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PALLADIOLIBRARY – A GROWING VIRTUALIZATION PROJECT TO UNDERSTAND ANDREA PALLADIO'S WORKS

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Abstract

This paper deals with the topic of virtualization of Information System related to Architectural Heritage in the age of Information Technology. The case of *PALLADIOLibrary* and its interface *Andrea Palladio - 3D geodatabase*, a comprehensive Information System about the architect Andrea Palladio and his work is introduced. The new system, gathering the legacy of a systematic and clearly defined original system based on an evident and effective virtualization process, it allows to provide support to the problems faced, clarifying the limits, characters, potential and advantages.

Keywords

Virtualization, Architectural Heritage, Andrea Palladio, Virtual Reality, 3D modeling, Information System

1. *Analog & digital representation: two identical faces of the same coin*

The use of the expression 'virtual representation' by almost everyone has become common since digital data processing turned into the main technique for image construction. Perhaps because of the ambiguous fascination contained in its apparent oxymoron, this expression was soon extensively used to define the partial reproduction of reality (objects, buildings, environments), achieved using a 3D model. This representation numerically described in the memory of a computer, can be displayed on a flat screen as a theoretically infinite series of images, some of them characterized by a very high degree of resemblance to the depicted reality.

The main feature of the 'virtual representation' is the ability to change freely and in real-time the observation point of view in the scene. This way it is possible to visualize as an observer a dynamic image of a virtual, freely navigable space. The observer, thus, has the perception of being in front of the real object, instead of a representation of it.

Two definitions seem particularly suitable to identify this context: the first states that «VR refers to immersive, interactive, multi-sensory, viewer-centered, three-dimensional computer-generated environments and the combination of technologies required to build these environments» (Cruz-Neira, 1993), while the second states that «VR is a mean of interaction, by which people can see, operate, and interact with extra complex data through computers» (Aukstakalnis & Blatner, 1992).

If the first definition clarifies the concept of 'virtual representation' in the most immediate and known terms, the second one is the richest in terms of meanings that are expanded to a broad and extremely fruitful domain of perspectives.

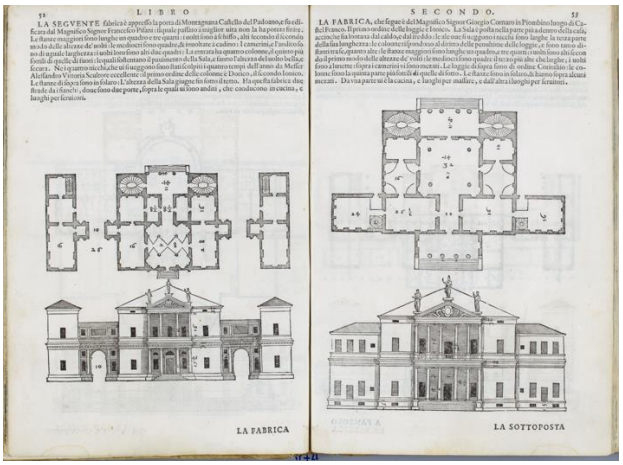

Fig. 1: Virtual solutions to know the real: a page from *The Four Books of Architecture* first published in Venice in 1570

This second definition basically derives from the observation that Information Technology (IT) offers much more than the simple digital access to existing analogical artefacts and various types of expressions. It allows also the use of the phrase to identify every coded and organized cognitive structure in digital form, up to whole global knowledge systems. One of the pioneers in this kind of vision was William J. Mitchell. In his *Smart Cities* project[1] he clearly showed that it is possible to take advantage of the integration into a single media of information and processes, able to channel and distribute themselves everywhere and every time.

Mitchell's concept of a global knowledge is not new, but it is only the last episode of a general vision of knowledge condensed into a single bin.

This container simply took on new forms over time, with the evolution of the human knowledge: in Antiquity this was shaped as a library (the library at Alexandria); the French philosophers in 18th century proposed a portable version in the form of the Encyclopédie; in the early 20th century a new vision emerged, speculating that all knowledge might one day be online to create a global brain. Today this entity has many names: *world brain, collective intelligence, collective memory, enduring knowledge, digital libraries* (Veltman, 2012).

