

Towards a Web-based Environment for Italian Prehistory and Protohistory

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Abstract

In the course of 2005, the chair of Prehistory and Protohistory of the University of Milan, in collaboration with the Department of Informatics, Systems, and Communication of the University of Milan-Bicocca and the Department of Archaeology of the University of Bologna, have started a long-term project for the creation of a set of web services aimed at supporting the sharing of knowledge on prehistory and protohistory in Italy. This very relevant research context for this country, in fact, has not exploited in a systematic way the innovative opportunities offered by the Internet and information and communication technologies, adopting only in a superficial way these new instruments or neglecting innovation altogether. The project provides for the development of two main prototypes, a web portal and a WebGIS, devoted to the Bronze Age in Northern Italy, which will be fully operative and available to the public by the end of 2006.

1 Introduction

Prehistoric and protohistoric archaeology in Italy are a very fertile fields of study; the number of completed research projects and the scientific debate over the results that have gradually been acquired is growing in intensity, involving equally the universities and the offices of archaeology as much as other research institutions, some of which have a solid tradition backing them up, such as, for example, the Italian Institute of Prehistory and Protohistory in Florence or some municipal museums. Over the years, efforts have been focused either in the clear-cut direction of the construction of general reference frameworks or in the more analytical direction of a thorough and extensive study of particular aspects hitherto uninvestigated or largely unfamiliar.

The wealth of knowledge resulting from the work of these researchers is vast and brings with it intrinsic difficulties in terms of management and the transmission of even preliminary results of the research in progress. Moreover, the scientific communication in this field is still being almost exclusively entrusted to traditional modalities of presentation, such as hardcopy publication or the organization of events of an occasional and educational character, such as exhibitions. Obviously, the innovative possibilities offered by modern technologies of communication—especially the Web—have not yet been systematically acknowledged.

The scientific community, in fact, has not yet legitimized these techniques of communication, and their usage is still sporadic and relegated to demonstration applications. Thus, they are not really being exploited and are of little consequence to the scientific debate.

Even if in some cases this situation is a symptom of a mind-set akin to technological rejection, justifiable to some

extent by the disillusionment caused by the failure of some initiatives developed in the last decade, today such an attitude must be overcome. If we do not succeed in promoting this way of thinking, the price to pay will be high—a damaging self-referential involution of the discipline, incapable of better sharing the knowledge to build itself anew.

Several projects deal with these issues with the aim of defining innovative ways of archaeological knowledge management through the use of information and communication technologies (e.g., Bogdanović et al. 1999; Barceló et al. 2004). Moreover, during the last few years the issues regarding the creation, management, and sharing of knowledge have been deeply investigated from both a theoretical and a technical point of view; a lot of diverse approaches have been adopted, as we can clearly see from a quick review of the contributions that are relevant to these subjects. This is, indeed, a very dynamic field of study, which offers a lot of possibilities for interdisciplinary research programs, capable of combining the issues raised by specific scientific communities with the application of new technologies.

During 2005, the Chair of Prehistory and Protohistory at the University of Milan, the Department of Archaeology at the University of Bologna, and the Laboratory of Artificial Intelligence at the University of Milan Bicocca embarked upon a long-term project of a distinctly interdisciplinary nature, whose goal has been to try to bring together the situations briefly outlined here in order to provide new tools for the sharing of knowledge to everyone interested in Italian prehistory and protohistory.

The system prototype, which is at an advanced stage of development and fully operative, presently consists of two

main components: a web portal and an information system based on WebGIS, both dedicated to the Bronze Age in Northern Italy, which we will further describe.

2 The Web Portal

The web portal, named “ArcheoServer,” currently provides contributions in Italian. This choice is due to the strong national character of this initiative, which is aimed at stimulating the discussion within the Italian scientific community. The main efforts of the project have been devoted to the definition of its general framework and in the technical development of the portal itself. The contents are being inserted, mainly by the students of the universities involved in the project. The official activation of the portal, with a proper domain name, is planned for the end of 2006.

The following Section (2.1) will illustrate the main sections of ArcheoServer, briefly discussing their setting and nature. After that (in Section 2.2), the paper will focus on the general architecture of the system and the technological aspects involved in the configuration and development of a Content Management System reflecting our requirements. ArcheoServer is also aimed at providing a platform for the experimentation of innovative technologies, with particular attention to the areas of Semantic Web, Knowledge Management, and of the scientific communities’ support systems. The main directions for future developments in this context will be introduced in the final Section.

