with Google maps to visualize the archaeological sites.

Figures 3 and 4. Settlements list and it visualization thought Google maps

Figures 5 and 6. List of the vessel of the reference collection and its information

A list of all the pieces has been created that conform the collection of reference and the name of establishment where they were documented, also indicating the conservation state in which they are.

The application allows the creation of users and the interactivity of these users throught the files upload, reason why can be understood like a Web 2.0 system, since this type of systems is defined as " all those utilities and services of Internet that contain a database, which can be modified by the users (adding, editing or deleting information or associating data to the existing information." [7]

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[7] Ribes, Xavier. *La Web 2.0. El valor de los metadatos y de la inteligencia colectiva* en Telos. Cuadernos de Comunicación e Innovación de la FundaciónTelefónica, n. 73 2007.

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The results of this project are exposed in the following Internet direction: http://cata.cica.es/ .

The sections in which have been divided this web are:

- Aims of the project

- Members of the project

- Description of the settlements

- References

5 Conclusions

In this article has been exposed the methodology followed for the achievement and storage of information regarding to archaeological ceramics. This constitutes a digital library of archaeological pottery documented in the andalusian area.

The articulation of the information constitutes an open system; since this information is available in Internet.

There must be agreement on common standards for sharing information and the use of controlled vocabularies. To achieve full interoperability it will be necessary to be able to translate between multiple European languages and to develop multi-lingual thesauri. The second challenge is to ensure that e-reference collections are developed in a way that is suitable for long-term digital preservation Thirdly, the work involved in re-purposing reference collections for multiple audiences is not trivial. Reference collections have generally been development by specialists for specialists and may required layers of supporting information to render them comprehensible to general users.

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