Application of Internet GIS tools for heritage management. ARKAS case study.

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APPLICATION OF INTERNET GIS TOOLS FOR HERITAGE MANAGEMENT: ARKAS CASE STUDY

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Summary: Geographical information systems are becoming a common tool in applications that involve spatial objects and relations, including heritage management. In the last years the internet technology is moving GIS towards web based applications, simplifying the interaction between users and GIS, and at the same time reducing the ownership and maintenance costs.

Archaeology is forced to incorporate the activities of protection, investigation and presentation to new tendencies of contemporary open society. It has to constantly renew and modernize its informational infrastructure with the purpose of more effective cultural heritage management and as an effective base for research. Internet based databases that include mapping capabilities can provide a useful and efficient way of storing and disseminating data and results to the public and researchers. At the Scientific Research Centre of the Slovenian Academy of Sciences and Arts an internet based mapping application for Archaeological Sites and Monuments Records of Slovenia (ARKAS) has been designed and implemented.

Keywords: internet mapping, heritage management, archaeological information system.

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1. INTERNET MAPPING TECHNOLOGY

Internet mapping technology enables the delivery of dynamic maps, data from Geographic Information Systems (GIS), and associated metadata over the Internet. Web browser is used as a client on the user's side and therefore no additional installation and download is necessary. It may be accessed from desktop and portable computers, and through a variety of mobile and wireless devices, such as cellular phones, personal digital assistants, ultra mobile computers, and advanced positioning systems. It can enable publication of high-quality interactive maps, with the ability to query, manipulate, and interact with data. Normally it can display both raster and vector data structures, enabling the dissemination of a wide variety of data types, for example satellite imagery, topographic survey data, excavation plans, and geophysical data. Maps may also be linked to databases and other information sources, allowing it to be visualised and queried. The system can also be extended to link to other resources and allow photographs, video, sound or further information to be displayed for particular features of the map [Longley et. al (2001)].

Internet GIS technology is composed of several components – the internet GIS server hardware and software, and server application that produces the output on user's side. The basic idea is to deliver a map to the remote user: user can display himself a map that is prepared on the server and sent to him via the internet. Since this map is not a static one, user can interact with it, producing desired view and performing desired functions. User needs only an internet connection and an internet browser, and sometimes also a plug in that has to be downloaded and installed. No other special software is needed.

Grand archaeological and other cultural sites are usually a magnet for tourists. Tourism flow management presents a formidable opportunity for internet based GIS, because on a large scale, tourism planning can play an important role in the protection of archaeological sites. For example, some sites can be over-visited while others have not yet been discovered by tourists. One way to protect sites is to divert tourism to other locations. Which sites to develop for tourism should be decided not only on the basis of the cultural and natural interest but also on their ability to support tourism. For both, natural and cultural areas of interest, a tourism carrying capacity can be calculated using GIS [Lo Tauro (2005)]. However important, this is only one example how GIS can be used and play an important role in protecting natural and cultural heritage. Integration of GIS and internet enables attraction of broader audience ranging from scientists, regional planners, local communities and tourists, and provide them with suitable data and tools to reach their objectives. Therefore, it is not surprising that there are numerous cases of applying internet GIS for cultural environmental management [Tsou (2004); Kelly/Tuxen (2003); Gouveia (2004); Zhu (2001)].

2. FUNCTIONAL AND STRUCTURAL FRAMEWORK

While deciding on the functional and structural framework of the mapping site, it has to be assured that a finished and fully implemented site will:

- combine and integrate geographic data and provide secure access to map services,
- give support to a wide range of users and have an appropriate range of GIS capabilities,
- have a highly scalable architecture and a standards-based communication and
- provide useful metadata services and have a management component.

The following basic concepts have to be considered to achieve the chosen goals:

- the site has to serve various potential users;
- it has to be simple, easily understandable and manageable;
- at the same time it has to allow (basic) GIS analysis.

If required, an internet site can be designed as a multi user level product. The suggestion that there is a need for such a division derives from the following principles: variation in user knowledge of GIS, variation in user interest (informative level, professional level), and variation in security policies for different data sets. For example, on one side there are common users, needing general information about the area or objects of interest, and on the other, there are expert users whose daily work is connected to the information an internet-mapping site can provide. These users can be divided further into users with average knowledge of GIS technologies and advanced GIS user. A distinct web GIS page should be accessible from the main (intro) page for each of the required user levels. It is recommended that web pages for different user-levels differ in: set of available tools, degree of availability of data (scale, set of layers), degree of data generalisation, degree of data correction (manipulation), number of data categories available, and different security measures (public access or password protection. login, min-max scale available, set of displayable attributes). According to this, many distinct internet mapping pages can be constructed [Kokalj et al. (2005)]. In the next sections an example of successful upgrade from classical database into web GIS mapping application is given.