2.1 Portal Contents

The portal contents are subdivided into seven main sections: Start; UniMi; Researches; Methodology; News; e-Library; and Links. The “Start” section provides detailed information about the project. We consider it, in fact, very important to explicitly state the goals of the portal, to present the involved partners, and how they are contributing to the initiative by updating the contents and contributions. The analysis, of other initiatives of this kind, has highlighted that very often these aspects are not very clear, and that this fact hinders the exact perception by the user of the nature of the pages he/she is viewing. Since the system also aims at representing an experimentation of innovative instruments for the Web, we also decided to present a detailed description of the portal architecture, with the aim of describing our approach and have the possibility to obtain feedback from the community of developers and, in general, by those interested in new technologies for the Internet.

The “UniMi” section is specifically devoted to the activities of the chair of Prehistory and Protohistory of the University of Milan, the main promoter of the project. The section presents information about the collaborators with the chair and the findings of this research group, and also offers the possibility to download teaching materials (lecture notes and illustrations).

The sections devoted to “Research” and “Methodologies” have been devised to stimulate the discussion and scientific communication through the Web between researchers that

deal with prehistory and protohistory in Italy. As stated in the introduction, we propose that new and much more dynamic modes of sharing and diffusion of information are needed to improve the results in this research context. However, the structure that these sections will acquire was not defined in a strict and precise way. We consider that a bottom-up approach, starting from the single contributions related to portal topics and coming from the community of researchers (rather than from a single normative framework), will provide more flexibility and will support an incremental definition of the structure of these sections. However, the “Methodologies” section will pay particular attention to the experiences of computer applications in archaeology: in addition to pages describing a survey of the main methodological approaches currently employed, more detailed descriptions of their applications to specific projects will be given. Every methodology, in fact, is implemented in a particular way in the single research experiences, and the sharing of these specific approaches and results has a relevant role in the methodological advancement of the discipline.

The “News” section gathers concise reports about recent events indexed according to a set of predefined categories: congresses, conferences and meetings; updates on researches in progress (before they are described in a more comprehensive way in the “Researches” section); editorial news and brief reviews; updates about the structure and contents of the portal. In addition to the news directly inserted by the editorial staff of the portal, we considered the possibility to include in an automatic way the news published by external sites presenting scientifically reliable information. This mechanism, in particular, is based on the exploitation of the potential offered by the RSS Web content distribution format, also adopted by ArcheoServer.

The “e-Library” section was devised to supply an effective mechanism for the retrieval of digital resources related to prehistory and protohistory, and in general to the archaeological research methodologies. In fact, even if there are a growing number of initiatives providing for the electronic publishing of scientific papers, their indexing by traditional search engines is often unsatisfactory. We aim at realizing an autonomous and progressive indexing of digital contents, some of which will be hosted by the portal itself. In this sense, formal agreements are currently being defined with some specialized Italian journals to obtain the rights to their publication in electronic form. The indexing and retrieval mechanism is inspired by DBLP (Digital Bibliography and Library Project—<http://dblp.uni.trier.de>), a project providing bibliographic information on major computer science journals and conference proceedings. The “Links” section will supply a selection of web resources, chosen on the basis of their scientific value, which will be accessible through a dedicated search engine.

2.2 From the Requirements to the Architecture of the Content Management System

The specification of requirements has constituted the first step of the structuring, design, and development of the portal architecture. The results of this analysis can be summarized

as follows:

- the portal must support the collaborative creation of contents by the users' community;
- since users may not necessarily have specific technical skills, it is necessary to have a sufficiently powerful, but simple instrument for the creation and editing of contents. Beyond the simple editing of page contents, the portal must support the upload of files (images, PDF documents, etc.), the modification of the structure of its pages (with the definition of menus for the access to basic contents, with sections and sub-sections), and must supply an integrated search engine;
- the software must be extensible and modifiable in a simple way in order to support the inclusion of new functionalities.

Another requirement that was considered since the beginning is the need to respect as much as possible the guidelines for accessibility of web sites defined by the World Wide Web Consortium (W3C), in the context of initiatives such as the Web Accessibility Initiative (WAI—Caldwell et al. 2006). In Italy, moreover, the accessibility principles are recognized and promoted at the legislative level, with specific reference to public structures' Web sites (see, for instance, the "Stanca Law" and following decrees).

