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### SOL: Spatial and historical web-based interface for On Line architectural documentation of Kraków's Rynek Główny

Jean-Yves Blaise  
Architect, MCC researcher

Iwona Dudek  
mgr inż. architekt

**gamsau** UMR MAP CNRS 694  
Ecole d'Architecture de Marseille-Luminy  
184, av. de Luminy 13288 Marseille Cedex  
Cedex 09 France  
Tel 33 4 91 82 71 70 Fax 33 4 91 82 71 71  
*email. jyb@gamsau.archi.fr*  
*http://alberti.gamsau.archi.fr*

Instytut Historii Architektury i Konserwacji  
Zabytków  
Wydział Architektury  
Politechniki Krakowskiej  
ul. Kanonicza 1,  
31-002 Kraków, Poland  
*email. idu@gamsau.archi.fr*

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Our paper presents recent developments of a co-operation program that links the MAP-GAMSAU CNRS laboratory (Marseilles, France), specialised in computer science and the HAIKZ Institute of Kraków's Faculty of Architecture, specialised in architectural heritage and conservation.

Before undertaking any action to a listed building or interventions in its neighbourhood, it is vital to gain a clear understanding of the building in question. Numerous heterogeneous data detained by diverse institutions has to be handled. This process can be greatly eased by enhanced classification of the information together with building-oriented database entry mode.

A major question addressed by our research is how to draw a link between the GIS technology paradigm, the traditional database systems, and an architectural scale 3D representation of the building that would show historical layers and serve as an entry point to the database.

The development we present ("SOL", <http://alberti.gamsau.archi.fr>) is a multidisciplinary platform independent information tool dedicated to education and research. SOL uses an http protocol centred computer architecture connecting a relational database, a VRML 2.0 representation module and a web search interface. It allows searches and updating of the database through a standard text based interface, a VRML 2.0 graphical module and a thematic search interface.

SOL is experienced on the urban fabric of the Main Square (Rynek Główny) in Kraków in which 3D-localised and historical-period relevant information can be searched.

The choice of a web-centred development, both in the search and updating interface and in the representation module provides platform independence and distant access to the database, and enables successive contributions of students or researchers.

## 1 **Background of the research: the ARKIW co-operation program**

### 1.1 Institutions involved

Within Kraków Faculty of Architecture, the HAIKZ Institute deals with research and teaching in the field of history of architecture and urbanism, and conservation. The main areas of its activities and interests are:

- research on the development and history of architecture (with a special attention to specific problems of polish architecture)
- evolution of the conservatory theory and doctrines
- problems of preservation, conservation and modernisation of architectural monuments



Figure 1: North-West panorama of Kraków and Kazimierz dated 1576 (woodcut)

- studies on history and urban developments
- history of architectural details

Institute of History of Architecture and Monuments Preservation represents strong practical competence, knowledge of the conservation and preservation of architectural and urban heritage with enduring interest in Kraków's architectural specificity and long educational experience.

The MAP-GAMSAU laboratory is a research team, located within the school of architecture of Marseilles, addressing questions related to the field of computer science as applied to architecture, urbanism, architectural heritage. Gamsau is

a multidisciplinary CNRS laboratory hosting architects, computer scientists, geographers and mathematicians.

Researches performed in the laboratory focus the completion of knowledge representations of the domain permitting scientific investigations on architecture and urban fabrics. Its activities follow three guidelines, based on the development of computer technologies and methods:

- Modelling of the architectural knowledge.
- Rendering, visualisation and network tools.
- computer-based implementations on the architectural heritage field.

### 1.2 Aims of the research program

The ARKIW programme deals with both questions related to the representation of architecture in the computer science discipline and to its historical evolution [1][2].

Its main theme is a contribution to the building-up of heritage investigation methods, the experiencing of knowledge modelling approaches and the use of information technologies in the recording, protection and studying of the architectural heritage.

The development of web-based patrimonial information and representation tools proposed is targeted at researches and post-graduate studies or training. Case studies are chosen in order to experience

and validate a technical platform dedicated to the formalisation and exchange of knowledge related to the architectural heritage (architectural data management, representation and simulation tools, survey methods, ...). A special attention is drawn on the evolution of the urban fabric and on the simulation of reconstructional hypothesis.

