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**INTEGRATION OF DIFFERENT CONSULTATION
MODELS IN CULTURAL HERITAGE WEB: THE
SIRBEC EXPERIMENT**

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Abstract

In this paper we present the SIRBeC web site, designed and implemented by CNR - ITC, showing its main characteristics, in particular: the methodology followed in defining the navigation and search models for different user typologies; and the procedure for the integration of geographic queries against georeferential data. Precisely, in addition to navigation and query capabilities, the SIRBeC web site has been supplied with a tool for the visualization and querying of the geographic data. The module is based on SVG, a standard application of XML created for the description of images by means of vectorial features.

Keywords : SIRBeC web site, cultural heritage, web design methodology, SVG, geographic data, consultation models integration, SQL query, images

Introduction

For the Web to be an effective tool we must develop techniques for effectively creating quality Web sites. Most issues and research relate to the development, through suitable design methodologies, and maintenance of Web sites and Web-based applications. The web application design process can be classed as a creative process involving a multi-disciplinary team of personnel. For a large-scale hypermedia application the team will include specialists with various competencies, such as conceptual designers, data base designers, information architects, and visual design specialists. The major hypermedia design methodologies published in the literature are:

The Hypermedia Design Model (HDM) 00

The Relationship Management Methodology (RMM).0000

The Object Orientated Hypermedia Design Model (OOHDM) 00.

There is a high demand for maps on the internet. Today, most mapping systems employ two approaches when delivering interactive maps on the web. The first approach is the Java applet. The second approach involves generating map images on the server and delivering them to the user in either GIF or JPEG image format. Java applets perform well

concerning interactivity, but have suffered from browser compatibility and firewall issues. Webmapping services that work with vector data, for routing and address matching, had to first convert the vector data on the server-side to raster formats, thus limiting the clients capabilities in interaction and graphical quality. SVG represents a new way to offer quality geographic information to any user on the web 0.

SVG is an open, HTTP compatible standard that allows fully interactive mapping applications - without the need for applets or a round trip to the server every time the map presentation is tweaked.

In this paper we present the SIRBeC web site, designed and implemented by CNR - ITC, showing its main characteristics. In particular, we describe the methodology followed in defining the navigation and search models for different user typologies; and the procedure for the integration of geographic queries against georeferential data with textual queries based on SQL. The SIRBeC web site has been supplied with a tool for the visualization and querying of the geographic data. The module is based on SVG, a standard application of XML created for the description of images by means of vectorial features.

The SIRBeC database

The SIRBeC objective is to set off and safeguard the Cultural Heritage present in the Italian Lombardy Region. To this aim, a database has been designed and populated with all the available data about a few typologies of objects - sculpture, painting, art objects (e.g. vase), architecture, etc. - distributed in the 1565 Comuni (Municipalities) of the Region. The database is composed of 6 ICCD (Istituto Centrale per il Catalogo e la Documentazione 0) archives, each of them corresponding to an object typology, namely: OA (artistic object), A (architecture), Cdr-A (architecture risk chart), RA (archeological object), BDM (folk-anthropological object), SMI (print, matrix, engraving). Each ICCD typology is described by a proper catalogue card form which contains text and images; the forms for architecture contain also geographic data.

Other two set of architectural objects (Museums and FRISL-Restored monuments), belonging to other cataloguing systems, are correlated to the SIRBeC data and added to the database . These two contain geographic data.

At present about 55.000 records, corresponding to as many objects, are stored in the database.

The Database is continuously growing both in the number of object cards and in the object typologies: for example, a new archive of gardens and parks is to be added in the near future.

Design of the SIRBeC web site

The web design methodology is fundamental to create sites which are efficient and effective, particularly in our case, in which:

It makes communication easier among the different competences: designer, computer scientist, final user, domain expert, Lombardy Region people, and so on;

The data amount is huge and constantly increasing, and might require finer and more selective modalities of querying and visualizing;

Some data typologies are interconnected. For their integration, both in querying and visualizing, strategies have been already implemented, but others must be foreseen for the future.

For the design and implementation of the SIRBeC web site, a well know methodology, tailored for the web has been applied: RMM 00.

