

# The EKFRASYS: a New Proposal of an Archaeological Information System

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**Abstract.** This paper concerns the archaeological information system development called Ekfrasys. It meets the demand to realize – with the contribution of computer technology – a management instrument of the data, result of the various survey's methods utilized in the territoriality and infrasite research. Its aim is the carrying out of a software capable to synthetize and to integrate in a logic way the outcomes produced by several and different collection's techniques of the informations. From this point of view, it may represent a spur to a deep reflection upon the actual research methodologies directed to the archaeological data analysis and individualization.

## 1. Introduction

The proposed research activities follow a long term collaboration between the Department of Mathematics and Computer Science and the Department of Cultural Heritage of the University of Salerno, in which a geographical database has been developed to manage data from different layers. The interaction between the two Departments arose from the need of archaeologists for a working tool allowing them to manage the collected data in an integrated way that is not affected by any particular a priori interpretation. Such a tool is really useful for a wide variety of research aims since it supports different elaborations of data. The proposed GIS solution is a prototype system for the integrated management of archaeological data that implements a user-friendly interface. Today Geographical Information Systems are a widely used tool to manage and preserve the artistic and historical heritage. The integration of usual database functionalities with visualization and spatial analysis tools of GIS technology leads to an efficient solution to information analysis and monitoring. The applications of GIS vary from natural environment management to human activity analysis and planning and social and economic studies. In each case, a GIS can be used to create maps, to integrate information, to visualize scenarios, to solve complex problems and to develop effective solutions in terms of qualitative and quantitative cartography, to define relations and structures on geographical data.

The analysis and design of data have suggested three related applications: – excavation, survey and archaeometric platform (site and maps); – an alphanumeric (archive system of stratigraphic units) and spatial (archive system of registration units) DBMS; – a graphical user interface for data population, manipulation and visualization. The prototype system has been experimentally used to build a vectorial representation of Irno valley, near Salerno (IT), a context that completely considers all the archaeological information and the entire sequence of deposits. Specialized operators and trained archaeologists have performed on-site data acquisition. The result is a GIS tool that, despite of its internal complexity,

allows non-expert users to simply and quickly perform several tasks, like general or detailed context overview, data elaboration, and thematic maps plotting. The alphanumeric archive system is a relational application where different kinds of data can be combine in integrated queries.

The corresponding database is a fundamental mean to efficiently manage the complex set of data generated by a archaeological investigation, since the quality and usability of catalogued information strongly depends on database organization. Thus the developed prototype system is continuously evolving in terms of GIS and database solutions, to consider new classes of data and new links between different applications. There are no compatibility problems for the system with respect to different hardware and software platforms since all the applications are developed using the programming language and with great attention to code readability and efficiency so that they can be widely distributed among the scientific community.

The aim was to build a smart tool to handle documentary apparatus related to different search methods to determine the archaeological environment in the territorial context as in detail. A modular, multiplatform and friendly-user database was developed to store heterogeneous data (different record layout to trace different search technique and their relationship), related to subsequent step (remote sensing, survey, excavation, geo-archaeological investigation).

This information system, integrated with a GIS, is a unique spatial reference that allows further implementation related to new hardware and software technologies. This paper focus on general issues to develop a management and analysis tool in accordance with conceptual logics and practices of the research. The study of a territorial context carry on multiplicity investigation methods and with different instruments. The aim is to make available to the archaeologist the query and evaluation of data and information carried on procedures different in quality and quantity.

In other words, it was necessary to develop a model of data management to basically define the formal and functional distinction of documentary apparatus, different in relation to methodological criteria of data collection.

## 2. Methodology

### 2.1 Philosophy

The Ekfrasys project is the product of different experiences. It is the outcome of the synergy of different fields of knowledge, experimented in different fields of archaeological investigations. Such an attempt, first of all caused by the need of processing the different excavation data we have collected, is the product of a renewed interest of the archaeologists in the different theoretical and practical aspects of their studies. Here we do not want to discuss the important relationship between “archaeological document” and “historical matter”, but we should rather analyze the aspects of another delicate question, that is the big amount of archaeological data, in relation to the same amount of investigation activities, which is often not organized in a uniform network of relations and it more often produces different interpretations. That also comes out from the evaluation of a very often sectional specialization of the application fields of the archaeological interests.

