

# An Innovative Tool for Web-GIS Applications SVG and the Open Source Format

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**Abstract.** The paper deals with a new technical solution addressed to implement an innovative tools for the sharing data through the web. This new way for the creation of a Web-GIS is based on the SVG (Scalable Vector Graphics), a simple and open web-compliant format, belonging to the XML (eXtensible Markup Language) language-family. This solution allows to access and to share the data in a fast and user-friendly way reducing the time-consuming for the processing and converting data. By means of this application is possible to publish easily GIS applications without giving up the typically functions of GIS software. This "light" solution enables archaeologists (with low computer skills) to perform data-search in a fast and not difficult way without having complex solution on the server-side, neither on client-side.

**Keywords:** Web-GIS, SVG, XML, Open Source Software, Pontecagnano

## 1. Introduction

This paper concerns a web.GIS application using the new open source extension SVG (Scalable Vector Graphic) for the sharing of vectorial data; the case-study is based on the funerary context of Pontecagnano a prominent Etruscan-Campanian center, lying about 70 Kilometers south of Naples. Up to now, over 7.000 burials, datable from the Iron Age (9<sup>th</sup> century B.C.) to the 4<sup>th</sup> century B.C. have been brought to light (D'Andrea, De Nicola, Giordano 1999).

In order to manage this huge of burial data, spanning six century and documented by a wealth of plans, drawings and photographs, in the 1998 has been performed a vectorial-type GIS using Mapinfo. The most important alphanumeric and graphic source is represented by the graves and their grave-goods. The burials have been geo-referenced and superimposed onto the photogrammetric map, the cartographic base used in urban planning.

For making more easy the use of GIS system for the archaeologists and for the operators involved in the preservation of the cultural heritage, we have tested two different and innovative solutions. The first one is an user-friendly application based on a sample belonging to the western cemetery. For this solution we choose the programming language Mapbasic for customizing the Mapinfo application. The solution is addressed at giving to the researchers a simple tool to extract and visualize thematic information starting from an easy query-builder based on the alphanumeric data of the graves and their grave-goods.

In the same time we are testing a new web-GIS solution, based on previous experiences performed by different authors using MapXtreme (D'Andrea and Niccolucci 1999) and GRASS (Crescioli, D'Andrea and Niccolucci 2001).

In the next section we give a short summary of the previous experiences developed in order to make the GIS available on the web.

## 2. Previous Applications

The first solution was realised using MapXtreme. It is MapInfo based, the Map server is MapXtreme (Java edition); a set of Java classes have been combined into an application specific for managing the visualization of funerary contexts and their grave-goods. This solution is developer-oriented, not for end-user, and it is based on a commercial GIS software (D'Andrea and Niccolucci 1999). The map required by the user, processed by the server, is returned as html page, containing the map as raster image. The prototype was based on a trial, limited time version with full functionality. This solution was abandoned for the high cost (over 20,000 US\$ at that time) and for low customisation possibility. It was an useful test to verify the potential of such an approach.

For this reason it was subsequently tested a new application. The GRASS solution, presented at Lubjana CAA 2000, had the advantage to be an Open-source GIS software, using PHP3 server modules, Apache server and a few CGI-BIN shell scripts (Crescioli, D'Andrea and Niccolucci 2001). In that case, the request, written as command line, returned as html page, containing the map as raster image. The solution derived from Grasslinks, the well-known University of Berkeley web Grass software. However, it was completely re-engineered and greatly simplified. In any case, these technologies required a long data format conversion for publishing and making data available on the Internet and showed not interactive raster graphics. Both solutions needed a complex configuration from server side and the installation of specific software like MapXtreme and web-solution for Grass. For these reasons we explored new approaches addressed to solve the problems occurred in the previous solutions, also to test platform-free solutions.

### 3. The SVG Project

The SVG project, actually in progress, is carried out in the framework of the Archaeozone project, a web portal of the Classical and Oriental Archaeology of the University "L'Orientale" of Naples. This innovative solution, oriented to an open source approach using an interactive vectorial graphic format, allows to manage informative themes and layers in the same way of the typical GIS platforms.

#### 3.1 About SVG

Scalable Vector Graphics (SVG) was created by the W3C Working Group in 1998. The specification is quite stable by 2000, with first implementations. Version 1.1 became a W3C recommendation in January 2003 and mobile profiles is almost ready. Versions 1.2 is expected in January 2005.

