GIS SOFTWARE TOOL FOR DIGITALIZATION OF GREEK CARTOGRAPHIC BACKGROUND

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Abstract

During the last 2 decades, the technological development of computers (hardware and software), has given the opportunity of a new approach at spatial information manage. The Geographical Informations Systems (GIS) belong to the information systems that manage the models of geography data. This application makes possible the complete digitalization of Greek cartographic background, which can be used in many cases as research proposes, agricultural management, maps creation etc, but for this paper the data of province of Giannitsa was used. Application’s coordinate system is the Greek National Geodetic system (E.G.S.A. 1987) and it was made with programming language “Avenue” of the ESRI ArcView 3.2. The application was made in such a way to be user friendly, to cover probable future requirements, to accept add-ons for increase of the application capabilities, and to predict – avert possible errors or skips of the users.

Introduction

Maps have been used for thousands of years, but it is only within the last few decades that the technology has existed to combine maps with computer graphics and databases to create geographic information systems or GIS. The process of making maps with GIS is much more flexible than are traditional manual or automated cartography approaches. GIS is used to display and analyze spatial data which are tied to databases. Maps can be drawn from the database and data can be referenced from the maps. When a database is updated, the associated map can be updated as well. GIS databases include a wide variety of information including: geographic, social, political, environmental, and demographic (Meuser, 2006). GIS is often described as integration of data, hardware, and software designed for management, processing, analysis and visualization of geo-referenced data. Its software component has a profound impact on the capabilities to effectively use the spatial data for solving a wide range of problems (Neteler and Mitasova, 2004). Maps are being used increasingly in local, networked and mobile information systems for communicating
geographically referenced information. This has become possible because of the now relatively widespread availability of digital map data and developments in geographical information system technology. Interaction with a digital map is typically based on a cycle of elicitation of user input via menu and dialog boxes, selection of a map areas or features, and return of information, which may in turn induce modification to the map content. The maps themselves are often close replicas of traditional paper map cartography (Li and Qi, 2003). GIS software provides the functions and tools needed to store, analyze, and display geographic information. Key software components include tools for the input and manipulation of geographic information, a database management system (DBMS), tools that support geographic query, analysis, and visualization, and a graphical user interface (GUI) for easy access to tools (Throckmorton, 2003).

The purpose of this paper was the creation of an application with the following aims: easy search of information, use of cartographic background, printing maps, and the complete digitalization of Greek cartographic background. The application has the capability to predict – avert possible errors or skips of the users.

Materials and Methods
The development of the application become at four stages: a) definition of aims, b) definition of the functions, c) planning of the application structure and d) implementation of application. Definition of aims become with thorough analysis of crucial issues such as: informations that would be available, data input system, search capabilities, way of view of available informations, easy use of application, and probable future requirements and uses of this application.

Definition of the functions was the result of these aims. This application makes feasible the digitalization of all Greek cartographic background, but for the needs of this paper, data from the province of Giannitsa was used. Application’s coordinate system is the Greek National Geodetic system (E.G.S.A. 1987) which is the most recent coordinate system in Greece. Greek National Geodetic system is the result of cooperation of Hellenic Military Geographical Service, School of Rural and Surveying Engineering of National Technical University of Athens and Hellenic Mapping & Cadastral Organization (H.M.C.O.). The main target of the application is the field planning – digitalization of the topographic maps of Greece. For that purpose, the application supports the induction of topographic maps concerning Greek areas. Greek dominion is sectored in 13401 orthophoto images which are defined of Topographic Service of Greece. Orthophoto images dimensions are 4km*3km and the total
area of each one of them is 12km². The use of these orthophoto images is the easier field’s planning – digitalization which can be done in combination with topographic maps. Apart from the orthophoto images, the application can also support the usage of satellite images in order to achieve higher quality visual images of the lands. The application function is accomplished with the usage of several layers. The application as default shows all the layers together. The user has the capability to interfere in the application’s visualization by selecting the layers which he desires to be showed.

As long as the function of the application has been determined, the next level of its development was the planning of the structure in order that the final form would be the expedient result. The aim of this level was the definition and the creation of the tables – thematic background (Units, Fields, Municipalities and Cartographic Maps of Giannitsa) as and the definition of these relations. There are 4 basic layers. These are: “Cartographic background”, “Fields of Giannitsa”, “Units of Giannitsa” and “Municipalities of Giannitsa” and their format are (.shp) which is a digital vector storage format for storing geometric location and associated attribute information. In shapefiles (.shp) area features are represented as closed loop, double-digitized polygons, and attributes are held in a dBASE® format file. Each attribute record has a one-to-one relationship with the associated shape record (ESRI Shapefile Technical Description, 1998). The application has 5 tables (Figure 1).

