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# GRAPHIC VARIABLES FOR DYNAMIC 2D/3D DOCUMENTATION VISUALISATION IN THE CONTEXT OF HISTORICAL ARCHITECTURE

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## Abstract (EN)

In the field of the architectural heritage, people in charge of studying the evolution of objects face a growing mass of documentation to organise and analyse, when not to discover. Most of this documentation is not formalised, and remains often unpublished. This opens a methodological challenge : what concepts can integrate various pieces of information about architectural objects?

In parallel, 2D or 3D representation has historically been at the heart of the way edifices or sites are documented and understood. State of the art shows this simple idea is today far from being a reality. 2D graphics, with the development of SVG, have undoubtedly found a role in geo-visualisation, but they have not yet found it in architecture. In parallel, 3D scenes remain most often in relation with communications goals only. Virtual renderings, although presented as visualisations of an edifice, mask the semantics behind the scene : in no way can they be visualisations of the deeply uncertain architectural heritage data.

We have established that since the documentation relates to architectural objects, those objects can be efficient in information delivery and visualisation. In this contribution we present the principles of our research and focus on the development of graphic variables used to convey within the 3D scenes elements of information about the objects represented.


**Keywords:** Architectural heritage, Information visualization, Virtual reality, Data uncertainty.


## Zusammenfassung (DE)

Auf dem Gebiet des architektonischen Erbes ist die Forschung, die sich mit der Evolution architektonischer Objekte beschäftigt, mit einer wachsenden Menge an Objekten konfrontiert, die organisiert, analysiert und noch erforscht werden müssen. Der Großteil dieser Dokumente ist nicht in Form gebracht und bleibt allzu oft unveröffentlicht. Dies stellt eine methodologische Herausforderung dar: Welche Konzepte können unterschiedliche Informationen über architektonische Objekte integrieren?

Die 2D oder 3D Repräsentationen besitzen in der grafischen Übersetzung von Gebäuden und Orten eine historische Kontinuität. Der Stand der Technik zeigt aber, dass diese einfache Idee noch weit davon entfernt ist in die Realität umgesetzt zu werden. 2D Grafiken haben mit der Entwicklung von skalierbaren Vektorgrafiken (SVG) zweifellos eine Rolle in der Geo-Visualisierung gefunden, aber noch nicht in der Architektur. Parallel dazu verbleiben 3D


 

Szenen meistens nur in Verbindung mit den Kommunikationszielen. Virtuelle Renderings verbergen, wenn sie auch als Visualisierungen eines Gebäudes präsentiert werden, die Semantik hinter den Kulissen: In keiner Weise können sie Visualisierungen der zutiefst unsicheren Daten des architektonischen Erbes sein.
In unserer Arbeit haben wir, da ja die Dokumentation mit den architektonischen Objekten in Verbindung gebracht werden kann, festgelegt, dass diese Objekte für das Sortieren und die Repräsentation der Dokumentation eingesetzt werden können. In diesem Vortrag präsentieren wir die Prinzipien unserer Forschungstätigkeit und konzentrieren uns auf die Entwicklung grafischer Variablen, die dazu eingesetzt werden innerhalb der 3D Szenen Informationselemente über die dargestellten Objekte zu transportieren.

**Schlüsselwörter**: architektonisches Erbe, Visualisierung von Information, virtuelle Realität, Datenunsicherheit.

## Résumé (FR)

L'étude des évolutions dans le temps d'‘objets architecturaux fait appel à une masse croissante de documents à organiser et analyser, voir à découvrir. La majeure partie de cette documentation n'est pas formalisée, et reste souvent non publiée. Ceci ouvre un défi méthodologique : quels concepts peuvent intégrer diverses informations au sujet des objets architecturaux ? Les représentations 2D ou 3D se placent dans une continuité historique dans la façon dont elles viennent traduire graphiquement des éléments de connaissance. Cette idée semble une évidence, mais une proportion importante des travaux d'imagerie nous prouve le contraire. En effet, le résultat de tels travaux est souvent une représentation dont le caractère exhaustif (en terme de géométries), et l'absence de justification, masquent les doutes ou inférences faits lors de sa construction, éléments qui sont pourtant essentiels dans le cas du patrimoine bâti.
Paradoxalement, on peut observer que l'exhaustivité géométrique des maquettes numériques tridimensionnelles, et la qualité de rendu, tendent à soustraire à la représentation de l'édifice l'évidence du dessin traditionnel, représentation par nature interprétative. La représentation devient outil de séduction qui loin d'éclairer sur la logique de constitution ou d'évolution de l'édifice et du tissu urbain en fournissent une image globale aussi confuse que la réalité elle-même.
Dans notre travail nous avons établi que puisque la documentation peut être liée à des objets

architecturaux, ces objets peuvent en retour être utilisés pour trier et représenter la documentation. Dans cette contribution nous présentons les principes de notre recherche et nous nous concentrons sur le développement des variables graphiques employées pour véhiculer à l'intérieur scènes 3D des jeux d'informations sur les objets représentés.

**Mots clés:** Patrimoine architectural, Visualisation d'informations, Réalité virtuelle, Incertitude de données..

# I. Introduction

## 1. Statement of need

Architectural representation has historically, since the renaissance, been at the heart of the way edifices or sites are described, visualised, documented and understood, and in close connection with textual documentation analysis efforts.

It seems that with the development of computer techniques architectural modelling has mainly focused on issues connected with realism, in the so-called computer graphics discipline. In parallel, scientific analysis of raw documentary sources has benefited from the development of various data management techniques, but often without even a concern for graphical visualisation.

In other words, one can observe that architectural representation and architectural scientific analysis have been divided by frontiers of computer techniques and disciplines. This means that researchers and practitioners in the field of the architectural heritage face a lack of appropriate solution when they want to integrate documentation analysis and representation: the latter should result in the possibility given to visualise through graphical means what the expert understands from the former.