This methodology was first proposed by Isakowitz et al 0. RMM is suited to hypermedia applications that have regular structures, with classes of objects that have definable relationships. The original RMM methodology provides a structured approach to design and implementation of hypermedia applications, and it has been extended to enable it to model a much richer class of applications, such as, for instance, web sites.

The steps of the Extended RMM Data Model are:

Requirements analysis

Conceptual design E-R Diagram

Navigation design Application Diagram Top-Down

M slice

Application Diagram Bottom-up

User interface design

Implementation

Requirements analysis: Data, users, aims

Data: The data of the SIRBeC cultural heritage database are structured in catalogue cards according to the standard of their respective archives . The cards contain text fields as name of the object, author, location, etc. To each card one or more images are associated. To the cards of architecture, architecture risk chart, museums, and monuments geographic data are also associated.

Users: Three main kinds of users have been identified:

Lombardy Region users: people in charge and technicians, who should have complete visibility of the data, and perform very complex queries on them;

Professional users: the experts, art historians, professionals, and students, who should have a simplified interface to submit queries to the system, but nearly complete information about the objects;

Generic users: they should have oversimplified query interface, and the query results should show only the fields easily understandable to everyone.

Aims: The basic aim of the site is to allow, to each kind of users, a satisfying consultation of the database through both navigation and search.

Conceptual design: ER diagram

In this phase the Entity-Relationship schemas have been designed, one for each object typology. Each entity represents one or more card fields, grouped according to their semantic affinity (e.g. in the catalogue card the data about the object technique are

distributed in more fields, while in the ER schema they result in the same Entity “Technique”. Here the various fields appear in the form of attributes). Each relationship makes the semantic link between two or more entities explicit (e.g. the entities “Technique” and “Material” are linked by the relationship “Use”).

Figure 1 shows the ER schema for Architecture typology.

The schemas of the different typologies of objects will be integrated, so that the end-user could be able to query, for example: "what are the medieval vases (art object typology) stored in the museum (museum typology) of Faenza?" and the search engine could find the two schemas with the corresponding keywords.

In figure 2 the relations among different schemas are shown.