Starting from these requirements, we tried to identify the technical solutions that would allow, in a reasonable time, suitable architecture to meet our requirements. The attention was focused on Open Source software, which seemed the only choice able to supply the level of flexibility required for the design and development of the portal. In this way it was possible to create and assemble autonomously the most suitable solutions without adopting closed solutions that would have been very hard to modify.

At the beginning, we considered the possibility of developing a lightweight web portal management system from scratch, adopting the PHP language, able to integrate with existing Open Source modules (file manager, photo gallery). A small experiment was carried out with this endeavor; following this path we have had the chance to explore all the issues related to the basic functionalities of a portal. Unfortunately, it became apparent that this option was extremely time consuming. After this first experience, a deep analysis of the existing Open Source Content Management Systems (CMS) was conducted. Even the most complete and successful CMS solutions considered (such as Mambo, <http://www.mamboserver.com> or PHPNuke, <http://www.phpnuke.org>) were revealed to be, on the one hand too difficult to extend and on the other too binding from an architectural point of view. For instance, all of these solutions employ a database in the backend of the system, whose structure cannot be changed, and moreover, it would have been difficult to alter the structure of the displayed pages according to personal Cascading Style Sheet (CSS), which is different from those provided by the CMS.

For all these reasons we considered the adoption of a Wiki engine, which is less binding than a traditional CMS, with specific reference to the navigability structure of the portal and to the structure of the displayed pages. This requirement, given the structure of the contents described in Section

2.1, had a higher priority over the others. A Wiki (Aronsson 2002; Ebersbach et al. 2005) is a Web-based software that supports the creation, editing, and removal of contents in a very simple way, representing quite common choices in situations requiring the collaborative generation of written contents. The editing of pages in a wiki happens through the use of a specific format (sometimes called "wikitext") that is much simpler than complete markup solutions such as (X)HTML. Moreover, one of the features offered by a Wiki engine, which is tightly related to its collaborative writing approach, is the automatic management of the different versions of a given page. The test that we implemented, with a relevant subset of our end users, many of whom lacked any programming ability, illustrated that it was possible to rapidly learn how to use the system, and within a few days a typical user can autonomously create pages including hyperlinks, images, and attached documents.

There are a large number of Open Source Wiki engines currently available, and our choice was to adopt SnipSnap (<http://www.snipsnap.org>), a system based on Java technology and developed by the FIRS (Fraunhofer Institut Rechnerarchitektur und Softwaretechnik). The adoption of a tool that is based on the Java platform supports a simple integration with an increasing number of innovative instruments developed in the computer science context (for instance, in the Semantic Web research area). All the contents of the portal, leaving aside the images and the attached documents that are directly stored in the file-system, are contained in a MySQL database, which was chosen due to its good performance and the availability of simple tools for its management. The overall architecture, summarized in Figure 1, also adopts Apache Tomcat as a Servlet Container (hosting SnipSnap) and the Ubuntu Linux operating system.

Although SnipSnap represents a quite complete system, this specific application required some modifications and additional effort in its configuration to effectively reflect our requirements. The flexibility of the accounting system, for instance, supported the definition of a personalized user model that is quite different from the typical wiki approach. In particular, during a preliminary analysis we identified the following portal user categories:

- Not registered user: these users are only allowed to visualize its contents;
- Registered user: users of this category are also allowed to submit comments;
- Editor: this kind of user can modify or create contents and comments, upload files, edit categories and menus' structure, lock contents to block their editing;
- e-Library Editor: these users can add, delete, and modify contents of the e-Library;
- Link Editor: these users can add, delete, and modify the collection of links directing to Web resources external to the portal;
- Admin: this kind of user has all the privileges of the previous categories, and in addition is allowed to delete pages and to change the category of other users.

In addition to these categories others were added to support the management of the WebGIS (which exploits the portal user manager) that will be described in Section 4.