### 1.3 Methods in use

GAMSAU-MAP's research in the field of the architectural heritage implements an architectural model considered as the core of an interdisciplinary representation. Handling the exchange of experiences and skills covering the wide scope of the architectural conservation discipline requires the use of models able to represent various problems. Relevance of our interdisciplinary approach therefore relies on the ability of a computer-based system to convey within the simulation process the information detained. High development prospective in web technologies along with necessities of a collaborative approach of the research naturally lead us to promote this approach as our major development frame. Our method is based on the analysis of non-ambiguous architectural elements thoroughly described in [3][4][5]. Architectural analysis is considered as a mean to federate information both on morphological aspects (issued for instance of a survey campaign) and more specific aspects of the patrimonial field [3][4][5].

### 1.4 Benefits of a collaborative approach

Our co-operation is about providing tools for studying architectural heritage environments and enabling computer based simulations of archaeological hypothesis. As a consequence of the necessity of enabling distant collaboration (partner institutions are nested in different countries), some technical choices were made in order to provide a platform-

independent access to all developments, to implement end-user interfaces to the architectural model, and to ensure the bibliographical referencing of the hypothesis through the on line documentation tool for researches involved in the program –SOL (Sources On Line).

## 2 *Sol: initial tool of the research program*

Kraków's Main Square has been chosen as the field of experiment for our co-operation program.

SOL (Sources On Line) has been initiated as a basic on line documentation tool and can be defined as a "self-growing" information source since its updating interface is open on the net to any computer connected to internet. It is a reference search tool in which criteria resulting from the analysis of each source are added to traditional bibliographical and iconographical data. It therefore proposes not only a catalogue-like approach of the sources but an added-value referencing modus. Each contribution to the system added through the updating interface is the result of a critical lecture of the source and is made available for the community of teachers and researchers involved, thereby enriching a collaborative information module .



Figure 2: Kraków's main square  
Plan K. Bąkowski 1785 in  
Tołwiński T. "Urbanistyka" [E]

## 2.1 The SOL tool objective

SOL is a bibliographical, iconographical and cartographical database search tool for the web. It references data connected to the urban fabric of Kraków's Main Square or to problems related to the disciplines of architecture, conservation and protection. As an addition to standard bibliographical data identification (author, edition, etc.) it features additional information for each source. This mechanism connects each entry to complementary data called *thematic bias* concerning for instance building considered, architectural detail, historical period mentioned, etc.. Specific query interfaces (textual, cartographical and 3D) allow the questioning of each point of view.

Since relevancy of such a system relies on the researcher's analysis of references, such a tool can prove useful only if it mirrors the constant evolution of his sources. An updating web-based interface is therefore proposed in order to allow distant interventions on the database itself.

## 2.2 Sol's main requirements

On the one hand references in the SOL database are books, researches, papers, etc. On the other hand, our main interest is focused on urban fabrics, architectural objects and their evolution. Therefore a first strong requirement for the system is to connect inside the data sheet itself and in the query interface type the former to the latter. This means providing the data sheet with particular info e.g. morphological-oriented information and retrieving it through a graphical localisation interface. A formalism of thematic bias has been developed in order to add to each data sheet such feature.

Another strong requirement for the system is to allow through the updating interface not only the addition or modification of entries, but also an interaction with the thematic bias. The operation of adding criteria is implemented so that for example

new building-specific problems (say "the Ave-bell of the old town hall", "the ceiling morphology of the cloth hall", ...), new generic theme (e.g. "wood roof coverings" in materials and techniques thematic group) can be also added to the system. This requirement corresponds to the necessity of encouraging a collaborative construction of the both database contents and its search criteria.

## 3 The database contents

### 3.1 Basic data sheet elements

References contained in the SOL database are 450 bibliographical, cartographical and iconographical documents gathered during the current research program. Standard elements of definition include author and publication identifications, as well as typical dating elements and additional comments.

