Understanding and creating WEB GIS

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Abstract. With growth of geoinformatics, new areas for developing new types of applications based on geodesy are opening. One of those application is definitely WEB GIS. In this article there will be words about powerful geographic information system which are reliable tools in creating and providing spatially oriented decisions. Examining WEB GIS application of „Sveti Duh" cemetery in Koprivnica, that can be found on server of Faculty of Geodesy, I am going to provide in depth view of development of application oriented towards larger groups of users.

Key words. geographic information system (GIS), geoinformatics, databases, spatial data, scripting languages

1. Introduction

Demand for more economic, accurate and efficient methods of using spatial data exists for a long time. Still, only with the development of specialized software and with the general growth of IT technology, developers have enough tools for creating systems which manage to analyze spatial data, create spatial queries over digital maps and visualizing the same. For this reasons geographic information system (GIS) was developed utilizing great possibilities of creating more accurate and better feedback information. With better and more accurate data used as input, more reliable information will be created. Geographic information system is oriented to users and their needs and it is also integrated in large number of science disciplines where there are being used for working with geoinformation. Data analyzed with GIS is collected through geodetic methods or through remote sensing. In rest of the article there will be few words about system which uses vector and raster data, while in analyses of WEB GIS only vector data is mentioned representing objects of real world.

2. Usage of GIS

There is large number of GIS users around the world. Variety of institutions, professionals and less demanding users is really impressive: from European commission, research institutes, local authorities, urban planning departments to smaller companies, tourist offices and tourists themselves as well as all other users with bigger or smaller demands of using this system. We are going to take a look at the some of the disciplines which use this system for their needs and some of the ways they help in every day work.

GIS is widely used in agriculture for forming agricultural statistics and controlling financial support to farmers based on analysis of their arable lands. This system is found in fifteen countries of European Union. By using GIS and GPS technologies, digital cadastre systems have been created, which are needed for proper development. Using this technologies it is possible to use fertilizers, pesticides and insecticides more rationally. It is interesting that GIS is used in monitoring narcotic crops.

GIS technology is also very important in ecology because provides solutions for tracking wild animals and endangered species as well as restricting human activities outside of protected areas. With tracking river Rhine, GIS is used in modeling of the river flow and understanding consequences on its navigation and drinking water abilities.

Tracking of forest ecosystem plays a very important role in evaluation of deforestation of tropical ecosystems. For this, special GIS solutions are created with feature of creating digital atlases of forest fire history in some regions.

In local and global activities, GIS proved itself as an excellent tool for evaluating damage caused by environmental disasters. Consequences of draughts, floods, earthquakes, hurricane winds, avalanches and volcano eruptions have great impact on economy and human activity. Information gathered with remote sensing is used to determine risky areas.

Area in which GIS is used traditionally is urban planning. An interesting example of such usage is development of agriculture, where areas liable of creating fish ponds are being found. Exploration of minerals and identifying areas with high seismic activities is

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Figure 1.
Spatial visualization of Oregon

by far developed with specialized GIS tools used for analyzing earthquakes and calculating time for rescue teams to react.

With transportation, GIS is used in tracking vehicles with navigation systems in real time and it is possible to calculate routes for cost reduction and better traffic control.

GIS is intensively used in other aspects of human activities such as tourism, telecommunications, humanitarian aid, gathering statistics about population and marketing.

GIS justifies its wide usage by providing accurate and easy readable information. Many disciplines have recognized their need for such a tool, providing better and more reliable answers what would otherwise be impossible without GIS tools.

3. Internet and GIS

Internet opens a new market for geoinformation and provides variety of services in field of geoinformatics. With development of technologies, and mostly open source initiation, there is a ever growing number of WEB GIS application developers. They are created for different groups of users. Advantage of this systems is availability not restricted with software of hardware, but an ordinary web browser is enough. GIS solutions can be distributed to users throughout web, optimized for users, upgradeable

in any moment if there is need.