If we try to observe this idea of a 'global intelligence' in today IT-based shape, from the point of view of knowledge acquisition, archiving, restitution, we can easily observe how it actually does not involve anything new. We simply need to redefine the virtual/material and man/technology relationships. This not involves the issue of the technology itself, but the issue of its use as an active tool in the existing processes and procedures. Further on in this paper we will focus on these relationships.

In our interest fields (the architecture and the urban systems), the definition of relationships between virtual, material, human and technology is neither a new topic nor a topic lacking of introspection, it is rather a subject driven by the nature of the architecture itself, which in the real virtualization sees the only possibility of becoming conceivable, communicable, manageable matter, as Vitruvius has already explained in his treatise: «Species dispositionis, quae grecae dicuntur ideae, sunt hae: ichnographia, orthographia, scaenographia»[2].

The IT introduction into a system already consolidated for at least half a Millennium is a key factor because, while maintaining the need to virtualize the real through representation (the usual topic of the communication in architecture), it alters the traditional and coded levels of iconicity and continuous discretization of the representative process. While analog media were limited to static and linear cognitive models (alphabetic, chronological or geographical), digital technology allows dynamic synchronous models, which can generate alternatives on demand. Digital objects can make the history visible, to revive settings, and to show processes. So, IT introduces multiple dynamic knowledge, allowing more efficient solutions to existing unresolved instances. Digital opens up new paths to knowledge and offers new means to reorganize and preserve our heritage.

For example, when analyzing the problem of art museums, it is possible to notice how cultural heritage is today nothing more than a collection of objects whose original context has been destroyed or at least removed. The entity and nature of this de-contextualization changed over the time as the museum's purpose changes: personal collections of the great Renaissance families; encyclopedic collections in the Baroque age; illuminist museums - sanctuary of the public knowledge and collection of exemplary shapes for the Fine Arts Academies; Napoleonic museums - the result of the war spoils and of the suppression of religious orders, convents and confraternities; great national museums, structures of high political prestige and high cultural specialization, small civic museums, custodians of local virtues and so forth. Connection and hypertextuality offered by IT, through the on-line integration of this heritage made up of monumental emergencies and masterpieces with the existing rich but neglected connective substratum, reconstructs synchronically and diachronically this link between work and context. This allows not only to rebuild the shattered link, but to create new situations rich in meaning.

Digital technology makes available the entire humanity's Heritage on the Web to different kinds of users and according to various ways of fruition, allowing each individual to create his own virtual equivalent of an analogue collection, multiplying

[1] <http://smartcities.media.mit.edu/>.

[2] M. Vitruvio Pollio, *De Architectura*, I, 2, 1.

the museums and relationships among the whole world heritage. Ultimately IT represents a fundamental change in our cognitive model of architecture. It radically changes the way we navigate through our cognitive corpus, teaching us not only to review the facts but also to recognize and create new relationships between them. Furthermore, it opens up a series of issues which represent many possibilities in the development and investigation of several themes.

More generally, digital virtualization enables many investigations in the fields of archiving and consultation data (drawings, photographs, texts, 3D models, quantitative data), spatial analysis, and verification of unrealized projects, in particular those relating to cultural heritage and architecture that would not have been validated using analog techniques. It also features integrated reading capability for the various types of data and, through the Internet, the real time consultation of different archives from a single desktop, replacing the mobility of scholars and architects with the information one.

Lastly, it easily allows the comparative analysis between different images or text or cross-analysis between both images and text, a key operation in the activity of Visual Arts and Architecture experts.

IT-based virtualization also stands for a key tool for knowledge-based processes also in asset management.

The conservation of a monument or an archaeological object or a site today is a process based on an ongoing collaboration between art historians, archaeologists, architects, scholars, conservators, managers and specialists, who work together to solve the same problem (Gaiani, 2012). This implies the need of a platform allowing a real collaborative work among all parties involved. At the same time, considering the process of conservation and restoration including its whole lifecycle, i.e. the related processes of knowledge, conservation, management, communication, exploitation, is a mandatory requirement (B. Benedetti, M. Gaiani, & P.G. Guzzo, 2008). Finally, it requires an increasing degree of automation to easily manage the large amount of multidimensional heterogeneous data, (3D models, images, photos, drawings, texts) generated from the process.