### 3.2 Database scope

The biggest historic complex in Poland – Kraków's Old Town – is the monument of the UNESCO Cultural and Natural Heritage. The Main Market Square (Rynek Główny) is located in the heart of its structure. [7] The original layout of the Market Square was set in Kraków foundation charter in 1257. The streets were planned to run diagonally from each side of the big square (approximately 200 x 200m). The existing pre-foundation structures influenced in the original plan. Therefore some modifications have been introduced to the schema in the earliest phase of a realisation. Since that moment its spatial layout has not been changed. [A] Almost from the beginning Market Square was a city trade centre and during the centuries was furnished with a mutable amount of public and municipal structures.[D][F][6]

Divers historical documents (e.g. old maps, inventory descriptions, photographs, etc.) that describes those buildings are preserved.[A] Depending on set of documents chosen different hypotheses were formulated. Difficult access to the sources detained by diverse institutions and lack of information on their reliability intrudes on critical analysis of proposed reconstructions.

SOL's aim is to allow complex search and authorise access to those materials accompanied by notes and remarks that can be added by researchers and teachers. Nineteen elements of Kraków's Main Square are referenced in the system. These elements are buildings or architectural items that may exist or have existed, have undergone transformations, have been partly or totally destroyed. Two examples of the medieval origin were elaborated in detail: Ratusz Miejski (Thown Hall) – demolished in 1820, only part of the basement and tower survived and Kramy Bogate (complex of buildings dedicated to cloth trade) - demolished in 1868.



Figure 3 Woodcut of Kramy Bogate in Grabowski A. [B]

SOL's scope is therefore the successive urban development of Kraków's main square. Evolutions are one of the thematic bias implemented in the system.

#### 4 The thematic bias approach

Thematic bias allow the system to take into consideration elements of information that do not fit in a traditional bibliographical

cataloguing. These elements of information are mentioned or represented in the source, they consequently stem from a studying of the references.

Their addition to the data sheet gives a possibility to query the database on conservatory-research relevant criteria. A short description of some biases is given below:

urban fabric relation to buildings and urban items located on the Main Square

architectural elements relation to the architectural corpus analysis

historical period relation to the period of presence or to the evolution of buildings

orientation relation to the angle and point of view presented on illustrations

media type references the type of media concerned (text - illustration type- plan)

thematic group relation to generic problems (materials and techniques, conservation, etc..)

availability location in public libraries and archives

building specific references building-specific problems (Town Hall's clock, etc...)

about who relation to authors or to conservators

URL connection to a url address (access to a local or distant url containing information irrelevant in the context of the database such as thorough text, images, etc..)

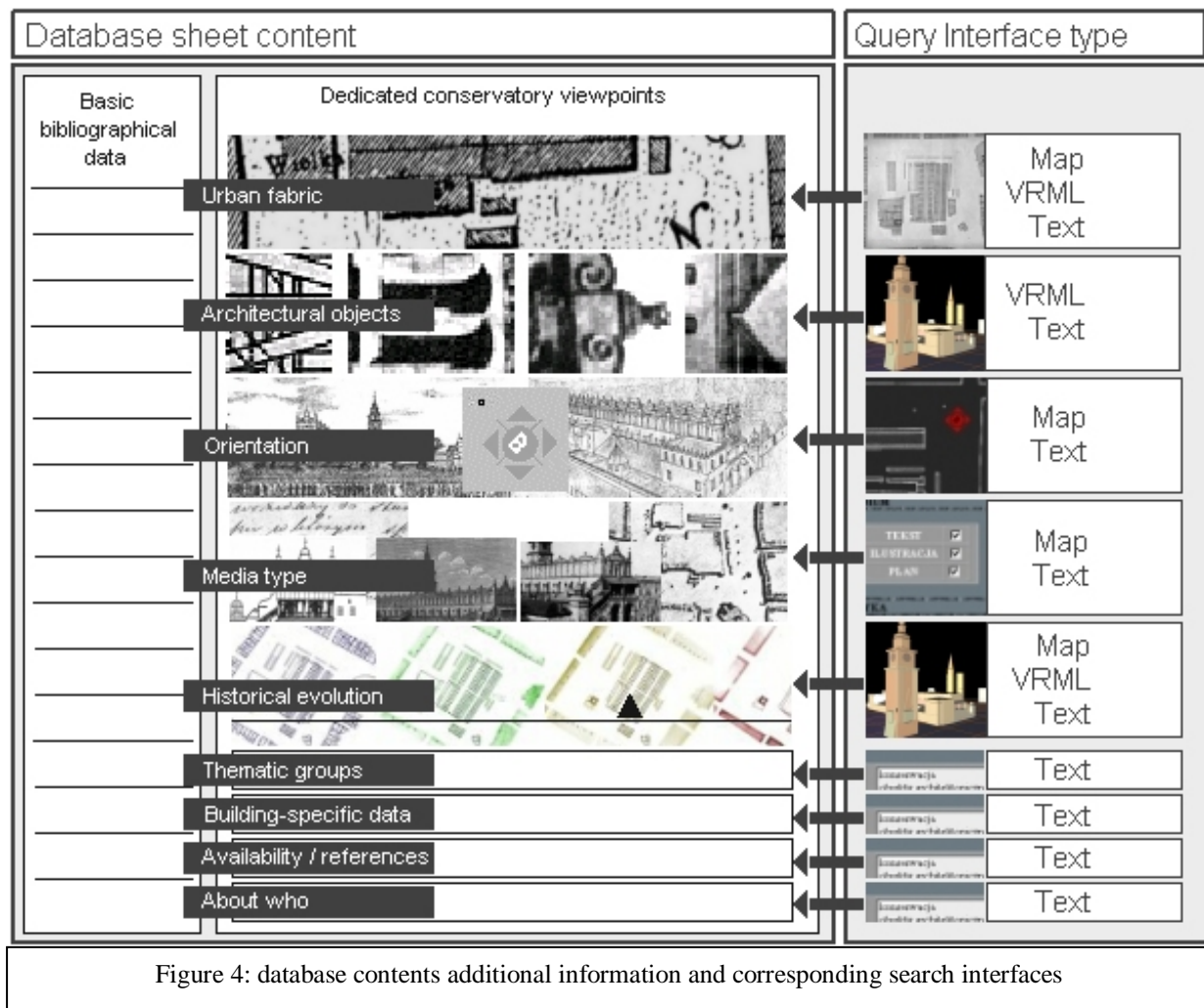
## 5 Web interface: accessing / adding data

