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Design and Development of a Large Scale Archaeological Information System A Pilot Study for the City of Sparti

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ABSTRACT

This paper deals with the design and development of a digital system for the management, analysis and documentation of large scale archaeological data, collected through excavations. The development is integrated through a set of software packages running on a PC. Special attention has been given to two issues. Firstly, to the visualisation methods of representing the archaeological data (characterised by geometric and thematic attributes) and secondly to the design of the user interface, since the system is addressed to archaeologists – scientists that are not familiar with geometric concepts. As a pilot study a project area centred upon the north-west part of the modern city of Sparti was used, since it is an area of rich archaeological excavations.

1. INTRODUCTION

The development of theory and method in spatial analysis the last two decades, provides archaeology new tools for the study, management and conservation of the archaeological sites. The need for using GIS for the implementation of archaeological information systems (AIS) has become apparent and recognised by the society of archaeologists worldwide, see for example Smith (1995) and Harris and Lock (1995). GIS methods are adopted in many archaeological projects, mainly as a presentation tool, and in some cases as a spatial analysis method for the prediction of non discovered archaeological sites. Although these applications are rather experimental, they can be considered as the first steps in a way leading archaeological work to an integration of computer based methods of recording, processing and storing data (Filippakopoulou, 1991; Koussoulakou, 1992; Baena et al., 1995).

Based on the above considerations a digital system for the management, analysis and documentation of archaeological data was designed and developed. Data refer to large scale records and representations of archaeological sites. The development of the system is integrated through a set of software packages running on PC. Special attention

has been given to: (i) the visualisation methods of representing the archaeological data (characterised by geometric and thematic attributes) and (ii) the design of the user-interface, since the system is addressed to archaeologists – scientists that are not expertise in computer technology and spatial statistics. The system was implemented in *ArcView* (v 3.0) environment and the user interface was developed using *Avenue* software programming language.

As a pilot study a project area centred upon the north-west part of the modern city of Sparti was used, since it is an area of rich archaeological excavations. Data was acquired by the 5th Ephoria of Pre-historical and Classical Finds, the administrative unit, responsible for the all the excavations of the area.

2. METHODOLOGICAL APPROACH

Greece is a country of rich and valuable archaeological finds. In almost every city of the Greek territory a significant number of archaeological sites have been already discovered and it is well known that there are many other existing, but not yet discovered. According to a state law, a special permission should be provided by Archaeological State Services (Ephoria) for technical operations, like excavations, in any parcel. The large amount of archaeological sites distributed in the urban network claim for special treatment in managing the archaeological data from different sources. The GIS technology can provide archaeologists with appropriate tools for collecting, processing, analysing and presenting the archaeological data. However, archaeologists are not expertise in computer technology and an additional effort should be addressed towards customising existing software platforms according to their needs through the user interface.

2.1 The geometric and thematic information of the system

The archaeological sites are spatially related with the parcels of the urban network. Within each parcel, the excavation is recorded separately and forms the spatial unit of the system. In every excavation finds are classified either as mobile or as immobile. The discovered mobile archaeological finds are collected and stored to special places for further study and analysis of their characteristics. In some cases certain mobile finds of high archaeological value are stored in museums. Each mobile find is associated with both the location (geometric information) that was fund, and the thematic information derived from the archaeological study.

The excavated immobile archaeological finds are houses, walls, floors, and pipes of the ancient settlement or in most of the cases are parts of them. These finds are located in multiple levels under the ground surface associated to different chronological periods. The geometric documentation of the immobile finds is accomplished by applying surveying techniques at scales 1:50 or 1:100. Considering the above scales all archaeological finds are treated as polygons. Each polygon is associated with thematic information derived from the archaeological study. Thematic information consists of qualitative and quantitative attributes.

The qualitative attributes refer to the description, type, initial use, chronological period, and current situation of the immobile find. This information is usually recorded in the excavation diary. Additional information is recorded concerning the name of the archaeologist that performed the excavation, the date of the excavation, related literature

references etc. The quantitative attributes are revealed by the geometric documentation and consist of the area, the perimeter and the level at which it was found.