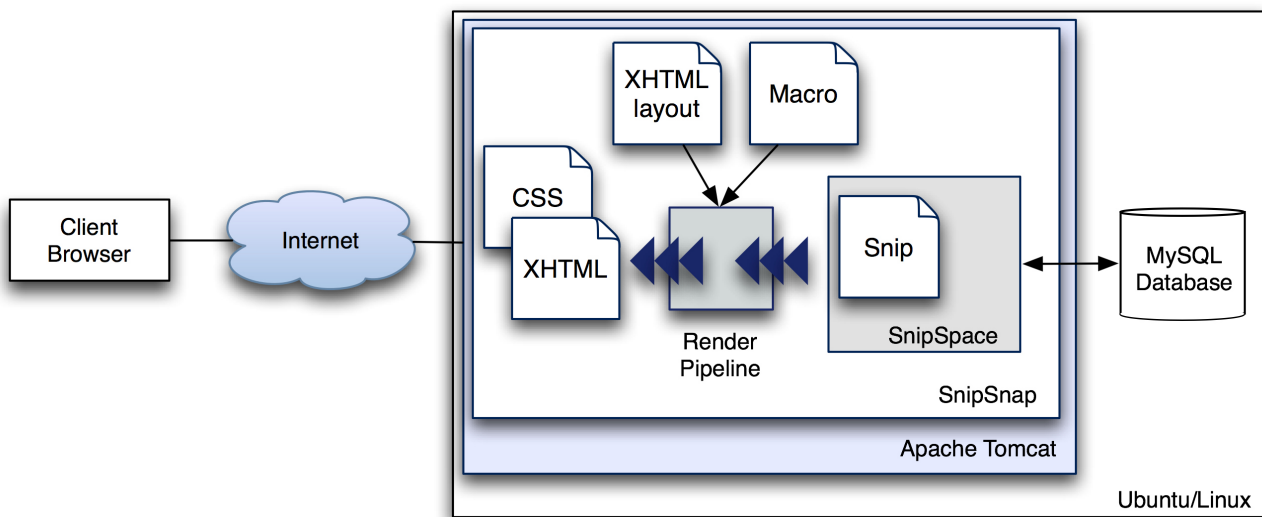


Figure 1. The architecture of the web portal.

SnipSnap's user management facility is based on the notion of "role" in lieu of users' category; this approach proved to be quite suitable to fit our needs. A role is related to specific rights of access, in a given way, to a specific type of content. In this framework, for instance, every registered user can be assigned the right to submit comments by specifying that they are related to the "write comment" access right by a specific "has role" rule. This approach permits the extension of the system both by means of new functionalities and through the addition of roles. The roles that were identified to support the above categories are as follows: Comment writer; Content editor (who can also upload files and lock pages); User Manager; e-Library editor; Link Editor.

Thanks to the possibility to directly modify the Wiki engine, we were able to customize several aspects of the applications, for instance modifying small portions of the source code in order to alter the portal page layout.

SnipSnap also provides for additional simple extension mechanisms. Among them, the most relevant ones are *Macros*, additional modules written in Java language that can be programmed separately and easily invoked in the portal pages. The external news aggregation function described in Section 2.1, for instance, was implemented by means of a Macro. In order to invoke this function from a given page of the portal, it is sufficient to insert a line "{rss:http://www.example.com/rss}." The possibility to develop macros and extensions, to modify the source code of the Wiki engine, and to alter the data structures in the backend of the system are crucial for the development of the portal, and in particular for the "Link" and "e-Library" sections.

3 The Web GIS

A particularly important section of the portal, relating to the Bronze Age in Northern Italy, and which for reasons of content articulation opens on an independent site, is dedicated to an information system based on WebGIS technologies. The purpose of this parallel and coordinated project is to take into consideration one specific research field in protohistoric archaeology, in which the promoters of the Web

portal project are extremely active, and to define in detail innovative forms of organization, management, and information flow. The specific context is also highly significant because this is one of the best-documented periods in North Italian prehistory and protohistory.

The Bronze Age in Northern Italy has been, in fact, the subject of a detailed analysis for some decades now. Scores of study sessions and publications are frequently dedicated to this topic, just as research in the field seems to be continuously carried out by the universities and the regional archaeological offices. As a result, we have a well-articulated picture of the period, which makes the study of this densely peopled area extremely interesting but at the same time difficult to perceive and grasp in its totality.

In the last few years, an important discussion has developed between the scholars of this period, and this in turn has brought about an expansion and intensification in the study of the relevant subject matter aiming to construct a scenario of the peopling of the Po Valley in ancient times. Efforts, on the one hand, have been concentrated on the individualization of cultural aspects specific to each "regional" interest, increasingly refining, as a result, the chronological and cultural articulation of the Bronze Age. On the other hand, scholars have been absorbed in a fascinating and inasmuch inexplicable phenomenon, the collapse of the Terramare culture. The Terramare represented an historical and demographic trend of exceptional importance for three or four centuries, and then suddenly disappeared in a remarkably short period of time (De Marinis 1999, 1997; Bernabò Brea et al. 1997). This is, moreover, a sphere of interest in which it becomes crucial to classify and organize all-inclusive and constantly updated data in order to stimulate further interpretation of the dynamics of the Po Valley civilizations. Currently the acquisition of data is directed to the retrieval of published information and is being undertaken by groups of archaeology students at the Universities of Milan and Bologna.

