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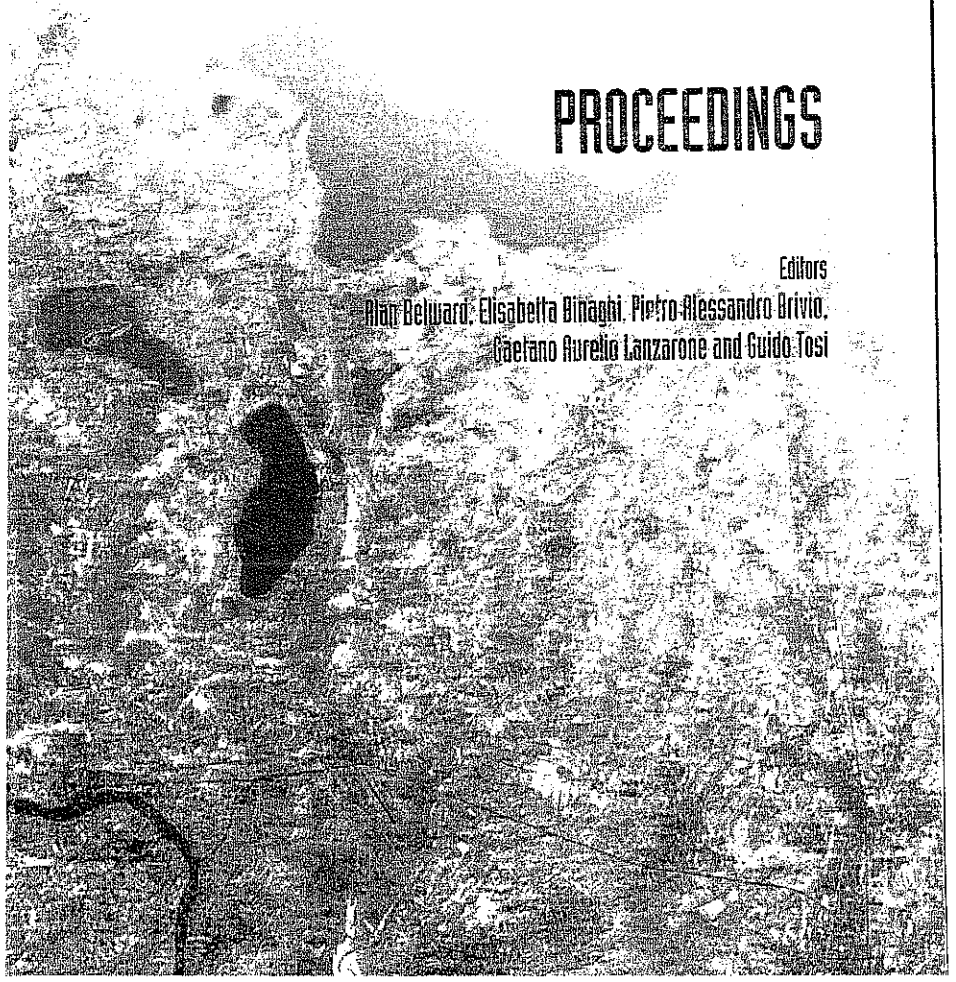

PROCEEDINGS

Editors
Alan Belward, Elisabetta Binaghi, Pietro Alessandro Brivio,
Gaetano Aurelio Lanzarone and Guido Tosi

SVG and the representation of spatial data

P. Carrara, G. Fresta, A. Rampini

ITIM and CNUCE Institutes - CNR
paola.carrara@itim.mi.cnr.it, g.fresta@cnuce.cnr.it

Abstract

In order to gain a full representation capability of spatial data on the Web, the definition of vector graphic formats is required, whereas only raster images are displayed on the Web without the aid of plugins. SVG (Scalable Vector Graphic) represents vector graphic on the Web, and produces many advantages with respect to similar proposals and approaches. In this paper, BANCO (Browsing Adaptive Network for Changing user Operativity), a prototypal virtual desktop on the Web for the manipulation of spatial data based on SVG is proposed. The characteristics of the system are shown with an example from an application in environmental field aimed to archive, catalogue, and monitor Alpine glaciers on the Web.

1. The SVG specification

The problem of representing information on the Web in a suitable and tailored way depending on various factors such as the data type, the intended users and aim, the display device, the communication technologies, etc., deeply affects application fields managing spatial data (and in particular geographic data). For a wide spectrum of spatial data, raster formats are straightforward (i.e. satellite images); however in order to gain a full representation capability of the spatial data on the Web, also the definition of vector graphic formats is required, whereas only raster images are displayed on the Web without the aid of plugins.