According to sophistication, WEB GIS applications can be divided into three groups:

• Applications with access to static maps and feature of saving them to the computer

• Applications with access to dynamic maps with different layers

• Applications with access to dynamic maps with different layers and query options. Information received by making a query is used for analyses and better understanding of map content and its layers

Restrictions and rights of users must be determined, as well as solving of administrative and security problems need to be solved. Registration and authentication of user is needed to manage that. It makes system more manageable and useful for every user.

Geodesy and informatics knowledge is needed in developing GSI systems. On Faculty of Geodesy, there are several classes where this knowledge is presented.

There is a variety of technologies used for developing WEB GIS. The real power of GIS is in its visualization of the real world. Databases feature spatial data which represents some of the geometric shapes. They are all vector data. Polygons represent fields, houses or abstract themes. Lines are used for representing roads, while points represent cities with small scale maps. Common format used for storage of spatial data are shape files, developed by ESRI. High degree of interoperability is available with accept-

ance of this format.

For spatial functions, PostgreSQL database needs PostGIS. PostGIS features functions like area calculations, to determine road length as well as some relations between geometry data. Now, we need some software for rendering our map. MapServer is used for this purpose. This powerful software can render objects from database or from shape files.

Application interface is embedded in web browser, so we need HTML (Hyper Text Markup Language). It is used for creation of buttons, checkboxes, input fields, images and etc. Once we defined interface, PHP (Hypertext Preprocessor) is used for interaction between users and system. PHP script is used for executing users commands and controlling the application. Module for connecting PHP with MapServer is called Mapscript. It is used interaction with the map, such as zooming, changing layer properties and other features.

Javascript, CSS and DHTML aren't necessary always, but are welcome in creating user-friendly application.

All of the software mentioned here is open source. Open source software is software with available code. Developers use this code to improve current applications and to make it more secure, reliable and faster. Open source software is free, but it shouldn't be mixed with freeware, in which case source code isn't available and its development is up to its author. There is no possibility of changing and adjusting. Open source software often comes with code that is needed to be compiled. Freeware doesn't allow this kind of optimization.

Open source community, together with programmers and users, is satisfying current need for spatial data and corresponding software within geoinformatics domain.

4. WEB GIS of "Sveti Duh" cemetery in Koprivnica

On the server of Faculty of Geodesy on the web address http://open.geof.hr/~vtatarevic/novo_groblje.php, WEB GIS of "Sveti Duh" cemetery can be found. Idea was to create a GIS which will provide user with great level of interaction. First, we have to ask

ourselves who and how it is going to be used. This GIS is meant for all users who have some rights regarding cemetery parcels. They must be provided with input of their own data and browsing the same. Digital map provides information on spatial data of cemetery parcels as well as on other objects. It is possible to browse through layers, make queries and search with some criteria.

Advantage of this digital form of map over analog one is very big. There is advantage of having more compact features and information can be read more efficient. Users can receive information of his interest anytime and it won't be under influence of various error that occur during reading data from analog maps. So, let's take a look inside of this system.

Data is gathered with orthogonal. In .dwg file, vector data of objects was created with all the different layers. AutoCAD has a feature of exporting data in .shp files used in getting data in databases. Database used for storage of data is PostgreSQL open source database. We implemented PostGIS extension which allows to create spatial queries. In spatial database we had relations with polygons, lines and points. Polygons define cemetery parcels, lines define infrastructure of the cemetery, and points are used to represent various surfaces. UMN MapServer generates map image from data inside PostgreSQL database, while PostGIS defines their geometric features such as surface, length and other. Some of
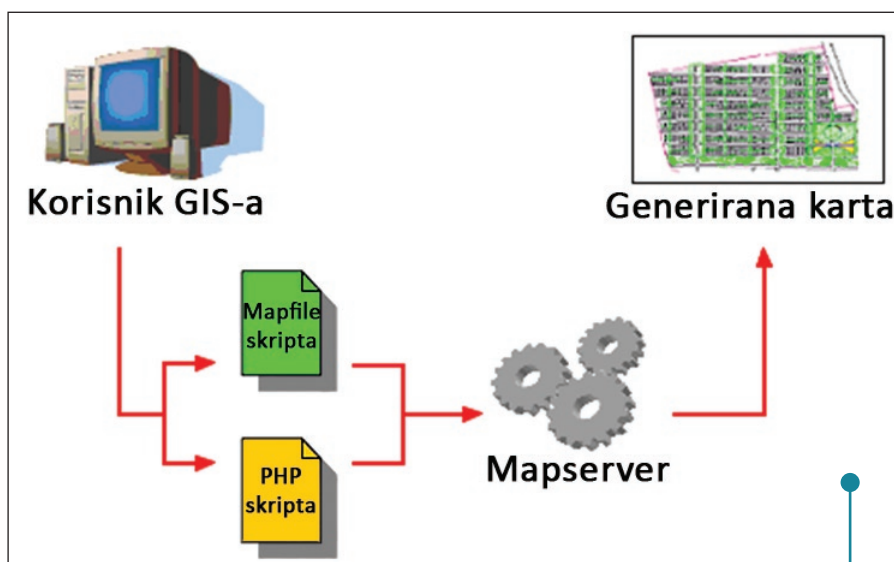