SVG is a language for describing two-dimensional graphics in XML (Fig. 1).

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<line x1='5' y1='5' x2='45' y2='45' stroke='black'/>
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**Fig. 1.** A black line described in SVG format

SVG manages three types of graphic objects: vector graphic shapes (e.g., paths consisting of straight lines and curves), images and text. Graphical objects can be grouped, styled, transformed and composited into previously rendered objects. The feature set includes nested transformations, clipping paths, alpha masks, filter effects and template objects. SVG drawings can be interactive and dynamic. Animations can be defined and triggered either declaratively (i.e., by embedding SVG animation elements in SVG content) or via scripting.

It is possible to implement sophisticated applications of SVG files using a supplemental scripting language (Document Object Model – DOM) which, accessing to the SVG files, provides a complete access to all elements, attributes and properties. A rich set of event handlers such as "onmouseover" and "onclick" can be assigned to any SVG graphical object. Because of its compatibility and leveraging of other Web standards, features like scripting can be done on XHTML and SVG elements simultaneously within the same Web page.

The main feature of SVG is to be an open source scalable vector format. It is full text-based, using XML-compliant language (files can be read and modified by a large range of tools, e.g. notepad). map features can be found by search engines. Compression in vectorial svgz format generate files lighter than a raster JPG. So the access to web page can be faster. Moreover the vectorial format makes images zoomables: any part of the image can be zoomed without degradation and can be printed with high quality at any resolution.

#### 3.2 OpenSVGMapServer

The starting point of this solution is OpenSVGMapServer, an "open-source set of scripts" for publishing GIS data based on SVG, JavaScript, PHP and MySQL.

OpenSVGMapServer 1.0 is a free, open source set of scripts that, run on a web server, dynamically generates vector map

files from spatial data in a database. The scripts are in the PHP scripting language and are designed for the use with a MySQL database. The files so generated have attribute data in the form of ecmascript/Javascript arrays. The maps can be viewed by means of a web browser with the SVG Viewer (a free plug-in) installed. The OpenSVGMapServer software package contains also a script that export GIS data and associated formatting information from the desktop GIS software application like ArcView into a MySQL format

The main features of this software are the following:

- to create the structure for MySQL server;
- to make available data stored into Access, converting database in MySQL format;
- to export a proprietary GIS format to open source SVG, adding the string containing SVG geographical information into the field called "Geometry" of the primary table. In this way both geographical and alphanumeric data are stored in the same table.

In order to create content on a web server OpenSVGMapServer uses another open source language, the PHP. It allows to query primary db table, through a simple query-builder.

#### 3.3 Web-GIS and SVG Approaches in Archaeology

In computing archaeology GIS on-line represented so far the best opportunity to publish, disseminate and share in the same time really high quality and interactive data and all information useful for the archaeologists and also for a broader public.

Up to now the integration between archaeological GIS and Web-based applications in order to make accessible georeferenced data, has been guaranteed by different solutions always based on proprietary software, in some cases developed using java applications (Crescioli, D'Andrea and Niccolucci 2001 for the bibliography; Johnson and Wilson 2002, Sarris et al 2002, Rußegger, Zeiner and Mayer 2004; Häser, Schulz 2004) In spite of these premises there are still few applications really capable to integrate different web-GISs and to allow the comparison between different data. Moreover each researcher implements a customized tool in order to query, search, group and visualize thematic maps. So is not possible to exchange data and all the documentation (maps, plans, drawings) and in the same time make the application useful for other samples. In this way only for visualizing and navigating an archaeological web-GIS it needs to download different java applications or install complex plug-in on the client server.

Probably in the future these difficulties will be overcome through the diffusion of open-source format and free plug-in for SVG format. Actually many computers are sold with the Adobe plug-in pre-installed and so will make more easy the implementation of open-source GIS applications based on SVG format.

Already now there are some interesting web-based archaeological data management systems allowing to publish and share vector illustrations using SVG format<sup>1</sup>. They are not exactly Web-GIS applications, but rather a technical way to make accessible graphical documents like plans which can be zoomed and panned using the Adobe SVG Viewer controls.

The IADB project (Rains., this volume) is probably up to now the best example of the use of SVG format for archaeological data base management system. It is based on a database (IABD) that can be explored freely. All the composite plans converted into SVG format can be directly added to the project database and then visualized. Similarly also the stratigraphic matrix can be presented in SVG format and linked to different records. Using java script has been added interactivity to SVG illustrations.