The information content of the system database was organised by applying the relational database model (Date, 1990) and includes the following themes per each excavation:

- Location
- Parcel owner(s)
- Identification
- Drawings
- Photographs
- Mobile finds
- Immobile finds

The above stated themes are developed gradually in more detail at three levels in the database.

2.2 Reference system transformations

The geometric data are acquired from different sources including the cadastral drawings at scale of 1:1000, the city plans usually at scale of 1:5000, the excavation survey drawings at scales 1:50 or 1:100 and other sources. Most of this graphic information is either recorded in different reference systems or in arbitrary ones. In a functional AIS all geometric data have to be transformed to a unique reference system, a remark that has been also stated by other researchers (Brovelli and Maurino, 2000). Considering a wider approval it is preferable to transform all geometric data to the National Geodetic Reference System. The design of the AIS should include the appropriate tools for the transformation of graphic data from all existing reference systems to the National Geodetic Reference System. The transformation tools should include translation, rotation, scale and other geometric transformations. Figure 1 illustrates an example of performing the appropriate transformations for the induction of an excavation survey drawing (1a) into the city plan (1b).

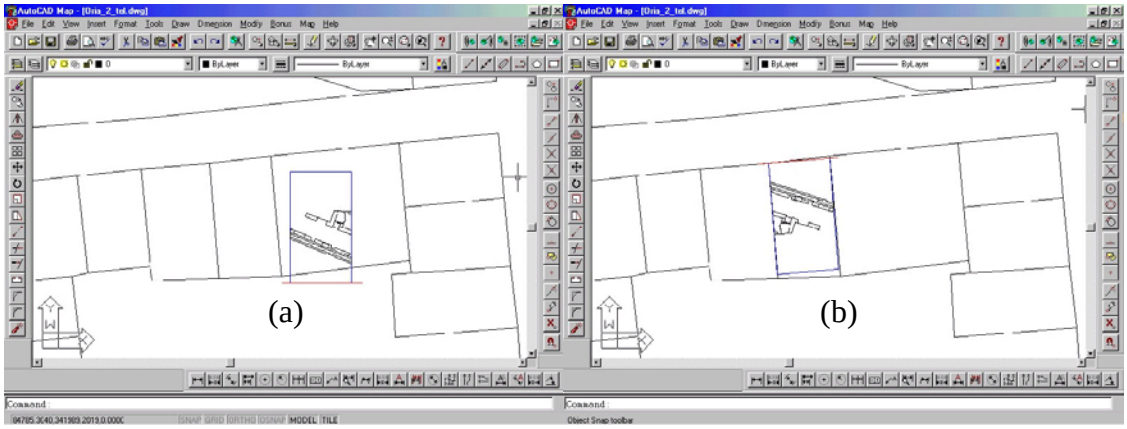

Figure 1. The induction of an excavation survey drawing (1a) into the city plan (1b).

2. 3 The user interface

The user interface was designed with the consideration that users -the archaeologists- are not expertise in computer technology. Two characteristics are of significant importance in order to create an effective user interface:

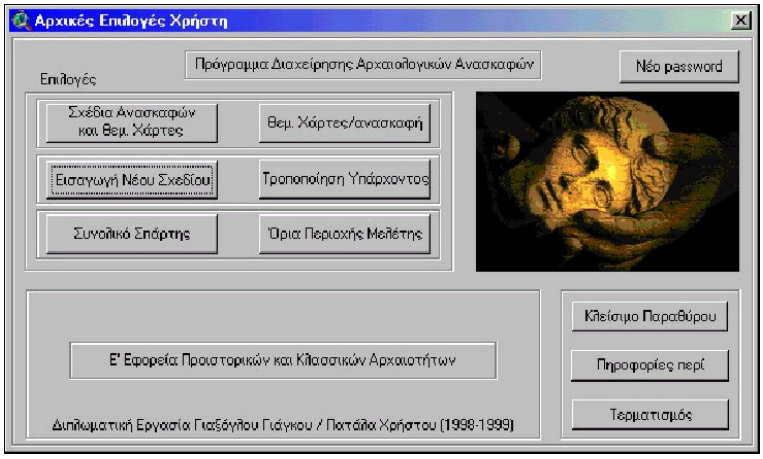

Figure 2. The GUI of the AIS.