To put it more simply, *can 2D/3D graphics be efficient in data visualisation or retrieval?*

*Can they offer semantic views on the data collection that are absent from other media?*

*Can they synthetically localise pieces of information with regards to a position in space and a moment in history?*

*Can they signify how uncertain our knowledge is on this or that part of the objects represented?*

Most often, historic buildings that we study have been widely transformed throughout the centuries when they have not been totally destroyed. This means that we face the challenge to visualise the shapes that in all cases are hypothetical. We have to be aware that we will always miss some information, we will face contradictory data, etc.

2D/3D representation of the historical objects should to take into account a large number of parameters:

- Morphological evolutions in time (form, construction, function, ...).
- Variety and precision of the documentation the investigation is based on.
- In consequence, the notion of scale (documenting the edifice as a whole differs from documenting each element of its morphology).

- In consequence, level of certainty on the hypothesis that is represented (sure, likely, feasible, theoretically possible, ...).
- Reuses or displacements of architectural elements.
- Evolution of our knowledge and it's consequences on the model's definition .

We in short address a graphics readability issue : can graphics in our field at last mean something for researchers, in the sense of [Alkhoven 1993]? How can one retrieve architectural documentation using the graphical signs available in the 2D/3D interfaces? How can one mark those graphical signs with indications about the content and analysis of the documentation, typically its uncertainty? These questions are important in our field, and remain widely unsolved. We herefater quote related works in graphics and data visualisation.

**Fig. 1**: 2D/3D graphics : graphical signs delivering various information; a means to an end.

## 2. Related works

Our field of experimentation is the preservation of the architectural and urban heritage. This includes a concern for the edifice itself when it is still standing, but it also includes a concern for the edifice's documentation helping to try and state for instance how the edifice evolved through time or how the edifice was when nothing is left of it today. In this research area, the meaning of the word visualisation is often narrowed to this of virtual reconstruction. But an undocumented virtual reconstruction can hardly be considered as something more than as a dead-end realistic 3D representation (see [Kantner 2000]). Communication through realistic renderings is all cases an abusive simplification since the morphology is not the only element that should be visualised, (see for instance [Kodym 1999]).

Although such realistic 3D models prove relevant with respect to communication goals (see [Perkins 2003]), we favour an opposite approach in which what is "beyond" the image is more important that the image itself, in line with contribution like [Alkhoven 1993]. What we try to visualise are not the ocular effect of elements in the real world, but a momentary state of knowledge on the edifice and its evolution. In our experiments, we give to the word visualisation another meaning: this of an interpretative graphical interface to the documentation (see [Dudek and Blaise, 2003] and [Dudek and Blaise, 2004]).

In the field of information visualisation, 3D graphics have been used to deliver "visual metaphors' that position the system's user inside search "spaces". Such metaphors may use virtual architectural spaces ([Göbel 2003] [Russo Dos Santos 2001]) or may not ([Müller et al 2003] [Andrews et al 03]), but the graphical signs or beings in all cases have no direct relation with the information they represent: they are intermediates chosen for their readability. However they can be exploited like 2D graphics are: in order to provide a semantic visualisation of information. Experiences like [Heinonnen et al 2000] or [Landes 1998] and experiences in "3D visual metaphors" show the potential role of graphics in providing easier navigation tools inside information sets. They show a 3D model can be an interpretation, representing pieces of information, a conclusion we base on. Shortly said, although architectural documentation is naturally space-related since it documents edifice or sites (3D beings) located at a given position in tile and space (2D being), it has not yet been given clear foundations for visual interfacing. Graphics used in architectural heritage are results, side-effects of the documentary effort, but they are not part of a research process in which the graphics would represent our state of knowledge.

We believe enhanced graphics usability may be fostered by adopting *a visual explanations* approach as defined by E.Tufte [Tufte, 1997]. The author underlines necessities that we believe may apply too in architectural representation; such as putting the data in an appropriate context to evaluate causes and effects or consider alternative explanations and contradictory data. It is clear then that advertisement-like virtual reality is no answer when one deals with pieces of data that will almost never let the researcher to formulate a single, 100% certain solution about how edifices evolved in time.

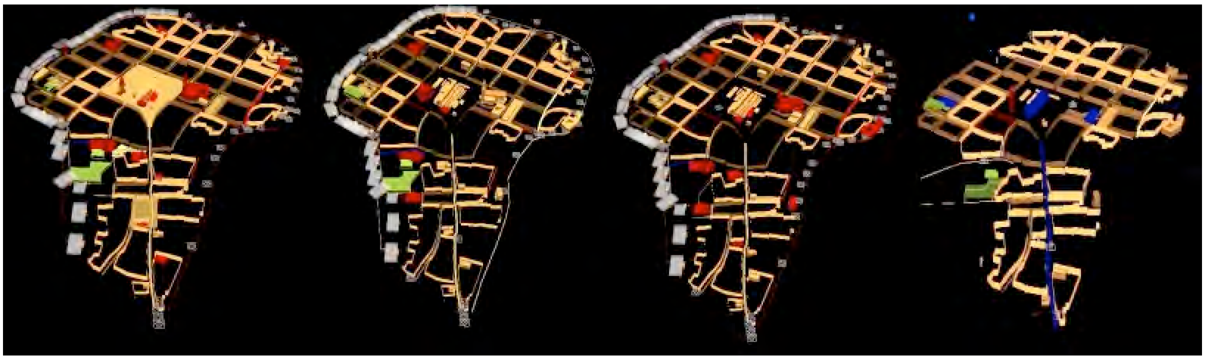

**Fig. 2:** Localising and visualising information in a time scale: scenes state of knowledge December 2003, calculated for dates 1550, 1646, 1751, 1894 (from left to right).

### 3. Research hypothesis

We consider that the best way to visualise, access and analyse the data related to the architectural and urban heritage is to use architecture itself as a mean to interface pieces of information, in line with [Donath and Petzold 1997]. We identify paradigmatic architectural shapes that will be used as filters on the architectural documentation.