SVG (Scalable Vector Graphic), proposed at the end of '99 (and now at the stage of recommended candidate) by the W3C Consortium to represent vector graphic on the Web (W3Ca, 2001), produces many advantages with respect to similar proposals and approaches (Neumann and Winter, 2000): it agrees with the 'open source' principle of Internet; it is XML (W3Cb, 2001); it is highly and carefully documented; it allows to identify and to group objects helping modification, transformation, and accessibility; it is fully integrated in the DOM (Document Object Model) (W3Cc, 2001) of Web pages and proposes a wide set of events and attributes to improve interactivity and programming; it is an ASCII, not a binary, format, thus allowing to associate metainformation (i.e. ancillary data, semantic and behaviour annotations, etc.) directly to objects or object parts.

Due to its characteristics, SVG lends itself to the implementation of chartographic applications on the Web with the usual facilities of:

- zooming-in and -out of images,
- switching-on and -off the layers,
- modifying graphic attributes,
- mouse-driven reacting to events (by example, visualizing texts by mouse-over),
- linking to data bases.

But it may be also at the basis of less traditional applications, at least from the architectural point of view, such as the example which will be described here following.

2. Active browser manipulation of geographic data

The ITIM Institute of the CNR develops applications for the monitoring of geographic data on the basis of classifications, automatically produced, of satellite images. In particular, a project is going to be activated to archive, catalogue, and monitor Alpine glaciers on the Web.

Data to be accessed are stored in distributed repositories and they may be raster images from satellites, but also classifications of classes of interest (mainly Ice and Snow), and images resulting from a spatio-temporal database (developed at ITIM, too) able to display areas in which a given class changed in a selected time range. The last two types of images may be better represented as vector formats. Moreover intended users (usually glaciologists) are allowed to access to tables and graphics, descriptive and formatted pieces of texts and, if they have permissions, to elaborate, edit and save data.

The application may be managed by means of BANCO (Browsing Adaptive Network for Changing user Operativity), which is a prototypal virtual desktop on the Web, developed in collaboration by the CNR Institutes ITIM and CNUCE. It wishes to represent a concrete proposal following 'in progress' researches about some interoperability problems in the Internet environment, i.e.:

- the adaptability of hypermedia applications (Brusilowsky, 1996)
- the semantic web (Berners-Lee, 1998)
- the dishomogeneous management of data formats, i.e. text/non-text, raster/vector, time-dependent/time-independent (Grosky, 1994)

BANCO is able to offer tools and display data representing elaboration products at different development stages: the idea is to suggest a new approach based on a client application, in which the user interacts in a suitable way, by simultaneoulsy display on the virtual desktop more pieces of multimedia information (nodes), which are lighter than traditional Web pages, without excessive burden in terms of associations and supporting information and can be modified and adapted by means both of tools offered by the prototype designer and of an editor allowing some users to "create" online their own computations. The basic application stresses new technologies of the XML suite, and in particular DOM and SVG.

In such an environment, once a user profile has been identified, the following users' actions become possible:

- to add user's annotations;
- to establish new associations;
- to modify an object by elaborating its appearance and contents by means of offered tools;
- to compare objects;
- to arrange objects on the desktop;
- to build user-tailored paths;
- to save new material in a local or remote server.

As regards design and development concerns, the prototype allows:

- to build suggestive metaphors for the retrieval of textual or non-textual formats in a homogeneous way (for example, parts of an image can be exactly addressed and their properties modified in the same way as parts of a text);
- to display the same fragment of information under different perspectives (for example, a legend can be read or listened);
- to let user modify display properties, content, position of the retrieved information;
- to design and develop objects to be programmed also at the client side;
- to limit effects of the user-application dialog to the browser side, without affecting the content and organization of the materials stored on the server (unless the user is an authorized one);

- to execute all above operations, and many others, not in a closed application developed by proprietary binary software, but on the Web by means of standard browsers and open source software.

BANCO requires a MS IE5 browser with a SVG viewer; the virtual desktop is presented to the user as a **rectangular space** (see figure 1), and **some menues** (on the top left of the browser window) allow to select available tools and pieces of information hosted in local or remote servers.

Each selected fragment (like the image and the graphs in figure 1) is contained in a **window** that the user may **close**, reduce to an **icon**, **move** in the desktop space, **put forward-backward** (the forward window is the active one), and **duplicate**, by using the first six buttons on top of the display window itself. The seventh button on the right activates an **editor**: depending on contained data and user's permissions, the editor allows to modify or add the content of the forward window or its display. The "tools" menu contains, for some users, a "save" facility, in order to **save** on the local/remote archive data elaborated by the user at the browser side.