In the next sections we will describe in detail the data acquisition procedures (3.1) and the general structure of the WebGIS system (3.2). In the concluding section we will outline future developments (4).

3.1 The Data Acquisition Methodology

The sites are catalogued by using a database built with Microsoft Access. It allows us to manage all the information that we consider fundamental for an exhaustive description of the foremost characteristics of each archaeological find. It must be stressed that an elaborate standard is not available at the moment; this issue obliges us to carefully discuss data structure improvements to avoid an unwanted closed system in the future. The files are divided into several main sections, which we will briefly describe.

The topographical section contains general references to the localization of the site, such as the location names, the names of the municipality, the province, and the region and the geographical coordinates.

The section referring to chronology contains fields about the Bronze Age phase or phases indicated on the site, the absolute corresponding date in terms of century, and the methods by which the chronology was determined. In particular, in the case of the relative chronology, it is possible to specify if it has been ascertained on a stratigraphic or typological basis or both; in the case of absolute chronology, if it is the result of radiocarbon dating, dendrochronology, or another method (to be specified later).

Then there is a descriptive section where one can find the definition of the site typology (e.g., the habitation, the burial area, sporadic archaeological discoveries, etc.) and a further

definition of specific sub-typologies. For example, if the site is classified as a “burial ground,” it will then be necessary to define, where possible, if we are dealing with a necropolis, a single tomb, or a tomb in a cave. Still within this descriptive section one can also find information regarding the modalities of the discovery (e.g., stratigraphic excavation, surface accumulations, a chance find, etc.), the depth (or if the site is on the surface or buried), the author of the discovery, the possible dimensions in square meters of the area, how the dimension estimates were arrived at, and a brief description in text format of the site.

Other detailed information is associated with each site. This information deals with the excavations that have been carried out (the length of time, the director, the description, etc.) and a list of the publications in which the site has been mentioned.

A last section of the database, still in a developmental stage, is dedicated to the inventory of materials recuperated (ceramics, metals, stone tools, and others). At a primary level, it is possible to define the presence or the absence of certain categories of archaeological materials (ceramics, metals, stone tools, or others). At a secondary level, a cataloguing operation is set up, dealing with previously published archaeological material, which will keep acquiring information relating to typology (e.g., “form” and “type”), available designs, and photographs.

The archaeological sites are geo-referenced on the regional map simultaneously with the compilation of the database files using ordinary GIS desktop programs (mostly ESRI’s ArcView). This operation completes the process of acquiring data that can flow into the integrated Web system, based on the WebGIS technology. The all-comprehensive structure of the data entry is represented in figure 2.

The data collected by each student have been exported in the WebGIS according to the procedures that will be discussed in the next section.

The sites that are presently catalogued are for the most part related to the Emilia Romagna region, a region that is being studied specifically by the University of Bologna. Already completed are files of about 300 sites, while another 500 sites are in the process of being completed. Another 1,500 files of ceramic finds have been completed, with their designs and, with links to the sites to which they belong, and will be soon uploaded on the server.

3.2 The Architecture of the WebGIS

As for the Web Portal, we used Open Source technologies and specific programming for the development of the WebGIS. However, in this case the technological