The archaeological Laboratory “M. Napoli” of the University of Salerno is working, as a research institute consisting of multidisciplinary units, for the development, application and testing of the present methods of analysis.

Among the different methods of analysis one has resulted to be of fundamental importance, the one concerning the study of data formalization, or rather the identification and processing of descriptive languages by the application of automation report techniques: computer science. The experiment of a new language, did however not lead us to create a new lexicon, or to the construction of a universal rational syntax. Although we had to pay, of course, for the application of all rules imposed by the use of a specific relation pattern, it led us to consider all integration strategies of the different fields of knowledge through the analysis of the methods of data collection and the study of their information potentiality. In other words, we have measured the efficiency of the present instrument as regards the “epistemological needs” of investigation, in order to match together, at this theoretical planning stage, a technological and semantic research of the processing procedures, aiming at integrating and making data be usable, at analysing the significant structures of the archaeological research.

Then this is the main direction followed by Ekfrasys: a narration of archaeological documents starting from reasoning about the criteria of their production.

### 2.2 Semantics

Ekfrasys comes from Greek and means description starting from a reasoning. Ekfrasys, an acronym, means a System (SYS) developed (EK) from the research experience carried out on the archaeological site of Fratte (FRA) in Salerno. Ekfrasys is the system of encoding and managing data which becomes language and narration. It is the SYS of FRA, a system developed from a concrete comparison with a specific historical-anthropic and therefore archaeological context, which is FRA. But it is also the Ek of this process, in order to make a language be a method, a process of classification and

management, which not only allows an internal coherence of the system and a functional support for the archaeological work, but which is also a possibility of relation as it is coherence link with other archaeological contexts and the other ‘sciences’. It is the assumption of a multiversum, which will produce infinite suggestions and relations. From this point of view the Ek of Frasys, when it makes its special character be evident, it disappears and opens the possibility of a narration which is the starting point of a new scientific question: the Sys of Fra. Ekfrasys comes out just as a scientific construction, starting from creation/formalization of a language which is narration of significant events, semantically rich within a context ready to be read and become known.

## 3. Technical Development

From a technical point of view the software used for the development of the Ekfrasys application consists of the following packages.

The GIS section is developed by ESRI MapObject, because it is an instrument for developers, allowing to carry out synergic relations between the maps and the information the user has to manage. It includes an ActiveX, Map Control, together with other 46 ActiveX, which allow its use in developing systems like Visual Basic. In the data pattern used by SDE (Spatial Database Engine) spatial data and attributes are managed by an RDBMS. The Map/Object application and the SDE client library implement the interface managing the users’ requests. As regards the server, we have the SDE, RDBMS processes and the data. The server carries out all spatial researches and collects data and gives back to the client only the data which meet the research criteria.

For creating and managing the database we have used Interbase. Interbase offers an InterClient package which allows the application to inquire and manage the database. SQL, a non procedural language, that is a language not linked to a special database, has been used.

The GUI-Graphical user interfaces have shown that an image is worth “more than a thousand words”.

Applications must communicate something which is considered familiar, because they are an interface conforming with a certain standard. Therefore, if we decide to create programs, it is necessary to have an instrument to create GUI applications efficaciously. The version 6.0 of Visual Basic by Microsoft Corporation is an efficient and reliable instrument for this aim, it allows to manage database and it is also the most efficient programming system operated by MapObject.

## 4. Operations

The program developed on this ground generally provides the possibility of managing data resulting from the main research analyses identified in a previously outlined territory. The definition of a territorial working field is necessary. It fixes the maximum relation limits of the examined data and from a computer science view, a real structure of representation and

working. The reminding to a geographical context does not put the Ekfrasys system solely within the domain of the so called landscape archaeology. The collection, at all levels, of all the analytical and synthetical, bibliographical and historical, exact and regional data, offers the opportunity of explaining the reasons of an old context within internal dynamics (cultural traditions, technological notions, production relations, etc.) as well as external dynamics (exchanges, commerce, defense of the territory etc.).