Our research shows they can act both as semantic and spatial filters on the set of information conservators deal with and offer a major support for documentation visualisation. This is achieved by displaying objects in 2D or 3D scenes with appearances and graphical disposals that deliver indications on each object's bibliographical analysis. Shapes delivered are as a consequence not intended to portray a likely edifice, but only to inform the reader on what we do really know about the edifice. 2D and 3D graphics are created dynamically, and can be used as day to day tools letting us represent what we know at time T of the research process. They are meant to support the data interpretation process that researchers carry out when studying edifices or sites; a process better portrayed using words from J.Bertin [Bertin, 1967/98] : " reduce the multitude of data pieces" or from E.Tufte [Tufte, 1990/2001] « not narration but explanation ». In this contribution we briefly sum up the research methodology and focus on the graphic variables we have developed as a first attempt to meet the needs arising from the application field.

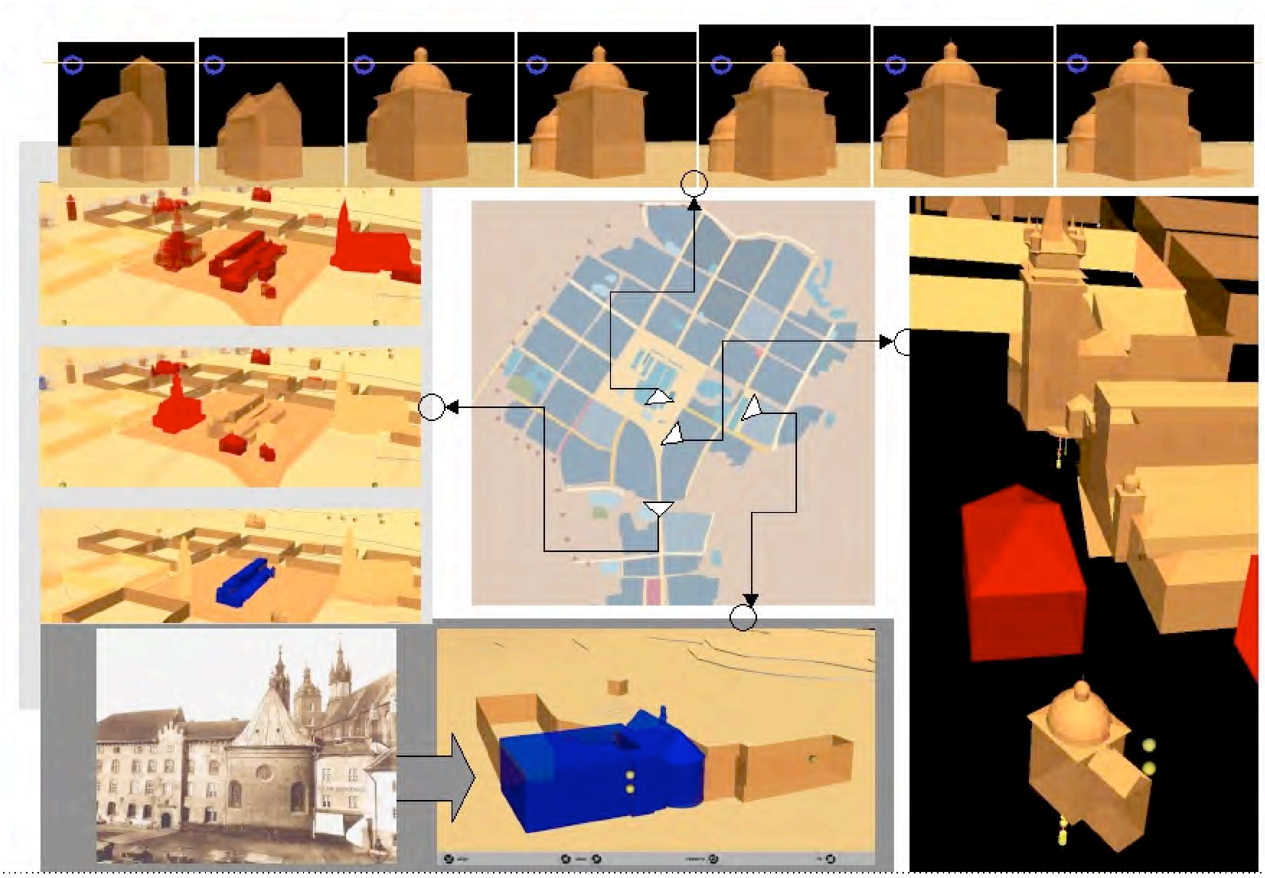

**Fig. 3:** Representation types as developed for structural scale scenes. Top: timeline scenes (an interactive slider lets the user to browse the morphological evolution of objects along time). Middle, left: analysis scenes on one date where colour coding bears qualitative information on each object's documentary analysis. Middle, center: 2D map generated using the same morphological information as the previous. Bottom, left: reverse scene querying, on selection of a bibliographical entry (in the example, a XIXth century picture) generation of a 3D scene containing all the objects mentioned in the entry.  One can then query the objects and thereby get "all other information than the bibliographical entry on the same piece of territory". Middle and Bottom, right: typology scene on one date in which each object can be compared to others thematically (style/function/structure).

## II. Research methodology

### 1. Foreword

During the period of life of an architectural or urban object, due to transformations throughout the centuries one element can have several forms. The transformations may be a consequence of human activity (ex. adaptations, additions, reconstructions,) or of a natural phenomenon (ex. fire, flood, earthquake). They can result in a modification not only of the object's form (ex. shape, stylistic affiliations) or structure (ex. material, constructive systems) but also in its position in space, function, property, etc. Typically, an edifice retains its name although many changes can have occurred on its morphology. We will need to document and represent each phase of the edifice's evolution, and will therefore we need to formalise a theoretical model of architectural elements in which each meaningful individual concept can be given identity persistence, but state evolutions. We will use architectural and urban concepts as a means to visualise information. In this stage, that can be defined as this of concept modelling, we need to identify the concepts that will be used as filters on the architectural documentation. This is done in an ontology-like approach based notably on [Pérouse De montclos 1998] and described in [Dudek and Blaise 2004]. Besides, the documentation is rarely precise enough to thoroughly document all aspects of a physical object. 3D shapes to which we will want to attach pieces of information may then be incompletely defined, and need to be visually marked with an indication on what information they are based on.