To fit these requirements, we need to avoid the typical case of multiple and specific Information Systems (IS). A common database targeted for all the users and a common data management is required to grant proper efficiency and to proficiently share contents. To fit specific needs, data are simply filtered according to the nature of the user. Overall, we refer to a model of global knowledge shared and made available at any time, in any place, to any user: researchers, professional operators, students, and city-users. It relies on general concepts and data systems like the Open Linked data[3], coming from raw data, and it is driven by the key property of being widely classifiable and self-demonstrable, as it has always been for every form of representation in architecture.

2. *The PALLADIOLibrary*

The *PALLADIOLibrary* (Beltramini & Gaiani, 2012) is an Information System developed by the Centro Internazionale di Studi di Architettura Andrea Palladio in Vicenza (CISA AP)between 2011 and 2016 [4] aiming at the unification and display of all the relevant digitized materials as well as a set of multimedia and virtual reconstructions for a clear understanding of Andrea Palladio's work, using new virtualization IT now available to all (RTR of 3D models, Web 3.0, geospatial systems).

The *PALLADIOLibrary* arises at the end of a long collection process among the sources and their digital conversions over the years, becoming the new starting point for the study and dissemination of the Palladio's work and his heritage, which is still alive and recognized in the world.

The *PALLADIOLibrary is* not yet another short life partial IS, on the contrary it is a fully integrated and standardized system in which the communicative side is central (Figure 2).

As the Information core system of the *Palladio Museum*, the museum dedicated to the work and life of the famous architect Andrea Palladio located in Palazzo Barbarano in Vicenza, the *PALLADIOLibrary* brings together and links all the materials gathered over years in the research by CISA AP, essential for the knowledge and enhancement of the Palladian work: his drawings, the largest existing photo library devoted to Palladio (over 5,000 photos), approximately 1,200 survey drawings, Palladio's writings (nearly 8,000 pages) as well as a set of multimedia and virtual

[3] < http://linkeddata.org/>.

[4] <http://www.palladiomuseum.org/it/>.

reconstructions that allow both specialists and the general public to learn about Andrea Palladio's world, 54 constructions spanning from houses and public buildings to palaces, churches, bridges distributed throughout the Veneto region.

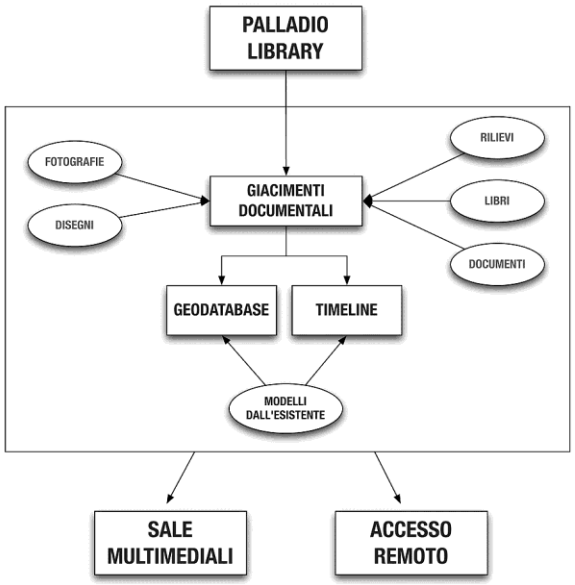

Fig. 2: Virtual solutions to know the real: the contents organization in the *PALLADIOLibrary*

The decision to use IT infrastructure to improve the study of Architectural Heritage reveals a strategic decision by the CISAAP, as promoted by the President of the Scientific Board, Howard Burns. This approach is not a simple adjustment to market novelties; on the contrary, the Centro intends to make use of new technologies (alongside the continued use of traditional formats, such as monographs, exhibition catalogues, and facsimile reproductions) to take advantage of the special opportunities that these new means offer. The information management through databases supporting the research across many types of catalogued materials (maps, drawings, manuscript documents, prints and photographs) not only makes the work of scholars more rapid but it also increases the range of possibilities.

Beyond the visualization of materials not always easily accessible, such as archival documents, using one's own computer screen makes these materials available in a more direct and immediate manner.