Apart from the general idea to put the information technologies at the territorial actors service, the territorial intelligence concept is based on an more fundamental analysis about information society and sustainable development …

3. SLOVENIAN ARCHAEOLOGICAL INFORMATION SYSTEM

A project of creating Archaeological Sites and Monuments Records of Slovenia (ARKAS) was launched in the early 1990s. It arose from the endeavour in the 1960s, focused on gathering and assembling data about archaeological sites from different sources such as museum collections, publications, archives, etc. The results were published in 1975 in lexicographic form with short descriptions of sites, concerning the geographic location, archaeological periods, bibliography and other references and with an extensive index for a facilitated search.

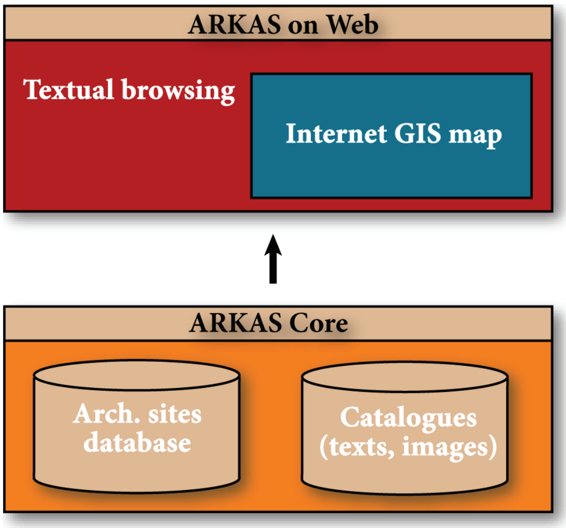

Figure 1: ARKAS System is composed of ARKAS Core and ARKAS on Web.

A further step was an extensive fieldwork survey in the late 1970s and 80s and systematic checking of complete archaeological sites data published in the some topographic notebooks arranged on the regional basis. These activities contributed to more detailed and accurate information about locations of archaeological sites, and resulted in new archival material such as topographic reports, photos, plans etc.

Traditional forms of publishing and distributing information are time consuming and costly. In addition, they cannot follow the dynamics of new discoveries. New information technologies offer better possibilities for updating and facilitating access to information. The ARKAS Core digital database was therefore constructed, which incorporated archaeological sites and monuments databases, bibliographic database, digital catalogues of preliminary reports and elaborations, photographs, drawings and geodetic maps [(Tecco Hvala (1997)].

From the very beginning parallel activities were undertaken to enable internet access to the ARKAS Core databases. The first version of ARKAS on Web was launched in 2000 and enabled text based information only. It was meant to simplify searching and compiling information by chosen criteria. Easy on-line accessibility was a big advantage in comparison to printed form. However, a mayor drawback was lack of spatial information. Therefore, we started integrating the ARKAS Core with spatial databases to obtain an effective internet based GIS [Pehani et al. (2004)].

3.1. Aims and applications of ARKAS

Nowadays ARKAS is built from two basic components: ARKAS Core and ARKAS on the Web.

ARKAS Core in an accessible and updated central archaeological database of Slovenia, which is to be used for different purposes and aims, such as cultural heritage management, research projects, education and promotion, and which allows an easy exchange and use of data among local, regional, national and international partnerships. The ARKAS Core is relational database containing around 7000 sites compliant with the core data standard principles, recommended by the Council of European Archaeological heritage. It can provide a firm basis and effective support for decision making for protection and management of archaeological sites as well as rational survey planning and information exchange.

ARKAS on Web has two user levels in mind. The first one is dedicated to professional use, so it is a complex application and offers many possibilities for text-based searches and more detailed site information. The most powerful part of the system is a web based mapping system, which enables creating optional archaeological maps based on different queries and criteria. Currently it is available just in Slovenian and is password protected (http://arkas.zrc-sazu.si/). Although ARKAS in dedicated to expert users, it's essential elements are presented also to general public within the Interactive map of Slovenia (http://gis.zrc-sazu.si/zrcgiseng/). This freely accessible web application presents ARKAS as well as different natural and cultural data layers.