#### 4. The Tool Pontecagnano.svg 1.0

In order to search and visualize all vectorial and graphical documentation and alphanumeric tables concerning the Etruscan necropolis of Pontecagnano, it has been developed a specific application based on SVG format and PHP scripts. This utility is addressed to make easy the search within all sources allowing to extract both whatever information linked directly and not directly to the archives of the graves, and all data concerning grave-goods with the relative photos. This tool rebuild the relationship 1 to *n* between graves and grave-goods; it links them to the images; it allows queries also on secondary table; it is possible to select all the tombs that contained “weapons” in the grave-goods and to show their photos. Moreover we developed specific tools for emphasizing the interactivity; the user can use a function to measure distances, lengths and width of the graves.

In order to make more interactive the navigation and the visualization within the database we implemented, using PHP language, specific controls: queries on primary and secondary tables, info tool, access to data and relating images (Fig. 2–6).

The updating of alphanumeric and graphical records has guaranteed through a simple procedure. Modified data are converted and imported into WEB solution without changing the structure of the application and their functions.

An important tool has been also implemented for the administration of web-GIS. So it is possible to limit the web-access. According to the user profile, the utility restricts or allow the visualization of the information stored in the database and of the relative or absolute geographical

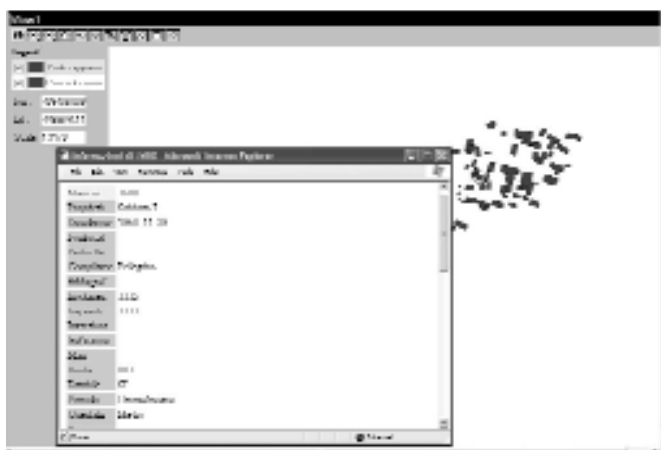


Fig. 2. “Info” tool: Fields of the record corresponding to “grave” selected are shown.

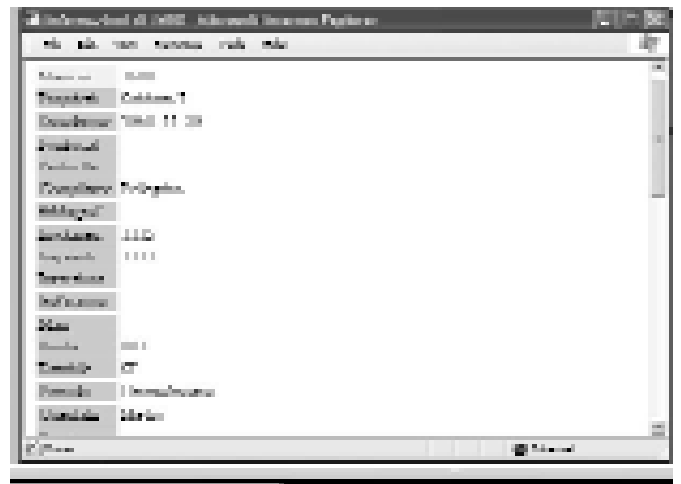


Fig. 3. “Info” tool: The field “grave-goods”, interactive, returns a grave-goods list showing only three fields of each secondary record: one of those is interactive (the “number” of the grave-goods).