- Friendly and flexible environment
- Automation

The graphical user interface (GUI) conveys the user with the system's software and gives to the user the first positive or negative impression about it (Figure 2). An effective GUI has to be friendly and easy to be used but mainly it has to be approved both by experts and non-experts. These are rather difficult requirements to be achieved since "friendly" and "easy to be used" are partially subjective factors. Special needs can be probably result during the execution of a project, so the GUI must have a dynamic character and must be easily adjustable or expandable to additionally defined needs. It can be stated that the only existing limitations are due to the finite possibilities of the software platform. The automation, the second basic characteristic of the GUI, has two significant advantages. By minimising the execution time the productivity increases. Additionally, it does not require users to be able to handle the software platform's commands.

An additional function of the GUI was the design of the appropriate visualisation tools for the representation of the archaeological data through different forms of graphical views, like maps, diagrams etc. Although GIS software platforms provide many alternative ways of visualising spatial data, in several cases users fail to communicate graphically, since they can not create maps according to the cartographic rules. The designed GUI supports spatial representations of the archaeological data by strictly applying the established cartographic rules of graphical communication.

3. THE PILOT STUDY

As a pilot study a project area centred upon the north-west part of the modern city of Sparti (Figure 3) was chosen (Patalas and Yaksoglou, 1999). The 5th Ephoria of Pre-historical and Classical Finds, the administrative unit of managing the archaeological data in the area of city of Sparti, has accomplished a large number of excavations during the last thirty years. The project area is a representative one, since it has quite a lot of excavation sites, with a variety of finds in many of them that belong to different historical periods. Furthermore, this area was also chosen because it is sited in the centre of a dense urban network. The twelve blocks of the project area have been excavated and the collected archaeological data have been kindly given to the authors by the 5th Ephoria of Pre-historical and Classical Finds.

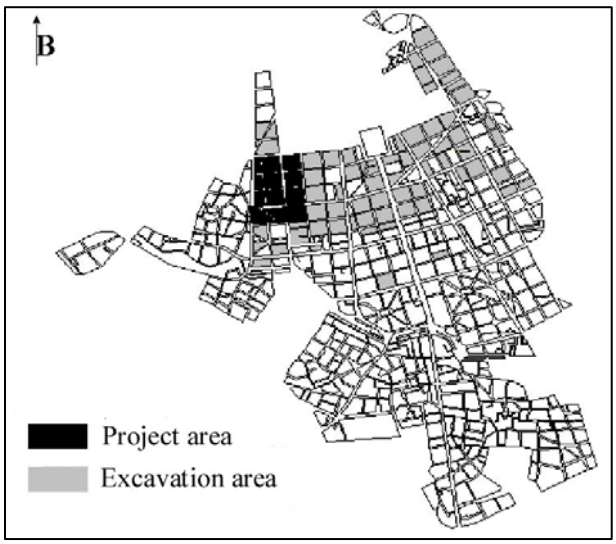

Figure 3. The urban network of city of Sparti.

3.1 Geometric data of the pilot study

The geometric data used for the pilot study are the following:

- Cadastral maps
- City plans
- Excavation surveys

Cadastral maps of scale 1:1000 in analogue form provided by the Ministry of Public Works. These maps represent the parcels, the outline of the buildings and technical details, the existing infrastructure networks and the contour lines. The cadastral maps are accompanied by associated tables giving the elements of the owners.

City plans of scale 1:5000 in analogue form provided by the Ministry of Public Works. These maps represent the blocks of the city and several technical details.

Plans of the excavation surveys of scale 1:50 and in a few only cases of 1:100 in analogue form presenting in detail all archaeological finds.

The geometric data was integrated into the system after digitisation and transformation by applying the implemented tools. Due to inconsistencies among the collected data additional field survey was needed to resolve all the encountered problems.

3.2 Thematic data of the pilot study

The thematic data of the system acquired by the excavation diaries which are kept by the archaeologists of the 5th Ephoria of Pre-historical and Classical Finds. Thematic data were divided into two categories:

- Archaeological data referred to the mobile or immobile finds per excavation.
  This category includes alphanumeric information about the chronological period of the finds, their use, type and their current situation. It also includes graphical information as are the photographs of the finds.