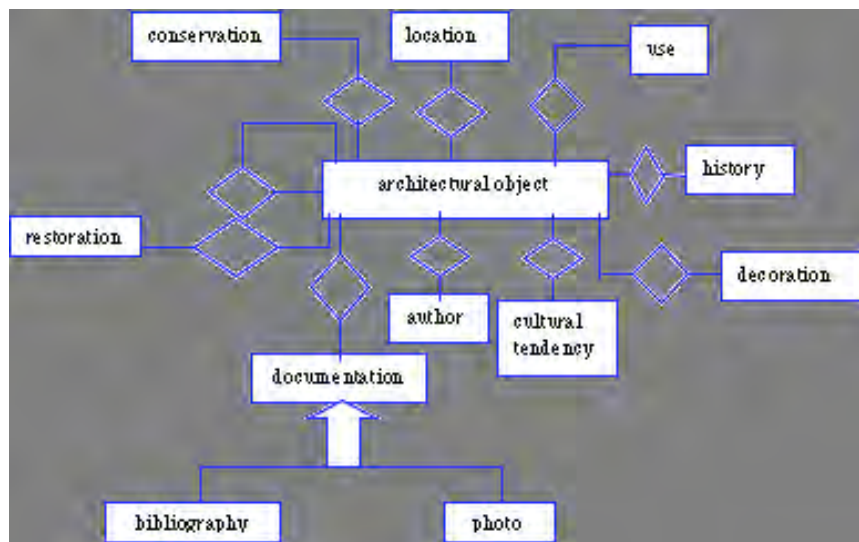


Figure 1: The ER schema for the Architecture object typology

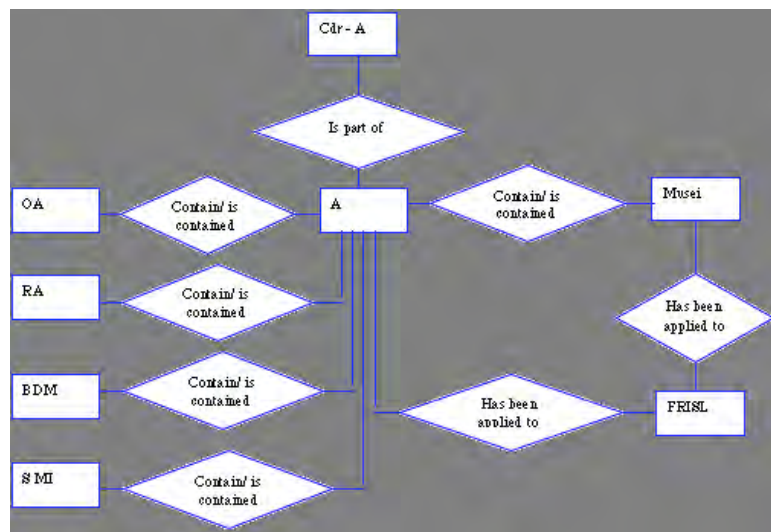


Figure 2: The relationships among the ER schemas of all the object typologies

Navigation design

According to the extended RMM, three steps have brought us to an application diagram which describes all the pages that the web site will present to the end users in the different navigation paths.

Application diagram top down This diagram provides a global view of the application, and represents how users and designers envision the final web site.

To this aim, designer, computer scientist, final user, domain expert, Lombardy Region people have met together and discussed about the navigation, usability and pages contents.

In Figure 3, all the web pages are depicted, where the external rectangles represent the pages, while the internal ones correspond to active objects in the page, e.g. buttons.