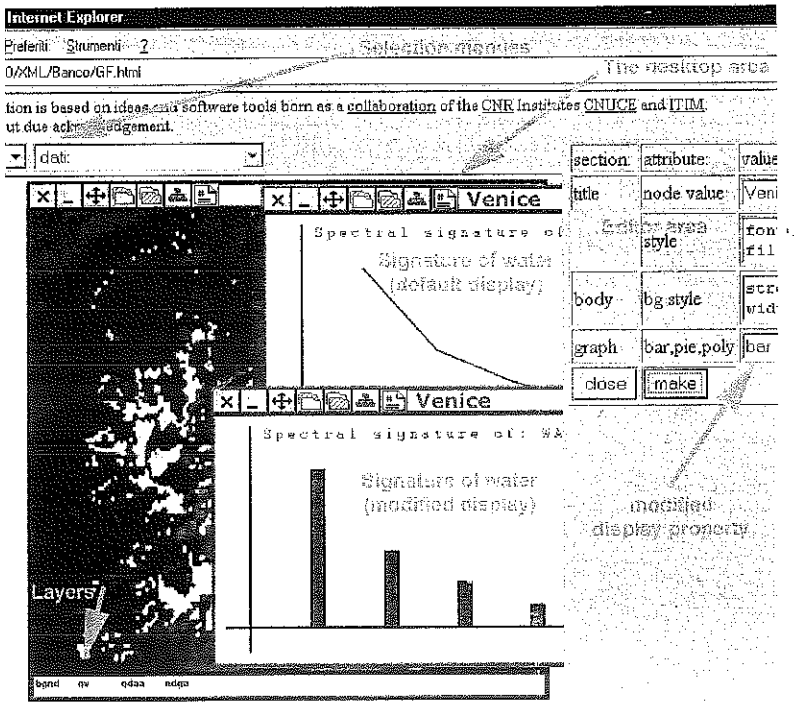

Figure 1: the Web environment interface is presented like a desktop offered to display and manipulate data; in the figure the desktop simultaneously contains the window of a raster image of an Alpine glacier with some themes visible as layers, and two windows of the spectral signature of water: in one window the signature is displayed as a polyline, in the other as a bar graph. The editor is active and an arrow indicates the modified display property.

An example of display modification of interest in the data analysis field is represented in the figure: from the menues, the user choose to examine the spectral signature of "water" which is archived in the server as an XML file containing a value for each spectral band, and is represented by default as a polyline. If the user wishes to look at the spectral values as a bar graph, she may click on the editor button and modify the suitable display property (see the 'modified display property' arrow).
Also content modification is possible: the raster image in the figure 1 is contained in a window with some hotwords at its bottom side; they switch-on and -off, over the raster image, some vectorial layers, corresponding to possible land-cover classifications. Like above, by clicking on the editor icon, the user may change for example the opacity of a layer, so that its background may be clearly observed.
The user modifications are only limited to the local side (the browser), without any change of the content of the server (unless the user is an authorized one)

3. A technological effort: is it worth the trouble?

All above examples show the feasibility of Web sites with vectorial images by means of SVG (and the techonologies in the XML family), without recurring to any proprietary, heavy and expensive application as in the operational IMS (Image Map Servers). In fact, though SVG itself needs to install a plugin on the user browser, it does not require a proprietary product, as all applications conforming to the criteria of the SGV specification (Conformance Criteria), can be used.
Many efforts have to be made to obtain a plug-and-play product, ready for common users' daily activities. However the perspective of SVG - mainly due to its open source character - is to let users concentrate on contents and interactions, without worrying about formats and data specifications.
The software tools exploited in the implementations were:
1. XML to define a support for information exchange, in accordance to the data types of the case study, to the nature of elaborations, and to the users' needs;
2. DOM and a scripting language for data manipulation;
3. XHTML and SVG to build the desktop and render objects.
As far as future developments, an attractive perspective consists in defining data with the Geography Markup Language (GML) (OCG, 2001), an XML encoding for the transport and storage of geographic information, including both the spatial and non-spatial properties of geographic features. This specification provides an open, vendor-neutral framework for the definition of geospatial application schemas and objects; supports the description of geospatial application schemas for specialized domains and information communities; enables the creation and maintenance of linked geographic application schemas and datasets; supports the storage and transport of application schemas and data sets; increases the ability of organizations to share geographic application schemas and the information they describe.
GML has been designed to uphold the principle of separating content from presentation: geographic feature data are encoded without regard to how the data may be presented to a human reader. Since GML is an XML application, it can be readily styled into a variety of presentation formats including vector and raster graphics, text, sound and voice. Generation of graphical output such as maps is one of the most common presentations of GML and this can be accomplished in a variety of ways including direct rendering by graphical applets or styling into an XML graphics technology such as SVG.

By suitably combining above technologies, we obtained a "semimanufactured" product, to be completed by the final user also in consecutive sessions, directly by the browser, that could be viewed as a working desktop, no more as a simple access portal.
It is an active, creative approach, to be suggested both as a support in defining tailored paths from a unique set of information fragments, and as a tool for cooperative activities, by manipulating and improving local documents without necessarily affecting server bases.

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