- General data concerning the process of the excavations.
  This category includes text information about the owners of the parcel, the archaeologists responsible for each excavation, the date and duration.

The finds of the project area are of great importance covering ten historical periods of time, starting from the Pre-historical (Copper Age) up to Byzantine period. The immobile finds are characterised by twenty-eight different uses and seven classes of types.

3.3 Examples of use of the system

The system is able to serve the needs of the users by responding to their queries. Users can easily have directly access to the archaeological data by choosing a specific selection of the initial menu. More specifically, users can:

- Add or modify the information content of the system.
- Create thematic maps representing retrieved data.
- Perform specific (a)spatial queries.
- Have access to the database at a gradually increasing level of detail.

An example of the way that the user can modify the information content of the system trough the GUI is illustrated in Figure 4.

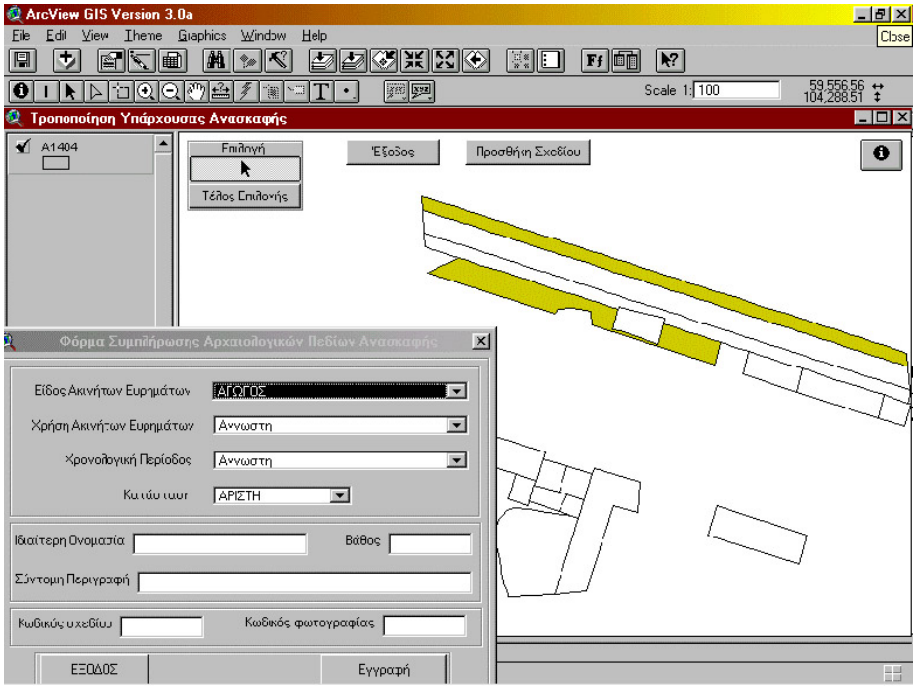

Figure 4. An example of the system's GUI.

Following are two representative examples of responses -in the form of thematic maps- to user's defined queries. In the first example the user is asking the number of excavations that have been taken place in the project area. The answer is given by the system through a thematic map (Figure 5) by applying value as visual variable for the representation of the number of excavations. In the second example the user wants to

know the type of immobile finds of a specific excavation that has been taken place in the project area. The answer is given by the system through a thematic map (Figure 6) by applying hue as visual variable for the representation of the different types of immobile finds (the original map is coloured).