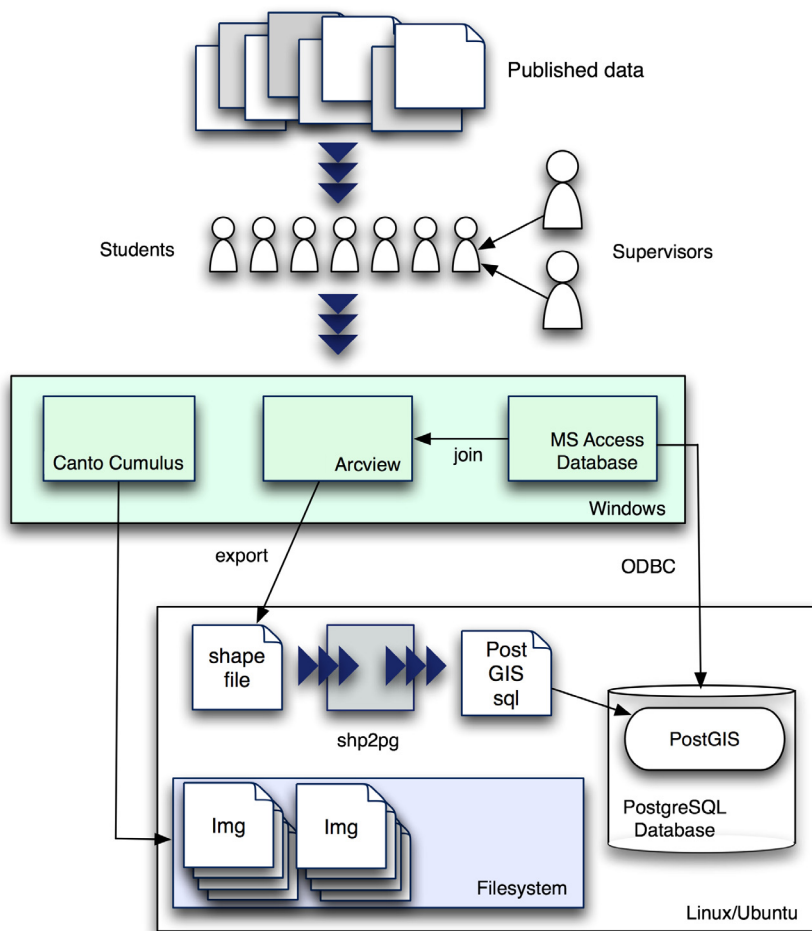


Figure 2. A diagram of the data acquisition procedure.

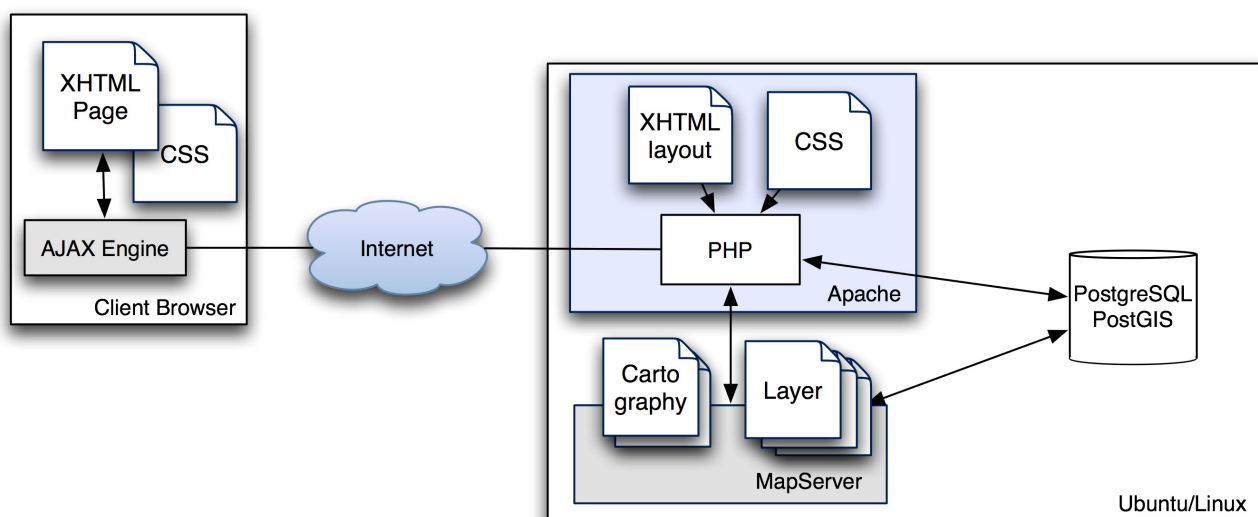


Figure 3. The architecture of the WebGIS.

choice was easier than for the Web Portal. As a matter of fact there's a kind of de facto Open Source standard for WebGIS architectures, which is based upon MapServer, as a cartographic server, and PostgreSQL combined with the PostGIS extension as a database server. The architecture of the system is represented in Figure 3.