A Web interface has been implemented in order to access and interact with the SOL database. Standard CGI forms, basic entry modes to the system, are used in standard text-based query interfaces. Other query interface types however are preferred in performing searches on the building-oriented thematic bias: cartographic interfaces and VRML 2.0 3D interfaces.

allows the user to choose in the thorough list of criteria the ones he/she considers as relevant for his purposes since the system generates contextual search interfaces.

Plan-based interfaces are proposed to handle the urban fabric, orientation, historical evolution and illustration type search modes.

VRML 2.0 scenes featuring architectural objects on the Main Square are another search mode, dedicated to architectural scale and historical evolution searches.



### 5.1 The web interface's query modes

All thematic bias can be handled through standard text-based search interfaces in which basic criteria are proposed starting from a media type choice. A text-based "choose your search mode" query mode

### 5.2 The Updating procedures

Two updating levels are provided:

- Updating data: a text interface displays the fields to fill in, and manages

problems related to data missing and accentuation (polish fonts).

- Updating criteria: current criteria are displayed in a text interface in which additional criteria can be added. The system manages the updating of criteria lists and allows the user to carry on his data updating with the added criteria and takes them into consideration in the query interface.

## 6 Web interface implementation

### 6.1 Accessing DBMS through Perl object modules

The SOL system technical background is a relational DBMS software interfaced for the web through Perl (Practical Extraction Report Language) object modules developed for the program.

In object oriented programming a field of knowledge is split into elementary concepts structured through refinements of classes. Objects thereby organised are described in a "behaviour and purpose" approach that allows a programmer to order an action from an object without knowing precisely how the action will be handled by the object.

This formalism is widely used in GAMSAU's architectural model [1][3] developed in JAVA .

The interface programming language chosen here (Perl) is an interpreted language commonly used in web developments handling CGI. So-called "OO modules" developed [here](#) in Perl perform only some object-oriented like programming basics: abstraction, inheritance, polymorphism and reusability.

Objects attributes and methods are described in modules used to handle the successive interfacing stages.