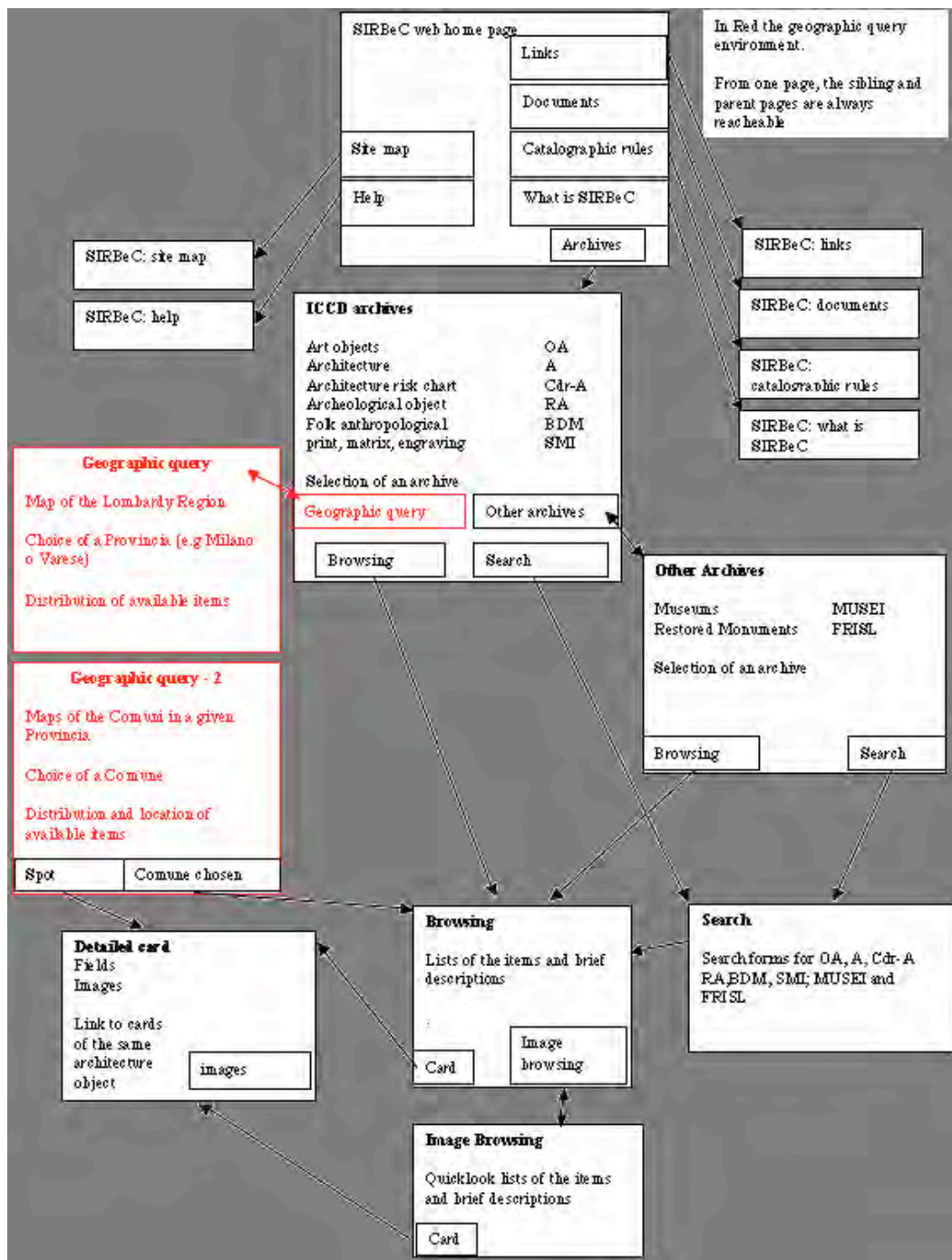


Figure 3: The final application diagram with the web pages

M-slice: M-slices are constructs of RMM used to group information into meaningful information units that are aggregated and nested to form higher level m-slices; that is, m-slices can contain other m-slices. M-slices are created by grouping together attributes from entities of the E-R diagram and/or previously defined m-slices.

M-slices are a very important constructs of RMM. They allow a precise definition of the information elements to be organized as a unit, while hiding (a) details, which are encapsulated in other m-slices, and (b) aspects of the user-interface - for example, the format in which an index is presented. M-slices describe what information is to be part of a unit and where to obtain it. M-slices do not describe how this information is to be shown. That issue is addressed at the user-interface design phase.

The following example is drawn from the Architecture archive of ICCD.

A m-slice “Archi-cover” has been obtained from 4 entities of the E-R diagram and is composed of the following attributes:

Title	from the entity Architectural Object
Function	from the entity Use
Where	from the entity Location
Image	from the entity Photo

The “Archi-cover” m-slice could be used in different contexts, when a compact presentation of the object is required. In figure 5, “Archi-cover” is used as a caption-like description.

This process is continued until all the objects present in the diagram has been analyzed and the corresponding m-slices are created.

Application Diagram Bottom Up Once all the m-slices at the higher level are created, they have been recombined to generate a diagram in a bottom-up fashion. The two diagrams are then compared and the final version is obtained in an iterative process.

Developers can use these two diagrams to re-shape the application by modifying the m-slices or the application diagram until the discrepancies are resolved. This iterative nature of RMM provides flexibility to the application designer by allowing continuous refinement. Also, thanks to the intuitive nature of the application diagram, users can take part in the iterative design process. The designer can communicate easily the structure of the application to the users, who in turn can express their needs and desires. This ensures a more effective system development process.

User-interface design

The first need we have taken into account in the interface design is usability, whose definition, according to the standard ISO 9241 is “Usability: the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use“.

To implement a functional, efficient and effective web site, in the design phase we have made use of a simple quality model so to cope with the issue of evaluating the site quality in a structured way, using 6 fundament criteria. In their application, site scope, users and use context have been taken into account.

Content. Is the site information content adequate to its objective? Is the information relevant? Complete? Reliable? Updated?

Functionality: Are the site functionalities adequate to its objective? Does the site correctly function?

Management: Is the site correctly managed?

Communication: Is the aim of the site immediately comprehensible, looking at its homepage? Does the site correctly communicate the brand of the organization? Is the communication style consistent with the aim of the site?

Usability: Is the site usable?

Accessibility: Is the site easily accessible? Are the access performances always adequate? Is the site easily reachable by the most common search engine? Is it adequately referenced by other sites? Is the URL easily remembered? Is the site independent from the browser? Is it accessible to disable users?