This implies the introduction of graphical codes for 3D representation, that would be used in order to visualise an evaluation of the nature or accuracy of the documentation attached to each architectural object represented in a scene. Such codes exist in traditional 2D representation but they are not used natively in computer-based 3D representations. We believe that, in 3D models representing reconstructional hypothesis, they could show for example the differences between the original parts and elements that were added later; or help in distinguishing what is certain in a hypothesis and what is only hypothetical.

## 2. System key aspects

At this stage of the research with have identified six categories of parameters that need to be handled in visualisation procedures:

a) Scale of representation : an object should be represented with regards to the scale observed. At urban scales, an edifice acts as a whole, at architectural scales each individual volume of this edifice acts independently.
b) Alternative representations : an object should be represented alternatively in one or another way depending on the role of the representation (for instance 2D/3D, or timeline scenes) basing on the same set of information.
c) Dynamic representation : an object should be represented dynamically with an appearance that assesses a state of knowledge, and therefore be updated automatically every time new information is gathered.
d) Dynamic behaviours : an object should be given behaviours that let the user to investigate it independently from the scene as a whole.
e) Coded representation : an object’s appearance should be monitored by the documentation’s analysis.

 

f) Canonical shapes : an object's morphology should be when needed represented by canonical shapes which support semantic indications connected to architectural ontology.

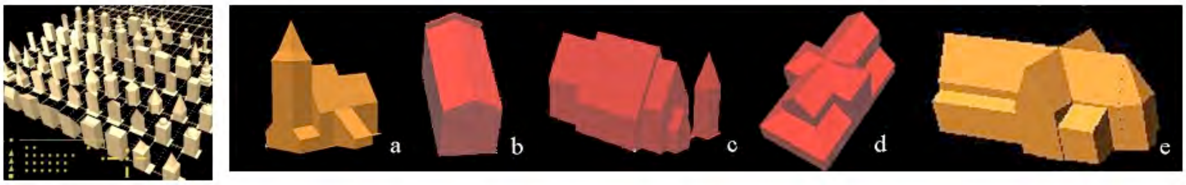


**Fig 4:** Canonical shapes (right) created by combining prototypical shapes (left) give hints on the object's ontological poistion.

We have implemented those parameters in a platform dedicated to our field of experimentation (open-source developments for Internet Perl/Php/MySQL, XML-SVG-VRML), the historical centre of the city of Cracow (Poland), in the framework of PICS and APN research programmes (CNRS / KBN, CNRS).

The system's key aspects can be described by isolating three steps:

**Step 1 :** Instanciation of objects defined in the hierarchy of classes. Each instance is defined by a set of qualitative properties and by a morphology. The absence of values in the former or the latter property set is however possible: documenting and proposing a morphology are independent stages of the research process. An object that has not been documented or not been dimensioned may be represented in the scene but with graphical signs stating that fact (see and [Dudek and Blaise, 2003]).

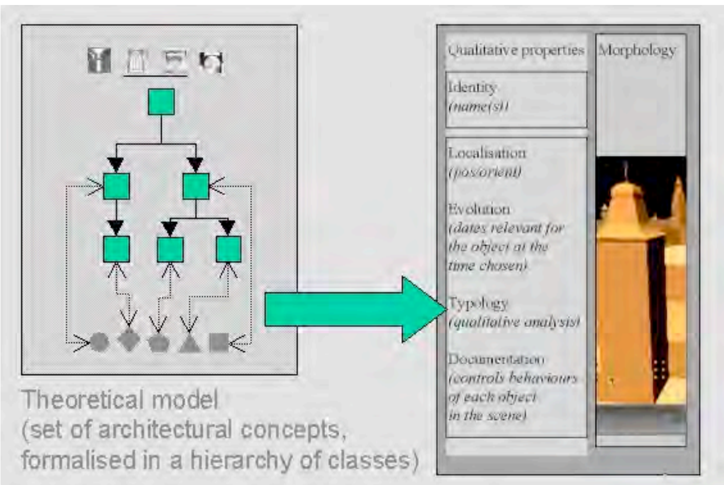


**Fig. 5:** A theoretical model, acts as a mould for individual objects.

**Step 2 :** Each instance's state is saved in a morphology file (XML) and a qualitative database (RDBMS). Evolutions of an object are linked in a common table, but each evolution bears its own set of qualitative justifiers (i.e for instance how credible is the information on the object's date of creation or transformation). Each object is connected to a bibliography maintained in yet another database, in which links can be provided to the resources themselves.