Hierarchies of such objects perform most of the connection, information coding and inputs handling. Restricted to these purposes, Perl OO modules are a satisfactory technical answer. This choice enables beginner programmers to develop

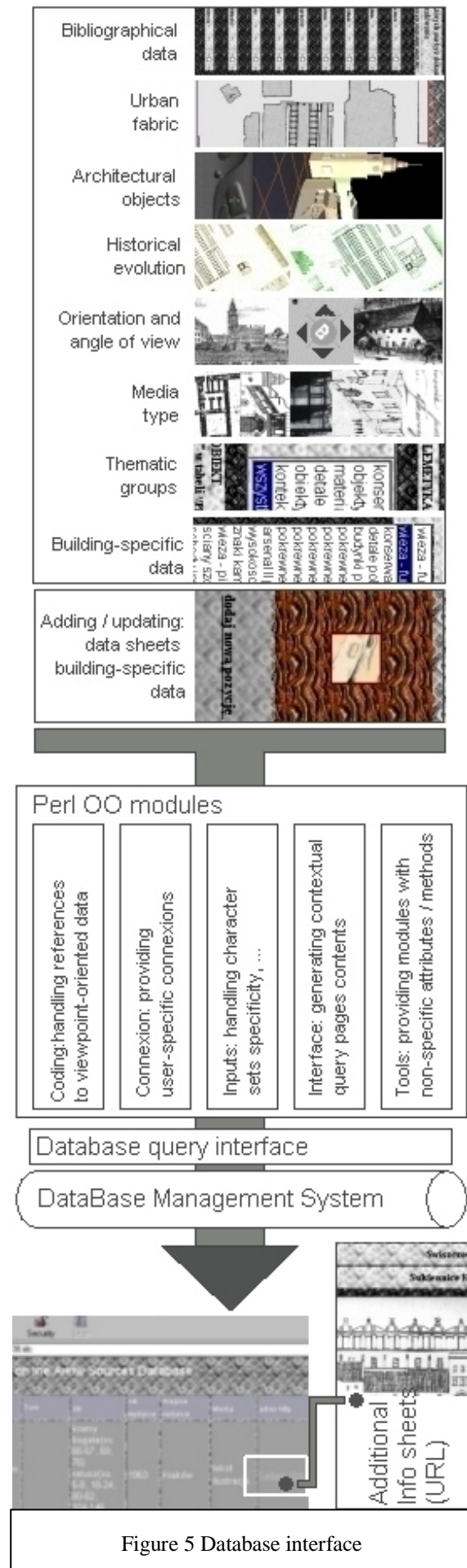


Figure 5 Database interface

new interfaces to the system never mind whether they know or not the structure of the database.

## 6.2 VRML scene authoring

The ARKIW program is part of a wider research called MOMA in which a VRML authoring tool called HUBLLOT has been developed [1]. The VRML 2.0 scenes presented as a database interface can be produced with this tool in which a non-computer scientist formalises reconstructional hypothesis buildings based on the analysis of relevant architectural corpus.

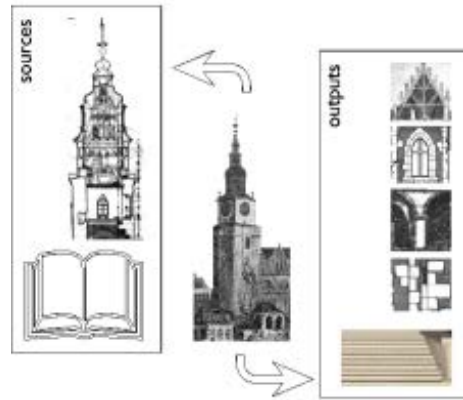
VRML authoring, and more generally 3D representation, is therefore not considered as an end but as an entry to patrimonial information and as the evaluative mirror of a research.

## 7 Ongoing developments

The SOL system is currently under validation process between the partners of the program. It has been developed in order to experience a first collaborative platform for patrimonial information and greatly encourages computer scientists and researchers in the scope of conservation to question one another.

Other developments of the program strongly focus on the creation of reconstructional hypothesis inside an online authoring interface [1].

The analysis of the architectural and urban evolutions of Kraków's Main Square is today a crossing point for historians, architects, archaeologists, etc.. Computer scientists are therefore confronted to a phenomenon in which both the concepts (the objects) and their representations for diverse disciplines evolve at high speed. Education and research in the scope of architecture and its history are in return questioned on how the development of information technologies, representation techniques, and platform-independent developments can enrich their discipline.



Consequently; as an answer to the growing complexity and quantity of data on architectural heritage environments the implementation of an architectural model generating spatial non-ambiguous nodes of information can greatly favour a better recording and understanding of urban fabrics.

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