The above criteria have been exploited both during the interface design phase and after the prototype implementation in the assessment phase.

On the whole, since all the pages have been accurately designed, and also the navigation modes, the interface design has been quite straightforward. Here we leave out to describe the interface details, mentioning only:

A visual index in the contents page, with intuitive images of the object typologies;

Different colors for different catalogues: green for ICCD cards (art objects, architectures, paintings etc.); yellow for museum cards; clear blue for restored monuments;

A system's feedback on each action of the user, both on the "mouse over" and on "click over". The feedback can be visual, e.g. the button color changes, or textual, a brief description is displayed.

A visual "breadcrumb" in the navigation bar at the bottom of the page.

Moreover, to assure a good accessibility, the main W3C guidelines have been followed.

Implementation

The system is based on a database Oracle 9i, with the web server Oracle9ias, using the Apache engine. The operative system is Linux SUSE Sles 7.0

Consultation Models

First of all, the user has to choose either to access the single catalogues or to use inter-catalogues geographic querying.

Catalogues access

After choosing one catalogue in the contents page (figure 4), the user can either navigate in the corresponding archive or directly query the archive using a form in which the available fields are those identified for each user typology as adequate by the Region Lombardy experts. More fields can be queried at once and each field can be filled in with more terms. The user can also select one term from a field dictionary, which is dynamically created.

The search results, as well as the navigation ones, are displayed as a textual or image list (figure 5). On the user click, the detailed cards are shown with links, if any, to the cards of

the same object in other archives (figure 6). In this case, the colors of the interface can help the contextualization of the objects.



Figure 4: Visual index for the choice of a catalogue. The mouse is over the Architecture catalogue and a brief explanation is displayed