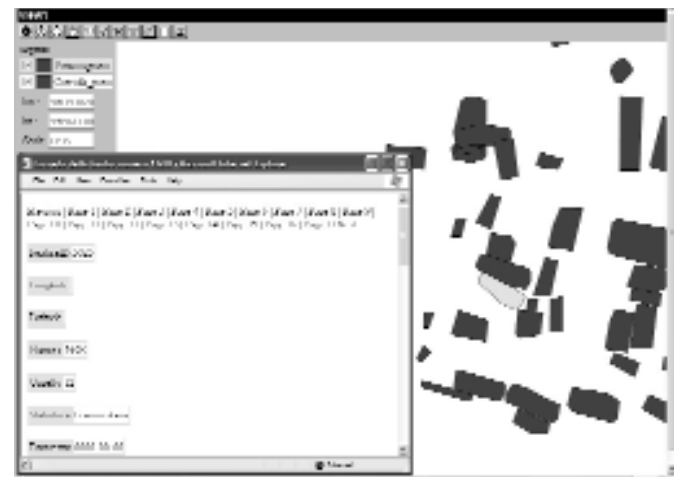


Fig. 4. “Info” tool: The “number” of the grave-goods links to a page showing all fields with interactive links for view next and previous.

coordinates. Since the SVG project is a part of a web portal project, we have some problems in order to limit the access to the data. Differing access has been created to filter the information on the base on the users profiling.

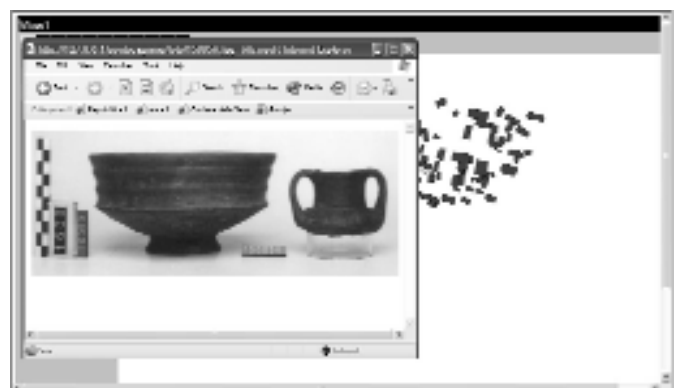
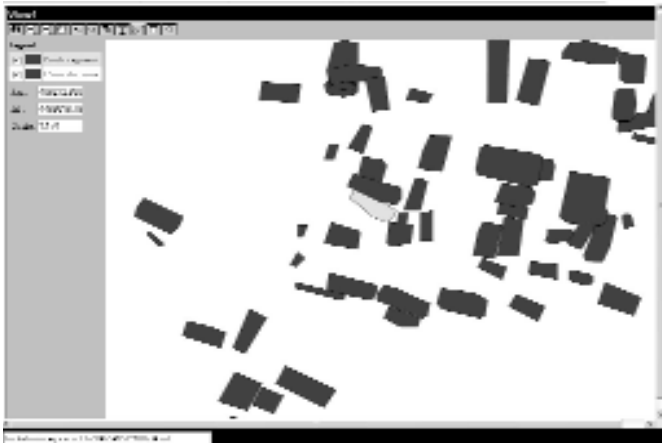


Fig. 5. “Info” tool: The page of the grave-goods-record contain an interactive field “Inventory”: it links to an html page with related image.



**Fig. 6.** “Distance measurement” tool. Dragging the mouse on the screen, distance expressed in meters is shown in the inner box (for example, we measure the length of selected grave).

Therefore, some fields of the database are accessible only for special user, like Institutions. This is aimed to preserve the security of non-public data. For example, the numbers of the Inventory of Archaeological Superintendence and cadastral are not accessible to non-authorized user, according to rights for the privacy of the land office and the owner. Furthermore, users non-authorized visualize only relative and not absolute geographical coordinates.

## 5. Conclusions

We exploited an innovative web-compliant format, like SVG, to develop a new solution to share data using Internet. By simply converting data into this new format it is possible to visualize and easily query GIS-system on-line without performing server- and client-side complex adaptations.

To improve the usability of this tool some important development have been anticipated:

- Integrate some of the tools directly within the SVG map to simplify access trough all browsers and platforms;
- Add layers in interactive mode and filter the access to them;
- Create thematic maps;
- Develop query builder also for complex searches, including all operators;
- Develop more complex maps, using filters to convert e.g. terrain models or aerial/satellite photos (examples by developers Schemasoft-Vancouver, Canada)
- Integrate some animation in order to allow to the user to visualize the changes of the necropolis patterns through the time<sup>2</sup>.

## Notes

<sup>1</sup> Iacotucci and Pellegrino, this volume.

<sup>2</sup> For other applications of modelling time through GIS technology, see Ceccarelli and Niccolucci 2003

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