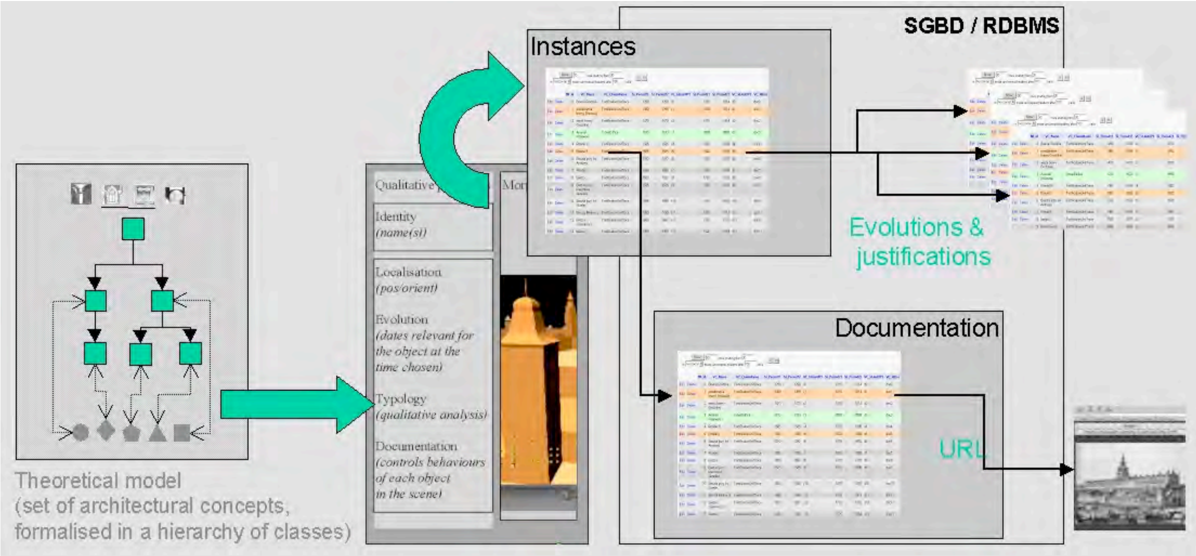


**Fig. 6:** Each instance's set of qualitative descriptors is handled in RDBMS context .

**Step 3 :** When the user queries the system, (asking questions that can be for instance "all objects of type Edifice at date 1551 on which the documentation says there have been preservation actions undertaken") all the instances matching the query are sent back by the RDBMS to a script which reads XML morphology files and dynamically creates 2D and 3D representations. Qualitative info is read from the DB and used to choose a proper graphical appearance for the instance, i.e an appearance that reflects what we really know about the object at the time of the query. Since they are dynamically generated, scenes always reflect the current state of knowledge on the territory observed. Each instance is not only graphically coded in order to mean something but also natively connected to a query on the bibliographical database.

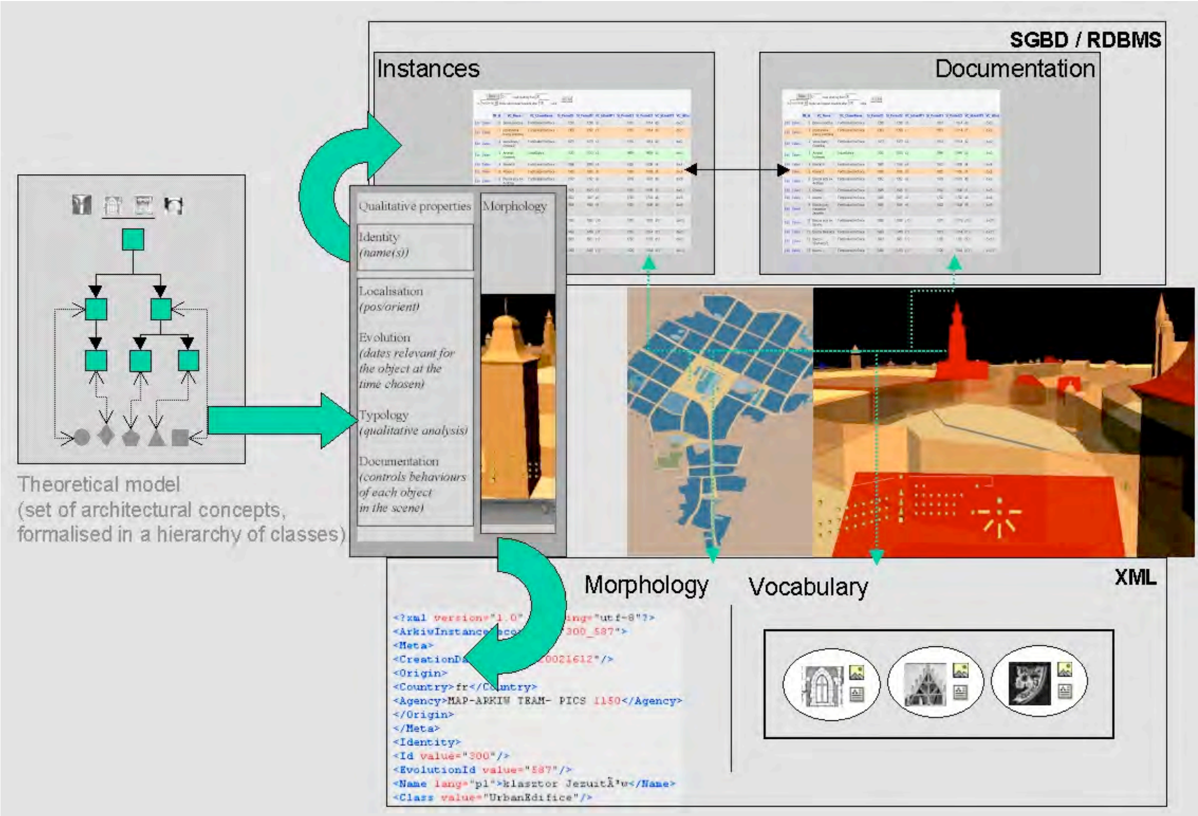


**Fig. 7:** 2D /3D graphics are generated dynamically, they provide graphical indications about each instance's qualitative evaluation (credibility of sources, hypothetical nature, typology, etc..) . Each instance's representation can also be used to query various data sets.

This system's architecture has been introduced in [Dudek and Blaise, 2003]. In the following section we detail the graphic variables we now handle.

## III. Graphic variables

Due notably to the diversity of technological platforms, as well as to the complexity of 3D spaces, providing interface-like control panels inside 3D scenes is rather rare. One may usually rely on the complementarity of 2D solutions (often mimicking a foreground ) and of 3D spaces in order to make navigation experiences easier. In our development, we have chosen to generate purely VRML scenes since experiences with controlling VRML from outside the plug-in have shown the link is too fragile in our research context.