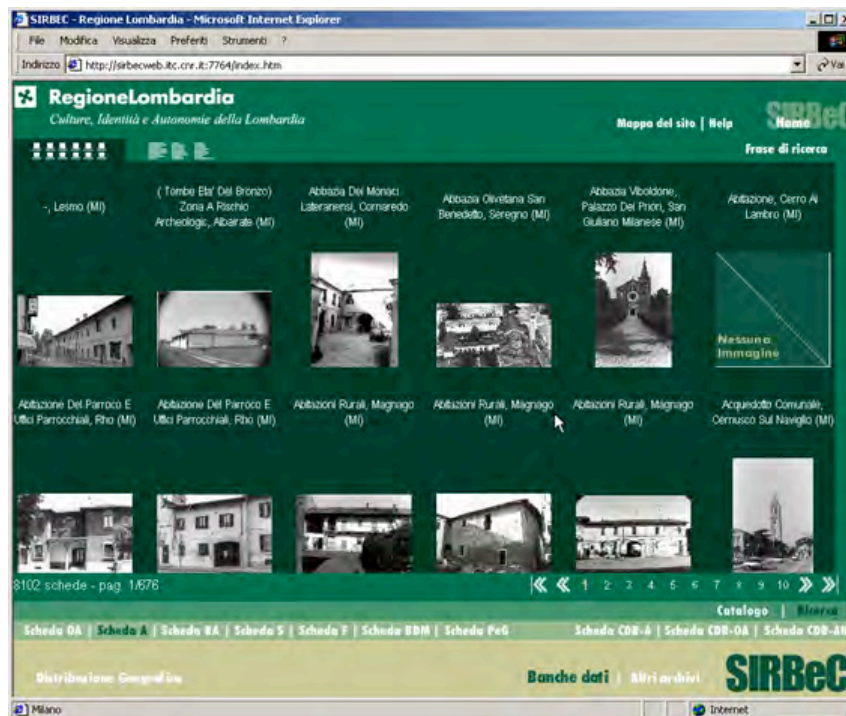


Figure 5: Image list of a query result in Architecture archive

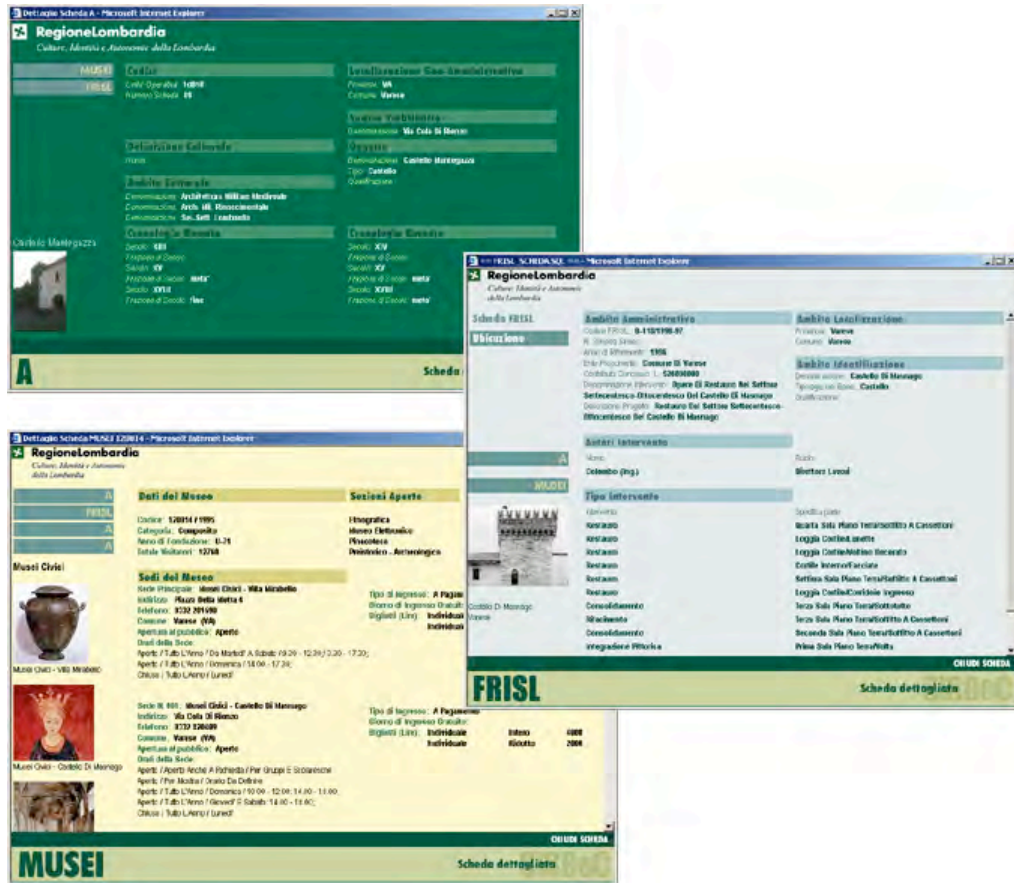


Figure 6: Detailed catalogue cards of the same building in Architecture, Museums and Restored Monuments archives

Geographic query on georeferenced data

In addition to navigation and query capabilities, the SIRBeC web site has been supplied with a tool for the visualization and querying of the geographic data. The module, which has been designed and implemented, is based on SVG. In the interface, there are both different levels at which the objects in the database can be seen, and the information on the objects distribution.

SVG Scalable Vector Graphics (SVG)00, a W3C-recommended XML standard, is ideally suited to display maps. It is vector based by definition and supports panning and zooming without loss of detail. Thanks to the support of JavaScript, users can interact with maps

and control what information is displayed. SVG can be displayed in web browsers with a standard plug-in.

SVG is a language for describing two-dimensional graphics in XML. SVG allows for 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. Text can be in any XML namespace suitable to the application, which enhances searchability and accessibility of the SVG graphics. The feature set includes nested transformations, clipping paths, alpha masks, filter effects, template objects and extensibility.

SVG drawings can be dynamic and interactive. The Document Object Model (DOM) for SVG, which includes the full XML DOM, allows for straightforward and efficient vector graphics animation via scripting. 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 SVG elements and other XML elements from different namespaces simultaneously within the same Web page.

Why use SVG? The SVG format is emerging through the cooperative efforts of the World Wide Web Consortium (W3C) and its members.