Figure 2.
Application development

PostGIS queries were used to determine cemetery surface, to determine spatial relations between objects and creating user-defined maps. In order to identify cemetery parcels, each parcel had a unique ID defined with primary key inside the database. With form for dynamic data input, owners of parcels can be found. Behind that form is a PHP script which allows input of attributes in database. In somewhat similar way, PHP script for browsing users is used for making map image based on ID and users of parcels. Users can switch on and off different layers which represent different features of parcels such as payment and occupation. With this queries it is easy to browse through the whole cemetery and making easy readable information.

With HTML were created all objects for controlling forms and Java-script makes system more reliable. Javascript is a very powerful language for creating interactive applications and interfaces that provide better usage of applications.

Creating applications such as WEB GIS, takes a lot of knowledge in programming as well as having some understanding of informatics. By getting this knowledge, a expert in the field of geodesy reduces need for assistance from other disciplines in process of making GIS systems. There are a lot of books written on this subject and there is a lot of active forums on the web where is relatively easy to receive some information how to create and develop WEB GIS systems.

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Figure 3.
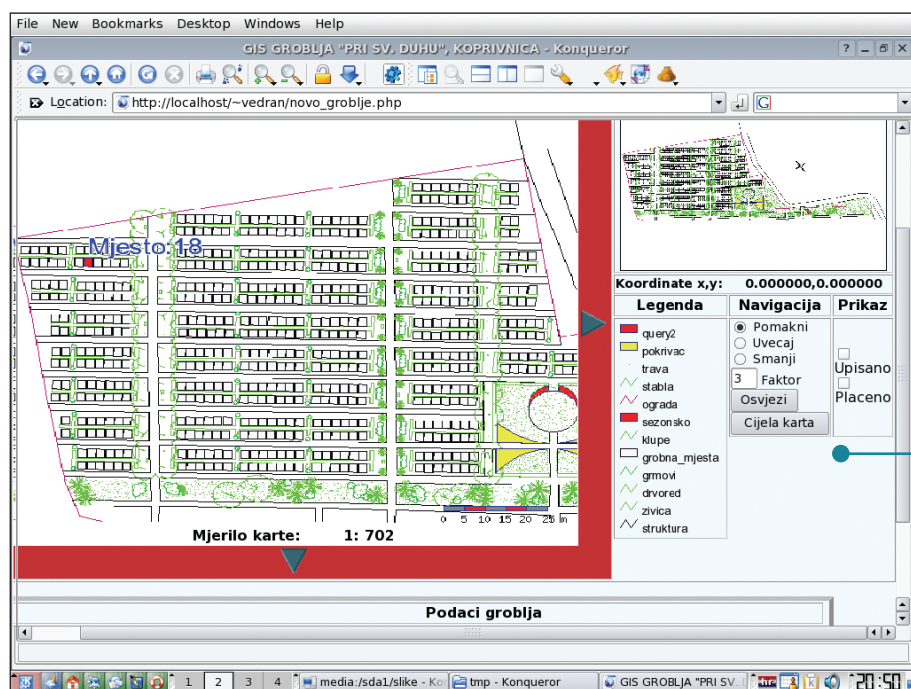Interface of the WEB GIS application of the cemetery "Sveti Duh" in the web browser