We therefore faced the challenge to nest all the graphic codes and controls inside the VRML files generated (through the massive use of VRML's PROTO node). This, although a heavy constraint in a way, does give us the possibility to exploit 3D scenes autonomously from the application as a whole.

 

As a consequence, 3D graphics we develop contain architectural objects with coded appearances, but also so-called selectors that allow the user to interact with the object from within the scene. These selectors may be part of a foreground "flying-with-us" control panel or attached to individual objects. We therefore will in the following section distinguish appearances monitoring (says what appearances an object may have and why, including when symbols are used to represent objects) , object controls (says what actions can be undertaken to query an object by selecting it or by applying some action to it), and scene controls (says what actions can be undertaken to modify a scene's features).

## 1. Appearances monitoring

**Red or blue colouring**

Objects that we study evolve through time. We may for evolution A of an object have enough data at time T of the research to give the object a shape, and lack time or information to do the same for evolution B. We then propose a coding that states "evolution B is represented by the morphology of evolution A". Red or blue colouring is used to state this, i.e whether the morphology proposed for an object in a scene is this of the object at the date of the scene or whether it is a copy of a previous or later evolution of the object. Blue colouring means the morphology proposed is this of an earlier evolution of the object (red this of a later evolution of the object.) : we know changes have occurred at the time of the scene but have not yet worked out the hypothesis, may it be by lack of time or by lack of documentation.

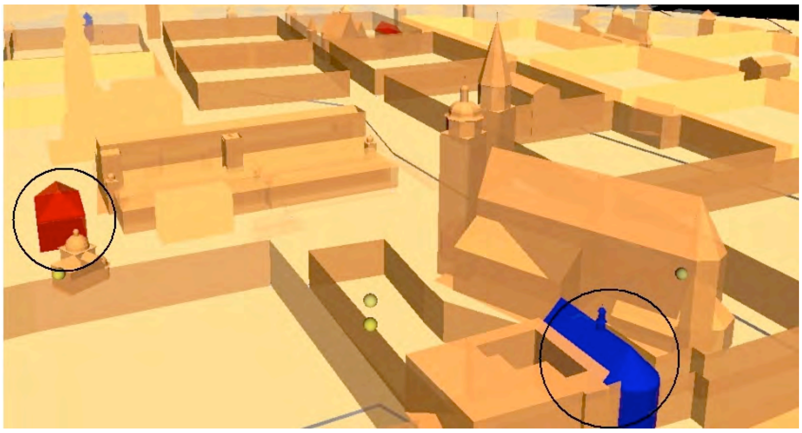

**Fig. 8:** Red/blue colouring, scene for period 1790, state of knowledge in november 2003

**Emissive colouring**

Shapes can be showed with a colouring mode using the emissive field of VRML's material node, giving shapes the appearance of neon light (no darker zones in the shape). This possibility is used to mark objects that are documented but not justified . In our jargon this means that we know a documentation exists for the object but that we have not yet analysed it in order to state for example whether the documentation provides recent hypothesis or observations that are contemporary of the scene's date. In other words, a shape with emissive colouring is a shape for which we stress the need to go through the documentation and issue an evaluation. Emissive colouring applies either to red / blue or to standard colouring.

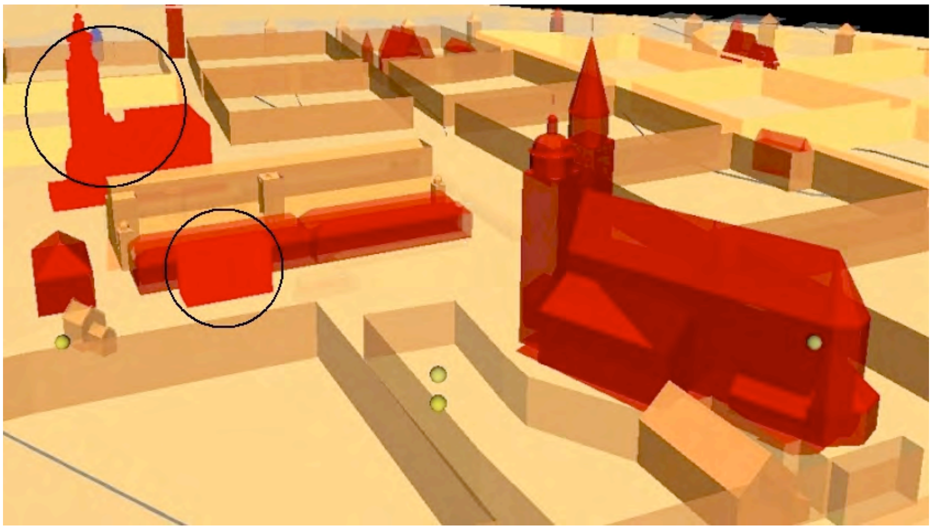

**Fig. 9:** Emissive colouring, scene for period 1570, state of knowledge in november 2003

**<u>Tranlucencies</u>**

Tranlucencies indicate either that the object is undocumented (level 0.9, almost translucent) or how we have evaluated the datation's precision with regards to the reading of sources (6 values from 0 to 0.7). In the first case the information visualised is that the data from which the existence of the object can be stated and a morphology proposed is not a primary documentary source but an interpretation, and therefore that the primary sources still have to be established. In the second case the information visualised is an evaluation of the primary sources from which the existence of the object can be stated and a morphology proposed. This qualitative evaluation states how precise the documentary sources are. Its helps having a synthetic, comparative view on the set of objects displayed in the scene. The actual information on the evaluation is available by selecting each object and reading the data in the RDBMS.