To Web developers, SVG will look and feel very familiar, thanks to its roots in XML. SVG is text based; therefore, coding techniques can be learned by leveraging the work (or code) of others. This drastically reduces the overall learning curve.

SVG is text based and works seamlessly with current Web technologies like HTML, GIF, JPEG, PNG, SMIL, ASP, JSP, and JavaScript.

Graphics created in SVG can be scaled without loss of quality across various platforms and devices. SVG can be used on the Web, in print and even on portable devices while retaining full quality.

Geographic query

The geographic querying modality allows to get information on the 4 architectural archives in the database, both on objects location and distribution (density) per Provincia (County) and Comune (Municipality). In the plural: Province and Comuni.

From every page of the SIRBeC site, one can reach the geographic query environment clicking on Distribuzione Geografica (Geographic Distribution) (figure 7). This environment is structure in two levels:

the Region level, in which the user views the map of the whole Region, and can interact with the Provincia, and see the distribution of the objects per Provincia;

the Provincia level, in which the user views the map of the Provincia he has chosen, and can interact with the Comuni, and see distribution and location per Comune.

In the Region level, the map of the Lombardy region is displayed, with the borders of the 11 Province drawn. The user can:

Select, in the list, one of the 4 archives to explore as far as the distribution of its objects is concerned; the system then shows the density data of all the Province both in figures and in colors (figure 8);

Choose, on the map, a Provincia to obtain further details and information on location and density per Comune. A new page, the Provincia level, is displayed, with the borders of the Comuni of that Provincia drawn.

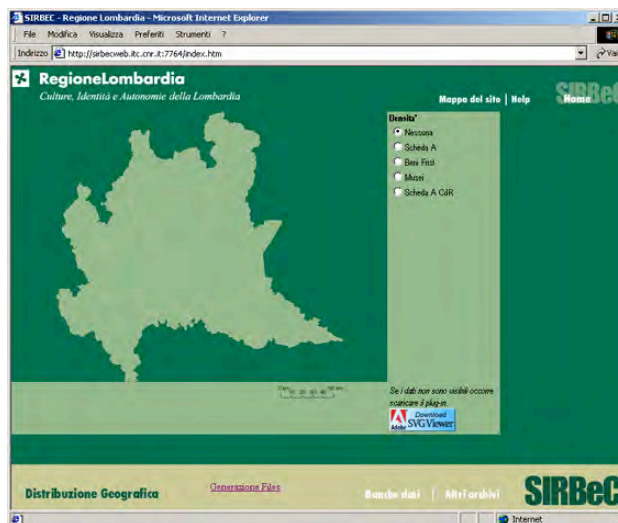


Figure 7: The geographic query environment: Region level

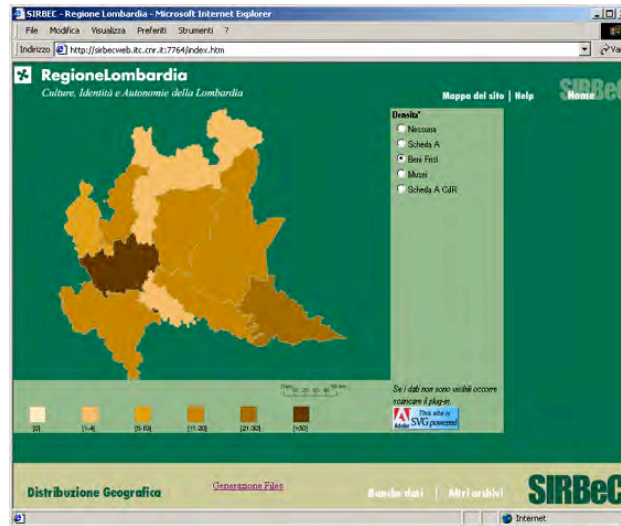


Figure 8: The geographic query environment: Region level, with density shown for FRISL archive

At the Provincia level, the functionalities offered by this page are numerous, and listed below:

Visualization of the density of an object typology: the system then shows the density data of all the Comuni in that Provincia both in figures and in colors (figure 9);

Visualization of objects locations that the system shows by means of spots on the map (figure 10). The user can choose one or more object typologies at once that the system distinguishes with different marks. Clicking on one spot, the detailed card is displayed;

Access to the textual or image list of the objects in the Comune, grouped by object typologies, by clicking on its area on the map;

Zoom on the map.