In this sense, we could refer to a generic idea of landscape: an area usually exploited by a human group in which economic and production activities give a certain shape to the environment, such as to determine, according to the data of the material culture, a firm reference point and even population definitions. Then the relationship between the information of the material culture, mainly coming from archaeological investigations, and the analysis of the characteristics of the landscape, according to an interaction process between the anthropic cultural structures and the resources of the territory, can give us an image of the possible settlement dynamics occurred in old times. In that way, to start we have to select the investigation area or to create a new one, by the input of cartographic reference documents. In the first case the program physically identifies a “folder-dossier” matched with its correspondent territorial unit while, in the second case, it will create it automatically. So a georeferenced basis, within which to manage the different investigation kinds and the related data, or rather a GIS, is created.

The second step consists of the choice of the investigation contexts to access (Excavation-Remote Sensing-Archeometrical Analysis).

They are four different procedures which are distinguished from each other in order to preserve the special character of each procedure. We know that as the study methodologies change, either analogic or digital media, the information typologies and within these, the relations among the collected data, change. It can also be important to remember that it is not always possible to carry out different interventions within the same territory.

The independence of each activity module from each other gives the program its strong versatile character. It should be said that because the structure of data is of a vector kind, this software does not produce an automatic analysis of the raster elements or of the electromagnetic reflectance. On the

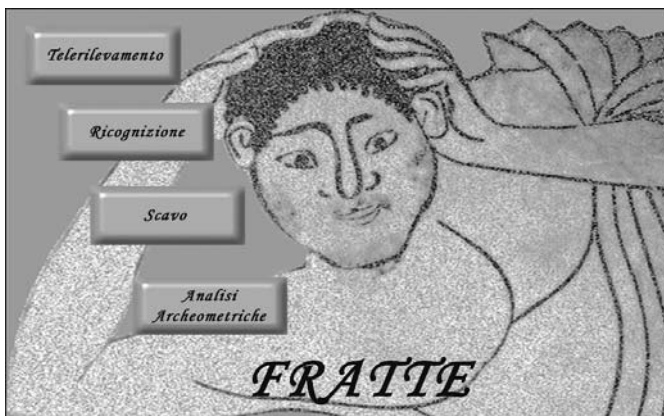


Fig. 1. Working modules.

contrary, it manages the documentary level of all data and of some of them it shows examination functions.

It is the case of the excavation section.

It is the product of a deep analysis of the techniques and methods carried out during the past years in the yards managed by the DBC, and comes from the consolidated experience of using the CNRS (UMR 154) program known as Syslat, but in the last resort strongly linked to the rules generally codified of archaeological stratigraphy. The philosophy of this project was that of repeating the procedures of the archaeological work on the field, in a special information system, making the patterns of the information recording coincide with those used for the identification and description of stratigraphy.

As regards this pattern, the idea of zone<sup>1</sup> for the distribution of the intervention areas, is still unchanged, and it is functional to the creation of a linking structure between the excavation data and those coming from the other investigations.

For example, the stratigraphic units, basic elements for the information organization, are identified by the ID number of the zone. In the same way, the topographic units, as regards surveys, are defined by the ID of a spatial zone called “square” compared with the zone. So a juxtaposition between excavation and survey zones could exist, but the relationship among the different spatial units is defined only according to statistic terms, showing the reliability of the diagnostic analysis such as the survey and analytical examination of the information carried out by the excavation.

Stratigraphic data are then organized from US, minimum reading contexts which are distributed within zones. No data exist except for its being in relation with the stratigraphic units. The file format for the information input follow this pattern. The elements characteristic of the stratigraphic units are always shown on the screen, while below the selection menus allow the access to the special databases for the input of data contained in the US.