 

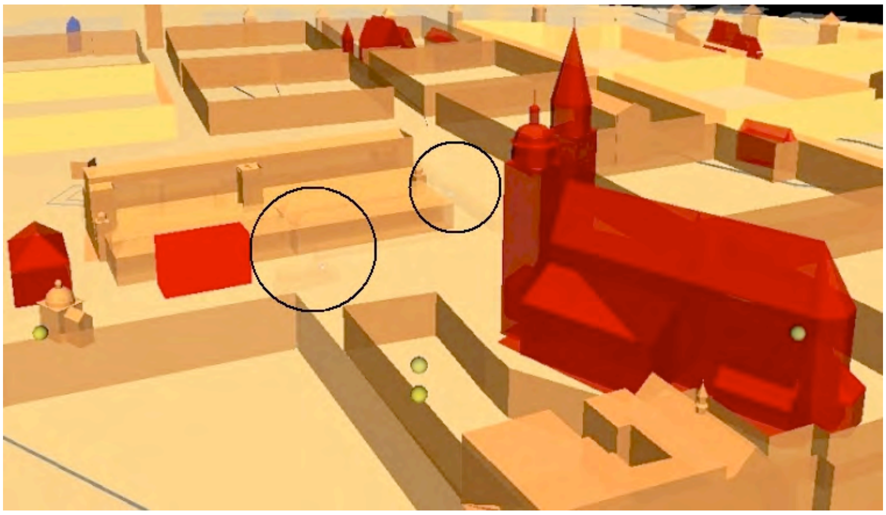

**Fig. 10:** Tranlucency, scene for period 1670, state of knowledge in november 2003

## Highlighting

Highlighting is used to check what type of documents are available for each object. Documents are divided in groups –conservation actions or documentary sources – and qualified in a two level hierarchy (example : conservation/actions/addition or documentation/cartography/historical plan). Each document type is represented by a sphere in the control panel. When selecting one of those spheres, each object in the scene for which such a document is available is highlighted, usually in green colour (i.e for instance "all objects for which we have documentation/cartography/historical plan).

**Fig. 11:** Highlighting, scene for period 1722, state of knowledge in june 2004, objects highlighted for value documentation/text material/analogies

 

**Symbols**

In the case of objects that we have documented but for which we have not yet given morphological properties, we use a library of graphical 3D signs that bear three indications. The bottom lineSet indicates the belonging to a hierarchy of concepts. The vertical line height indicates a scale (relative to other concepts in the same scene). Finally, a textured cube shape bears the same transparency/colour coding mechanisms used on all the instances in the scene in order to visualise the documentation's analysis. Symbols are often shared by a sub-hierachy of classes, such as all defensive structures (bottom lineSet with a star shape inside a square).

**Fig 12:** Symbols, scene for period 1430, state of knowledge in November 2003, symbol's bottom lineSet is this of an object of class Urban edifice (A square in a square).

## 2. Object controls

**Appearance Selector**

This control is positioned in the scene's foreground. It allows switches between highlighting / normal appearance mode, and controls levels of translucency.  A sphere serves as button to open the two types of controls : cones that control the level of translucency and spheres that control the highlighting of objects.

**Anchor Selector**

This control, also positioned in the scene's foreground, consists at this stage of  five bars each of them corresponding to a different resource that will be queried when an object is clicked. This control affects all objects in the scene at a time, moving the mouse over the bars opens a text indication on which resource the bar corresponds to. Alternatives are notably SOL resource database (the documentation of the object) VIA instances database (the qualitative attributes of the object) and a rotate command that lets the user to rotate an object around itself without moving inside the scene (a sort of object examiner). In that case no external query is performed. Blue spheres appear around the object to rotate, a click on those spheres sets the object's position back to its initial state. Default value is SOL (documentation of objects). Queries on the forthcoming vocabulary database will eventually be added.

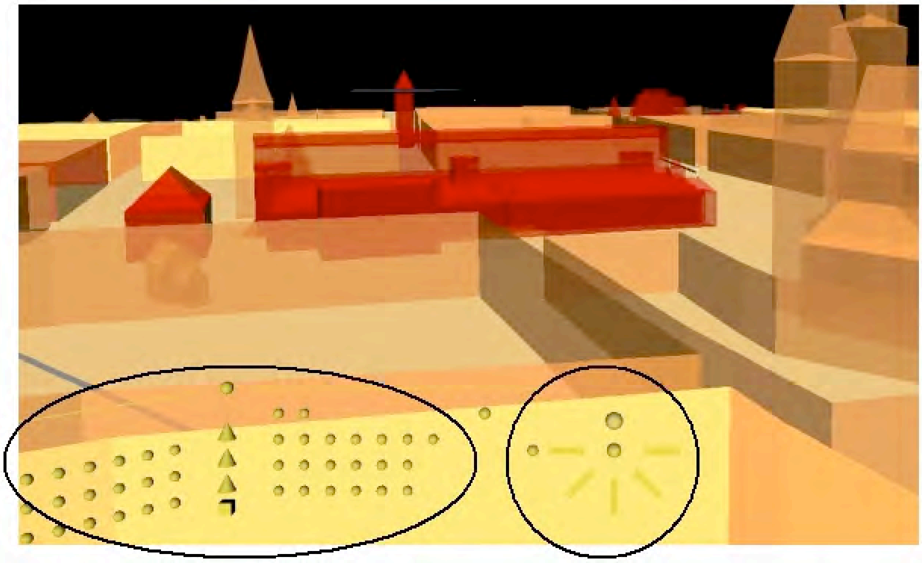

**Fig 13:** Selectors in the control panel, scene for period 1440, state of knowledge in June 2004.

**Typology analysers**

Each object may be provided on user demand with a control positioned at the object's origin (symbolised by a tripod) that delivers indications about its shape, function and structure. Naturally these indications do not replace a full reading of the database which contains the in-depth information about the object. But they provide a quick overview of those three features in a manner that fosters comparisons over the territory observed and helps raising questions. Three graphic signs are provided:

- a stylistic affiliation indicator where each style is positioned along a line that represents time. Styles are therefore distributed according to their position in history. Since we deal with edifices that have for most of them been transformed, it will not be rare to find and edifice with several stylistic affiliations. This is precisely what is meaningful, and what we could not visualise if we were representing realistic edifices. Stylistic trends tend to mask one another, the typology analyser formalism keeps trace of these changes.
- A functional program indicator where what is said is how many functions the edifice had and not which precise function. It is precisely the multiplicity of functions that raises questions.