These basic components have been integrated by means of a Map Server front-end based upon PHP/PHPMapScript and Ajax (Asynchronous Javascript and XML). Ajax represents a group of technologies (basically JavaScript, Remote Scripting, and Dynamic HTML) supporting a dynamic interaction between the client and server-side of a Web-based architecture without the need of refreshing the entire web-page. In this way the navigation is definitely more dynamic and easier than in a synchronous client-server interaction. The only drawback is that there are compatibility problems between Ajax and old browsers versions. There are a lot of alternative solutions for the development of a WebGIS front-end, as from Map Server basic functionalities to Java Applets, specific programming libraries and fully-functional products. In order to be able to fulfill the requirements of our project, we chose an autonomous development strategy by defining customized data navigation modalities which would have been difficult to integrate in an existing application. At the moment our front-end is quite simple compared to industrial-strength products such as Google Maps (<http://maps.google.com>) or Map24 (<http://www.map24.com>); however, it is fully functional and completely customizable. As a matter of fact, we were able to develop all the functionalities that are commonly available for this kind of applications: raster and vector themes selection; info tool; zoom (in, out, full extension); pan tool; reference map (Figure 4).

Data navigation in the system is quite articulated. For example, it is possible to use the "info" tool to select a site on the map, to view a synthetic file that relates to the selected site, and to move forward to view the complete file. It is also possible to perform a database query in order to obtain a list of results and to view the detailed files of each site. From the site file it is also possible to check the available photographs and to move back to the WebGIS to highlight the site localization on the map.

We are currently developing a database regarding the published ceramic finds which pertain to the sites we are cataloguing. This database will allow performing specific queries based on selected typological parameters. Another major improvement of the system will consist of making it possible to perform distribution analyses on the map. This functionality can be extremely important for our context, in that the typological analysis constitutes a fundamental means of chronological and cultural attribution.

Furthermore, our application is characterized by a specific data upload procedure. Our preliminary attempt moved towards the definition of several automatic procedures to provide an easy import of each student's file into the WebGIS system. The developed procedure consists in the creation of an ODBC link between the database server and each single Access database; Arcview shapefiles are instead uploaded by means of a PostGIS script (shp2pg). In order to provide data consistency and to manage concurrent dataset versions, we developed a web-based data entry functionality, which will substitute the current procedure. This functionality is based upon user authentication by means of a username and password assigned by system administrators. Each authenticated user can fill a new web-form or modify an existing one. At the moment it is not possible to edit the georeferenced vector data directly on the Web; the procedure supporting the upload of shapefiles is currently under development.

The authentication procedure led us to define two new roles within the Web portal user management system: the "WebGIS Editor" and the "WebGIS Admin". WebGIS editors, who are normally students, can insert new data and modify existing files. However, these data are not published until a WebGIS Admin, who is usually a professor, checks them and acts upon a specific unlock function.

4 Conclusions and Future Developments

The project must still be considered at an initial stage of development, with reference to both its conceptual and technical implementation and to the effective publishing of