Each typology of data is then filed, according to the needs of one’s own field of study, as for example ceramic, little objects, fauna, bones, etc. Taking advantage of the multimedia information software, the vector objects, defined as US

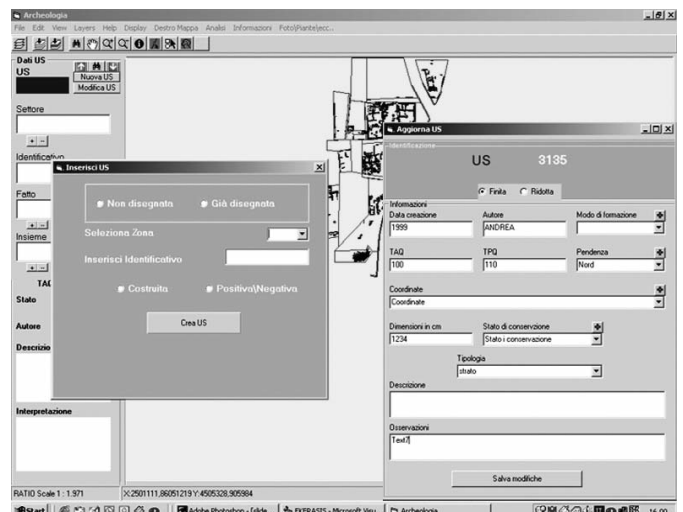


Fig. 2. US definition.

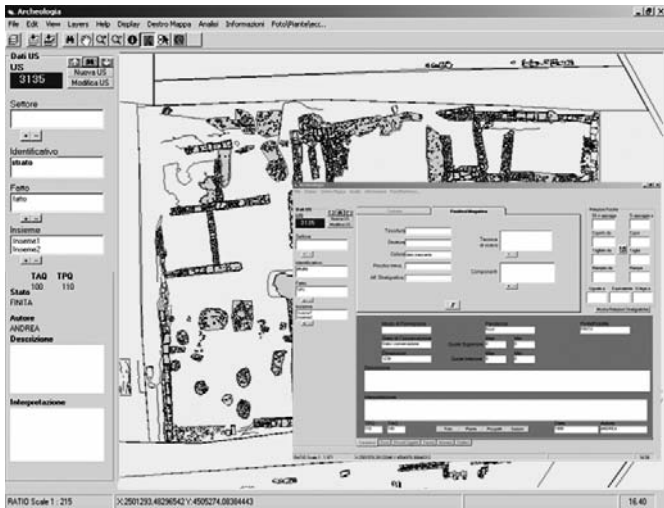


Fig. 3. US data entry.

elements, are matched with an individual documentation which includes the whole of the detailed plans, of the photos and, in some cases, of the videos or the tridimensional reconstructions. Finally some functionality patterns were prepared. They, using the programming resources of the GIS software, produce subject maps derived from statistical-spatial analyses.

As an example we can give the possibility of carrying out inquiries of the alphanumeric database in relation to typology, distribution and finding density characters.

The other section, here examined, is devoted to remote sensing. It opens with the request of identifying, as regards our territory, the areas 'covered' by the documents. In this case we can refer to an already existing and previously filed covered area or to provide for the input of a new information set, that is the georeference definition of the new media. According to the kind of the images, terrestrial, air or satellite datum, the program selects the file format suitable for the first input and description of the data of the medium or the media. It is a simple filing operation meant for organizing a complete documentary bank of the available images or scenes, and not, as we have above said, meant for providing one or more than one basis for computer based analysis. The exam of the media, independent from the recording operations of Ekfrasys, leads to identify the 'traces' which can be directly traced by the processing devices of the program or imported from another information system. After, these elements are classified and matched with alphanumeric data and represented with thematic modules



Fig. 4. Aero-photography marks restitution.

which reproduce its mediation function, typology, geometry and interpretation. Then, it is possible to evaluate the 'traces' by reading them in relation to the data represented in the section devoted to the excavation, by some analyses we could define as 'congruity analyses'. That is to say: if it is possible to have a convergence between the information of the remote sensing and the stratigraphic data. In this case, within certain risk limits, we went on processing algorithms according to coincidence analyses (perfect juxtaposition according to absolute coordinates of the track and the excavation vectors) or of the closeness (distance function of the track vector from the coordinate of an identified point), in order to find a possible relation, of the 'traces' read, filed and interpreted in the database of the remote sensing, with the 'objects' identified and represented in the excavation section, described and considered in their whole within the same territorial context.

**Note**

- <sup>1</sup> Concerning the organisation of the recovering system Syslat and the adopted notions in the division excavation yards see cfr. Py 1991; Py 1997.

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