- A structural indicator that says which combination of materials were used in the construction of the edifice. Once again only a thorough reading of sources will provide a full knowledge about the object's structure, but this indicator provides a helpful hint in trying to find out "*for which other objects than the one I am currently investigating do I have the same combination of material*" thereby gaining time in the research process.

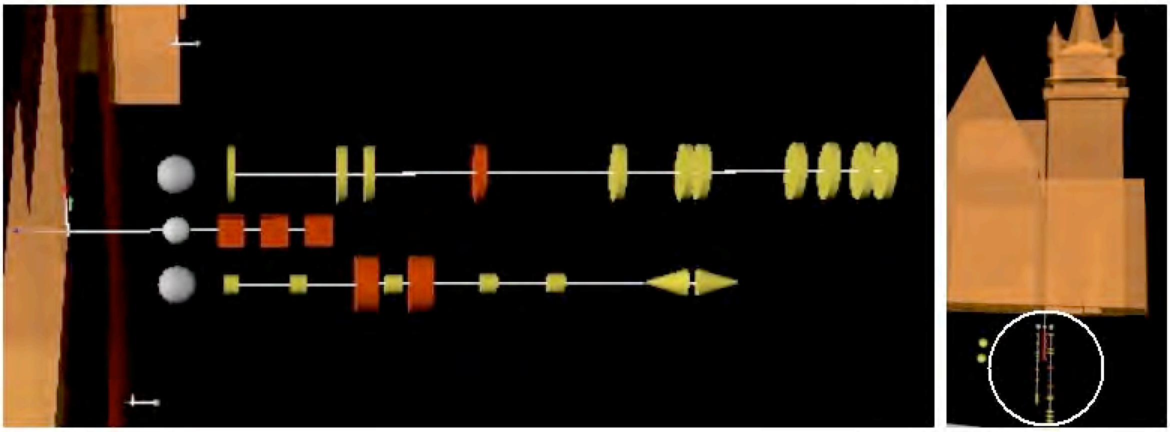

**Fig 14:** Typology analysers for object Ratusz Krakowski (periods 16th century, left, state of knowledge November 2003, 15th century right, state of knowledge June 2004). Top stylistic affiliation (here gothic) middle number of functions of the edifice (3) bottom material ni the construction (combination of stone and brick)

### 3. Scene controls

**Ground anamorphosis Slider**

This slider controls the ground's morphology scale. The ground's morphology is represented by successive horizontal slices, the slider affects each of the slices' height by increasing its scale factor. The triangle on the right side of the slider can be moved interactively in order to increase or decrease this scale factor. The indication given by this slider is of course only qualitative, its only objective is to provide a global view on the city's ground morphology.

**Light Slider**

This slider controls the intensity of the scene's general directional light The triangle on the right side of the scale can be moved interactively in order to increase or decrease the light's intensity. The scale is divided in four quarters, light intensity goes from zero to one (one is default in most scenes). The directional Light lits from top to bottom (Scene's Z axis, or VRML's Y axis) Directional light intensity changes will NOT be visible on Emissive shapes : this is a method to clearly identify the shapes that are coded Emissive (Documented but not justified) inside a scene.

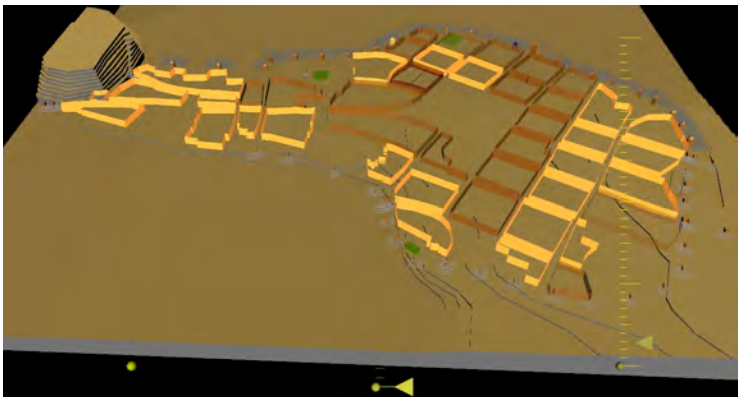

**Fig 15:** Scene controls for ground and lighting

## IV. Conclusion

Investigating the evolution of patrimonial architecture, whatever scale one focuses on, requires the analysis of a mass of documentary sources most often heterogeneous and distributed. The building of representations in which one can graphically simulate the morphological evolution of patrimonial architecture bases on an interpretation of those documentary sources. In return, such representations can be used as graphic interfaces featuring architectural objects in time and space. Historical sources as well as interpretations can then be visualised and accessed by selecting shapes in the graphics (3D or 2D).

But our research shows that such an approach requires the graphics to go beyond mimicking reality, and to allow a coding of objects so that they can convey more than shapes. Our research does not pretend having found the one and only graphical variables and disposals suitable for this purpose, nor did it intend to. Important efforts remain to be done in order for instance to further develop user-interfaces and evaluate their usability.

But, at this early stage, this research has let us to think that the time may have come to re-read works like these of J.Bertin or E.Tufte on information visualisation and readability and to try to evaluate how they can be better understood in the field of architectural representation. In other words, we believe our research can contribute to the emergence of a multidisciplinary research concern on the use of graphics in the architectural heritage. In definitive, we believe it is time for architectural representation in the context of the heritage to stop being scientifically lazy, to stop lying, to become again, with or against computer technologies, a tool for transmitting pieces of knowledge to future generations.

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