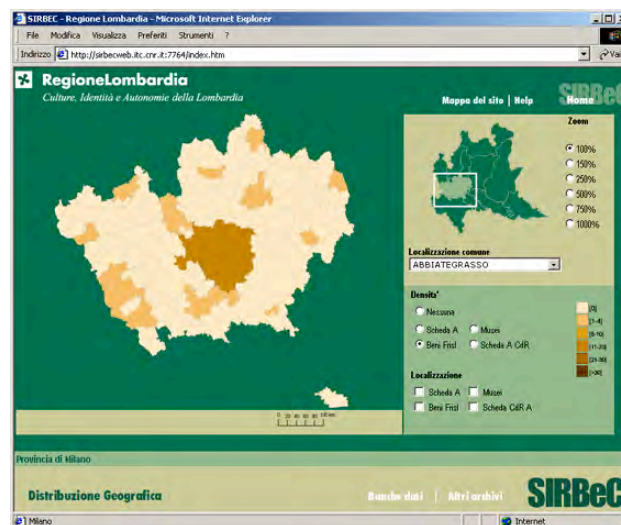


Figure 9: The geographic query environment: Provincia level (Milan), with density shown for FRISL archive

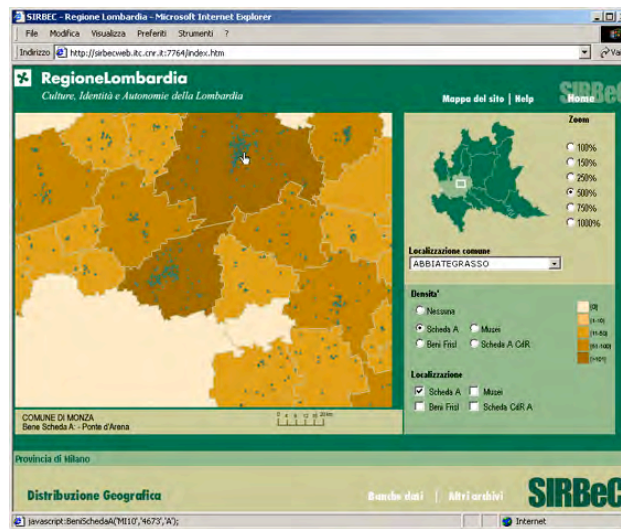


Figure 10: The geographic query environment: Provincia level (Milan), with location of Architecture archive. The mouse is over a spot and some more information are displayed.

The two different query environments are integrated, and it is easy, for all the user kinds, to pass from one to the other.

Future developments and Conclusion

The SIRBeC web site has been designed and implemented with functionalities and modalities of navigation and querying both on text/images, by means of SQL query, and on georeferential data, which allow the search of multiple object typologies by means of the same geographic location.

The geographic visualization of georeferential elements has turned out to be of immediate effect and comprehension, in that it permits the user to interact effectively with the system, as confirmed by the appreciation of the Lombardy Region people.

Data are regularly updated and augmented: at present about 40000 items of the same typology, that is art objects. In this cases like this, other visualization modalities are to be foreseen, that present the items grouped according to some classification criteria. This intermediate grouping level should be produced automatically from common attributes of different items.

According to another alternative visualization modality, both the results of an SQL search and the entire database will be displayed, with location and density data, on the Region Lombardy map, distributed per Provincia and Comune.

Adding these further data visualization modalities will produce some change in diagram of figure 3, confirming the choice of an iterative web design methodology, which allows the designer, in agree with users and Region Lombardy experts, to modify, add or delete elements of the web site, such as html pages, index, captions, and so on.

In the near future we will evaluate the opportunity to insert, into the visualization map, also elements such as rivers, lakes, roads, and the distance between two or more cultural items, present on the map, indicating possible routes from one to another.

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