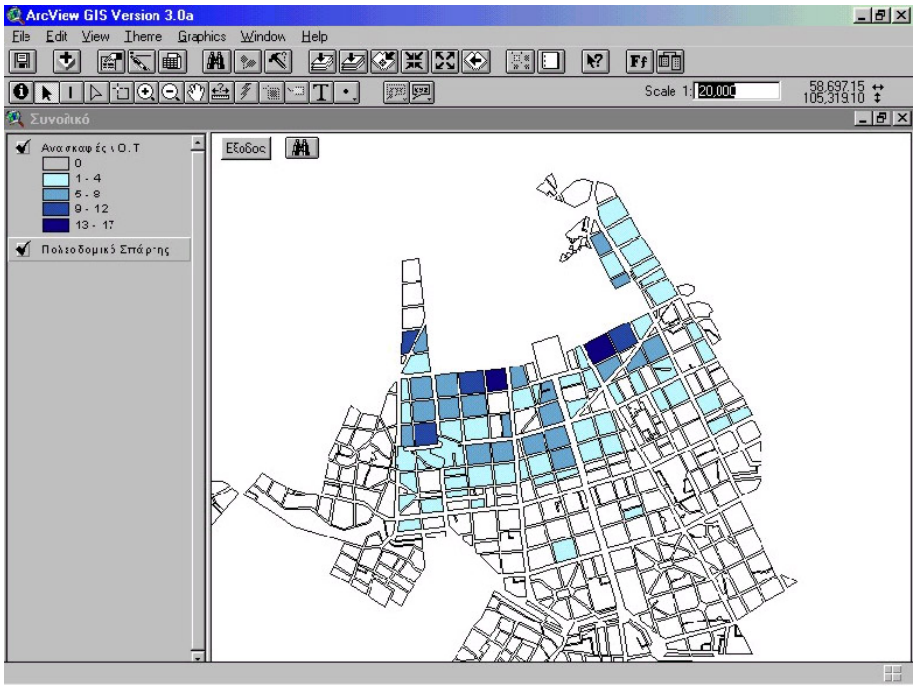

Figure 5. Number of excavations in the project area.

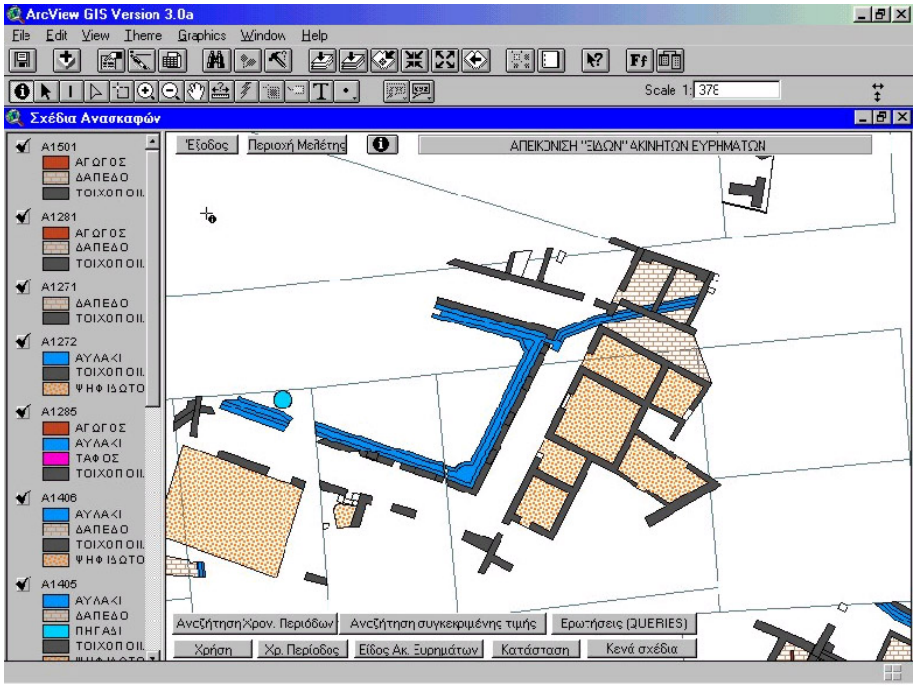

Figure 6. Types of immobile finds of an excavation.

4. CONCLUSIONS

Since the prototype AIS has been integrated in the project area and is already used as a pilot study some preliminary results of its application are known. So, from the up today use it can be concluded that the characteristics of the designed and developed system are:

- The transformation of the various geometric data into a unique reference system.
- The friendly and flexible in use GUI.
- The easy and direct retrieval of the archaeological data in the form of thematic maps.
- The possibility of applying additional functions (expandability).
- The possibility of automate in the near future all the stages of the spatially related archaeological work.
- The possibility of the system to be adopted by all the other administrative units of the State to form a National Archaeological Information System (extendibility).

Although at the present time the implementation of the prototype software was carried out, the results of the pilot study are very promising.

5. REFERENCES

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