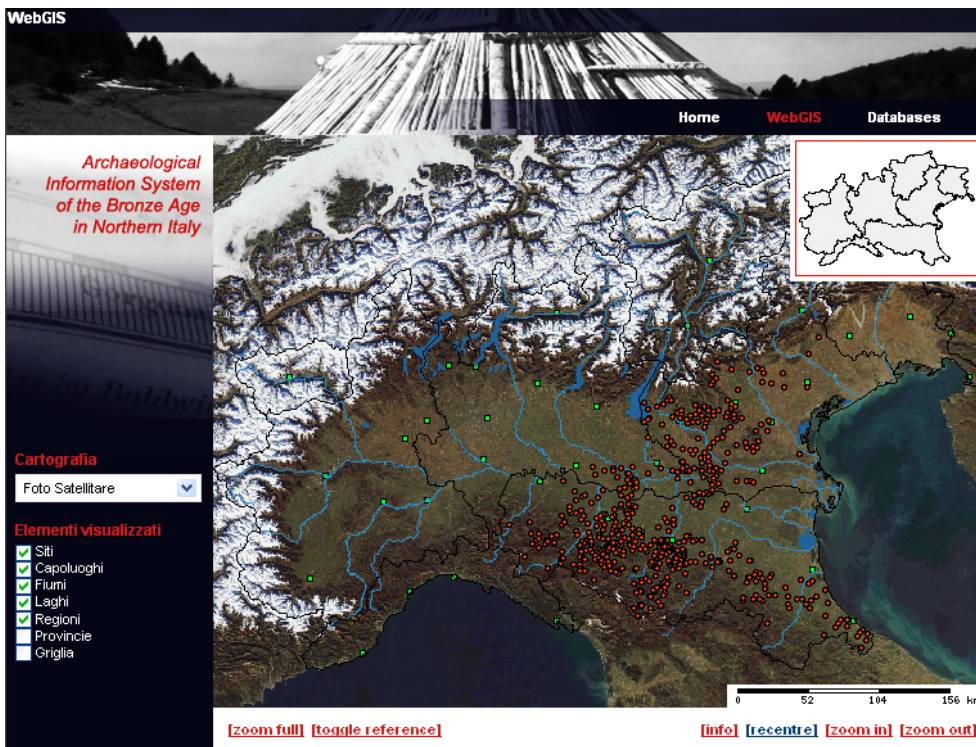


Figure 4. WebGIS map screenshot.

documents and data. However, we can already draw some conclusions from the experience and define some directions for future development.

From a technical point of view, the choice of adopting Open Source applications was successful. The flexibility of the products and modules that were adopted and the support of the users' communities allowed for the obtaining of the desired solutions in a very short time (most of the times). Moreover, OS software has a natural tendency to adopt and support as much as possible the standards of the Internet, such as those issued and promoted by the W3C (such as XHTML and CSS), but also those related to GIS applications, promoted by the Open Geospatial Consortium (<http://www.opengeospatial.org/>). This point represents an advantage over commercial applications, which tend to define and adopt proprietary formats that often hinder data and application interoperability.

The current version of the system represents a useful platform for the storage and sharing of information and documents, but in the near future it must evolve according to the vision adopted at the beginning of the project, and more precisely towards the experimentation of innovative mechanisms for the retrieval, browsing, and presentation of this kind of information. The use of a portal as a mere container would only represent a first step in a more ambitious process, providing a deeper reflection aimed at improving current archaeological practices and methodologies. An important element of this strategy, which was still not explored in a systematic way in the archaeological context, is represented by the definition and application of domain ontologies. These ontological descriptions will be focused, first, on specific and clearly defined subjects (for instance, the sites of the WebGIS or the contents of the e-Library), with the aim of extending their employment to other areas

and contents. Contents would thus be described with metadata related to a structured conceptualization of the domain. This kind of approach should grant, on the one hand, the possibility to support a richer and more articulated form of browsing, for instance exploiting the relationships between different contents (identified thanks to a similar ontological content description); on the other hand, this choice would represent a first step towards opening the portal to the access of other systems developed in the wider context of the Semantic Web initiative. Let us consider an example to better describe the possibilities offered by this approach: the portal

comprises a page devoted to the excavation of the "sese grande," which is a particular example of "sese," a type of monumental burial typical of the isle of Pantelleria (Italy). Our ontology describes "sese" as a type of "monumental burial," which in turn is a type of "burial." By adopting this kind of content description it is possible to include the "sese grande" page in the results of a search operation focused on "monumental burials." Moreover, the portal could suggest to the user to view other contents having a similar ontological description—that is, other monumental burials typical of the Italian context. While this kind of result could be achieved with a careful structuring of data describing portal contents, the Semantic Web initiative also aims at supporting the possibility of external applications and systems to explore this information and perform similar operations (i.e., perform non predefined queries, semantic navigation). In this case, the ontology that is adopted to specify the type of metadata that can be used to describe the portal contents must be defined adopting a shared standard language such as OWL (Web Ontology Language (McGuinness and van Harmelen 2004). A more thorough description of this approach and a report on the current state of development of the first version of the e-Library can be found in (Bonomi et al. 2006).

Even though these aspects require a substantial effort of analysis and conceptualization, they are not currently considered the most critical risk factors in the development of the project. The most problematic element that could hinder the advancement of the project is, in fact, represented by the difficulty of obtaining a free diffusion of knowledge and scientific data. In the scientific community, in fact, we can observe a tendency to excessively protect and limit the sharing of data; this approach negatively influences and dramatically slows the scientific progress of archaeological

studies. Therefore, a more dynamic management of the information and knowledge diffusion, exploiting the possibilities offered by the Internet, can be perceived as a threat, despite the intellectual property instruments currently available for Web contents (see, e.g., licenses for the “Creative Commons” at <http://www.creativecommons.org/licenses>, and “Science Commons” at <http://www.sciencecommons.org>). In this framework, the WebGIS module of the portal will represent a particularly interesting experiment since it will help in understanding how many partners and research groups agree to inserting and making available data related to their research before they are made available through traditional non-electronic publications.

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