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**Fields of Giannitsa**
- Area
- Field ID
- Tax ID

**Cartographic Background**
- Area
- Field ID
- Tax ID

**Municipalities of Giannitsa**
- Municipality Name
- Municipality ID

**Tax ID Database**
- Tax ID
- Surname
- Name
- Father name

**Unities of Giannitsa**
- Unity ID
- Unity
- Area of unity
- Orthophoto image ID

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Figure 1: Application tables
Unities called the areas which are defined of Topographic Service of Greece and which are
determined of natural and technical borders and have as a title the geographical coordinates
of their metacenter. The creation of layer “Unities of Giannitsa” was made by deleting all the
unnecessary fields from the shapefile of Unities Pella prefecture which we got from the
Topographic Service of Greece. Layer “Fields of Giannitsa” was created from “Unities of
Giannitsa” layer by deleting all the unnecessary unities and fields and adding 2 new fields
(Field ID and Tax ID), and “Cartographic background” layer was created from “Fields of
Giannitsa” layer where all the graphical information was deleted. Layer “Municipalities of
Giannitsa”, topographic maps of Greece and orthophoto images were supplied from the
Topographic Service of Greece. The relations of the tables are shown in Figure 2.

Figure 2: Relations of the application tables

The application have 35 scripts and about 4000 lines of code, and it was made in such a way
to be user friendly, to accomplish all future needs and to support all kinds of GIS. data. It was
made with programming language “Avenue” of the ESRI ArcView 3.2. The election of
ArcView 3.2 was due to its compatibility with all the versions of Microsoft Windows (Win95 to
Windows Vista) and in virtue of the umpteen capabilities and the flexibility of the
programming language “Avenue”. All application data are compatible with any GIS or
database program (e.g. ArcMap, Microsoft Access etc)
Results and Discussion

The use of application is very simple and no previous experience in GIS applications is required. The main screen of the application is shown in Figure 3.

![Main screen of application](image)

**Figure 3: Main screen of application**

The “Unités of Giannitsa” are represented with polygons whose sides are colored green and their center is transparent, the “Fields of Giannitsa” are represented with polygons whose sides are colored red, the “Municipalities of Giannitsa” are represented with polygons whose sides are colored turquoise blue and the “Cartographic background” is represented with blue polygons. The orthophoto image 364-506 and the re-allotment of Giannitsa land topographic map of 1980 (Figure 4), were used for this example.
The main menu consists of eight items: File, Find, View, Field Drawing, Fields Merging, Cartographic Background, Tax ID Database and Help. In the next paragraphs, there is a description of the main functions of the application.

To start drawing fields user must select **Field Drawing** → **Start Drawing** (Shortcut Key: F5). The drawing of fields is made by splitting or merging the polygons of layer “Fields of Giannitsa” and the area of the fields are calculated automatically. If the user made some mistake then he can select **Field Drawing** → **Undo Drawing** (F6). After the drawing of the fields the user must select **Field Drawing** → **Stop Drawing** (F5) and to confirm the changes.

After the drawing, the data of the fields must be added. To do that user must select with the selection tool the field and then from application menu to select **Cartographic Background** → **Add data** (F4). In the text boxes that will appear user must type the main data of the field (Field ID and Tax ID of the owner). The name and surname of the owner will be added automatically from the Tax ID Database. Application has a mechanism to prevent any user mistake. If the Field ID is already given (duplicate value) or the Tax ID is wrong then an error message will be appear and the data changes won’t be saved. If the data is correct then the
changes will be saved and the field will be copied from “Fields of Giannitsa” layer to “Cartographic Background” layer (Figure 5).

Figure 5: Field with ID data

If the user at drawing procedure tries to draw a field that already has cartographic background information then an error message will be displayed, and there will be no changes at the field.

If in the future there are changes at field data, user must select from menu **Cartographic Background → Modify data (F3)** and then type the new data (e.g. new field owner).

From find menu, user can make queries to find and see all the fields that have some specific data (e.g. Field ID, Owner, etc). This can be done either with Boolean algebra queries or with search boxes.

User can view and print field’s data by selecting **View → Field’s Information** if he wants to view the information of one field, **View → Unity’s Fields Information** if he wants to view the information of all fields into a unity, **View → Municipalities Fields Information** if he wants to view the information of all fields into a municipality or **View → Owner’s Fields Information** if he wants to view the information of all fields that belong to an owner (Figure 6).
The application has the ability to create and print maps of any dimension (e.g. A0 paper, A4 paper etc). To do this user must go View \(\rightarrow\) Print Maps and then a new menu will be open in which the user can modify the map (e.g. Scale of map, selection of North Arrow etc).

All the data or the selected by query data can by exported by selecting File \(\rightarrow\) Export data. The export data can be shapefiles (.shp), drawing files (.dwg), tables (e.g. .xls) and images files (e.g. .bmp, .jpg, .emf)

There are many other useful options as: statistics, help file, pre-drawing button, Tax ID database editing, color options of the layers etc

The application support add-ons. To install an add-on user must select form the menu File \(\rightarrow\) Install add-ons. Figure 7 shows the Field’s Cultivation add-on which allows to the user to add the cultivation information of the fields, to print cultivation maps, to have analysis of the data (e.g. acres of cultivation in a municipality, change of acres of cultivations through time), graphs, and many more options.
Figure 7: Field's Cultivation add-on

Conclusions

Aims of the application are: the easy search of data, the use of the digital cartographic background for the needs of studies and researches, print of maps, and the full digitalization of Greece through a user-friendly GIS-based Graphical User Interface (GUI) that takes full advantage of the GIS capabilities. User doesn’t need to have previous experience in GIS, and the application has the capability to predict – avert possible errors or skips of the users. This application mantles the specifications that were needed for the GIS application that Greek agricultural advisors must have and was examined with various operative examples, which accomplished huge number of occasions and degree of complexity and established that can be capable to operate unexceptionably.
References