Application for the textual browsing part of ARKAS on Web is written in PHP server language, using Window Internet Information Server as a web server. User authentication is provided with a basic username/password protection. Browsing is done with forms based on known parameters that enable searching for archaeological sites, documents, photographic material, and ground plans. Search results are displayed in an easy to read a tabular form. Textual browsing part gives the end user a complete set of database browsing capabilities, however lacks the spatial-visual information. Even though every archaeological site is described with many spatial parameters (region ID, settlement ID, coordinates, page number from the Atlas of Slovenia in scale 1:50,000, index of topographic maps 1:10,000 and 1:25,000), the user has to have very good spatial understanding to visualise site in an interaction with spatial reality and in relation to other sites.

This problem was eliminated with the introduction of a web mapping module into the ARKAS on Web.

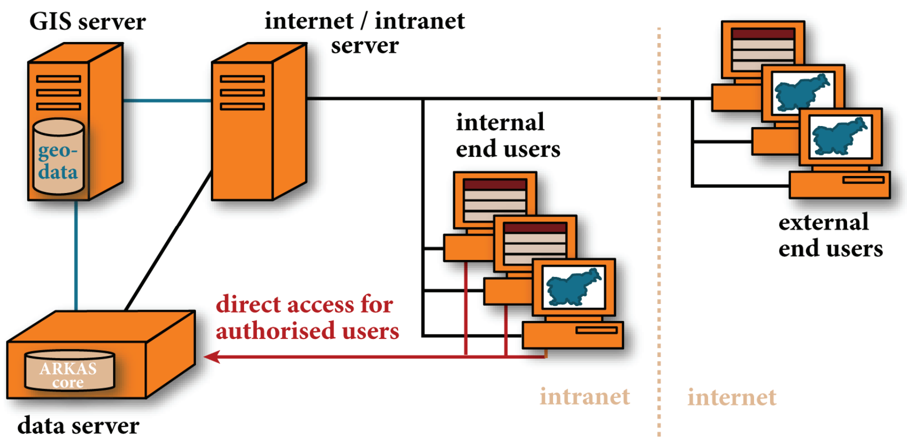

Figure 2: Architecture of the ARKAS System. Web GIS components are denoted in blue colour.

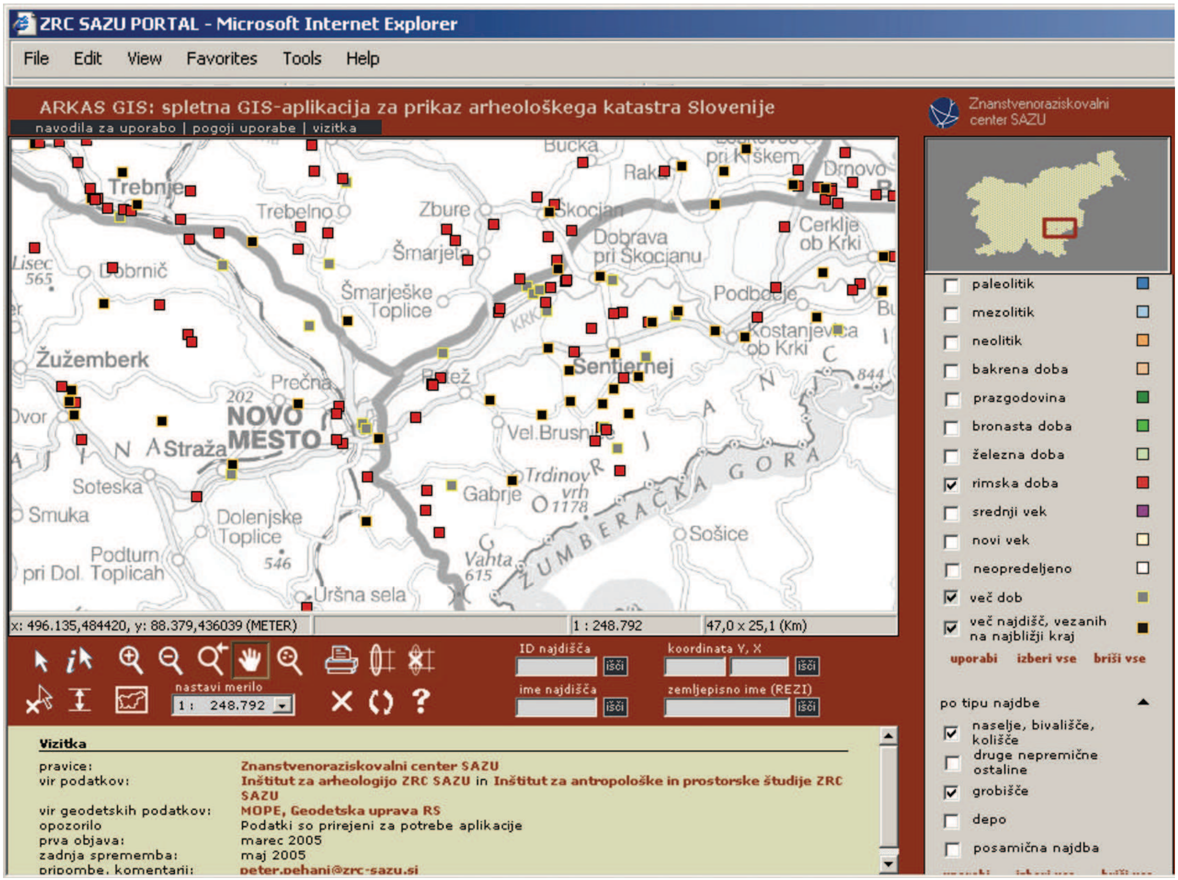

Figure 3: ARKAS mapping module user interface.

3.2. ARKAS internet GIS map

ARKAS internet mapping is implemented by using the Autodesk's Map Guide 6.0 as internet GIS server software after extensive testing of several products, including ArcIMS from ESRI. Two of the main reasons for this decision were stable performance and ActiveX component capability. We were especially interested in high-speed raster display, based on raster catalogues and tiled images. An application was developed in Microsoft's server language ASP, and the result can be read with the MS Internet Explorer (IE) only. IE is, however, by far the most spread browser in the target population.

The complete system architecture, including the mapping module, is shown on figure 2. GIS server, equipped with all the necessary software and spatially orientated data, thus enables users to work with geopositioned maps.

User's side of application resembles a typical GIS viewer: the central part is a map, at the top right corner there is an overview map (showing which part of Slovenia is displayed within the map). Beneath it there is a layer list enabling layer manipulation. Under the map there are icons for GIS tools and search forms that enable refining the view and performing different operations, and a text-box for displaying response information and other textual messages.

The most important layer in the layer list is the layer of Slovenian archaeological sites. Each site is presented as a point, with colours being period dependant. By default, all sites are visible, user, however, is able to refine the presentation by selecting a combination of periods and types of the site. One can for example make visible only sites of types 'settlements' and 'cemeteries' of the 'Roman period'. The source for this layer is SQL Server driven ARKAS Core.

An extensive set of auxiliary layers is also available to the user, giving spatial context needed to visualise topographical background of the sites. These are: country border, borders of municipalities, topographic raster maps (different rasters are displayed at different scales within this layer, scales range from 1:1,000,000 to 1:5,000), and digital elevation model with 25 m resolution; most of the data was provided by the Surveying and Mapping Authority of the Republic of Slovenia.

The user of the system can use different basic and advanced GIS tools, including: several ways of changing the scale of the map, panning tool, identify sites (i.e. display basic attributes of the selected sites), distance measuring, and producing buffer zones. Different search forms are useful in case one wants to find a site according to known criteria: user can find a site based on site ID, site name, coordinate, or municipality. User can also search through the Register of geographic names of Slovenia. Among other functions available are print tool, on-click jump between the textual ARKAS on Web and its mapping module (works in both directions, the key is site's ID). Additional functionalities can be added according to the needs of particular users or groups of users.

Conclusion

New technologies provide excellent opportunities for upgrading the ARKAS Core relational database into an up-to-date internet-based ARKAS GIS System. In short-term our goals are to provide dedicated expert users with high-quality spatial data infrastructure and efficient tools for spatial analysis. A preference is to integrate archived digital graphic and photographic material, however in the long term we intend to harmonize the databases and connect them with other databases with reference to Slovenian archaeological heritage, such us museum collections, excavation documentation, and databases of paleo-environmental studies. The ultimate aim is to ensure a solid infrastructure for cooperation with local, regional, national and international organizations and partnerships.

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