Following this cultural trend, in 1995 CISA AP abandoned the publication of the *Corpus Palladianum* (the series of systematic studies on Andrea Palladio's buildings, which the institute edited since the Sixties) to start a project for a Palladian database. This was initially settled through two different projects: a database system developed in collaboration with the Graduate School of Design of the Harvard University and the School of Architecture at MIT (Tsai, 1997), and three visual-multimedia CD-ROM databases on Palladio's themes (Beltramini, 2008), to be considered as a digital evolution of the Corpus Palladianum, still in collaboration with MIT and the University of Ferrara: *Andrea Palladio: le ville* (M.Gaiani, G.Beltramini, & H.Burns, 1998), *Andrea Palladio e il Veneto* (M.Gaiani, G.Beltramini, & H.Burns, 2000), and *Palladio e Vicenza* (M.Gaiani, G.Beltramini, & H.Burns, 2002).

All of these CDs address the Andrea Palladio's works, but they consider different themes, purposes and results. *Andrea Palladio. Le ville* and *Palladio e Vicenza*, offer graphic and textual documentation for Palladio's villas and his Vicentine works. *Andrea Palladio. Il Veneto* is a guide of historic and touristic interest for all Palladian constructions in Veneto. The main goal of their design, which is not targeted to a specific final user (it could range from researchers to city-users), was to give a response to the issue of joint re-contextualization of cultural expressions with spatial and architectural information. The information was organized according to the double dimension of architectural descriptions identified by James Ackerman: documentation and interpretation (Ackermann, 2002). This organizational scheme was translated, i.e., in the first CD-ROM *Andrea Palladio. Le Ville* in a double access: the first part is titled Exhibit, which is descriptive and non-interactive, while the second part, titled Catalog, is analytic and meant to support further research.

The experience gained thanks to the CD-ROMs led the awareness that any further research could only take place having a solid documentation allowing an easy querying and accessibility.

The Digital Palladio project was activated between 2002 and 2004 with the aim of digitalizing and reorganizing into a unique database the documentation on Palladio's works (photographs, 1,200 drawings of Palladian architecture surveys, the main ancient editions of the treatises by Palladio, archival documents and Palladio's original drawings scattered among some international institutions) (G. Beltramini & M. Gaiani, eds., 2003).

Fig. 3: A room of the exhibition *Palladio 500 anni*, held in Vicenza at Palazzo Barbarano, in 2008

These digital assets have become the basis for the scientific research, exhibitions, publications led by CISA AP in the last fifteen years (Figure 3).

The *PALLADIOLibrary* comes as a cognitive system built over this solid documentary apparatus.

PALLADIOLibrary deals with the whole Palladio framework, with the history of the cities and the Veneto region, with the figurative arts of his time, with his contemporary architects and successors, with his clients. *PALLADIOLibrary* aims to spread the knowledge of techniques and building materials of the Palladian age, the problems of restoration and conservation, not only for isolated buildings, but for the entire urban systems and countryside surrounding the villas. The availability of materials on the web allows not only the dissemination of the knowledge and its access from anywhere in the world, but it allows to reproduce some of this information even *in situ* at the various Palladian architectures (e.g. Villa Poiana, where a permanent Palladian exhibition is put on display). This allows the construction of a Palladian museum spread throughout the Veneto region, still coherent and homogeneous.

PALLADIOLibrary is an answer to the issue that, despite decades of studies, the knowledge of Palladio's work is still far from being definitive, as recent findings of unpublished drawings prove; they allow the identification of new Palladio's buildings, still today unknown (Beltramini, 2010). The use of digital media is strategic in this field. On the one hand it allows to gather in an unique form all the documents and drawings on the Palladio's work reconstituting a complete corpus, on the other hand, it allows the reconstruction, through highly immersive 3D models, not only of the existing built architectures, but also and especially those that have been lost or even never realized, fostering the understanding of the graphic documentation even to a non-specialist audience, as proved by the work that guided to the attribution to Palladio of the original nucleus of Villa Contarini in Piazzola sul Brenta (Apollonio, Beltramini, Fabbi, Gaiani, 2011).

PALLADIOLibrary aims to be an exhaustive system, open to the implementation by multiple users, at different times and from multiple sources, in order to establish a general model easily applicable to other cases.

Finally, *PALLADIOLibrary* aims to create new integrated use of representations at different levels of iconicity (3D models, images, texts) that can be archived and recalled according to their intrinsic properties. This allows to increase the communication ability, which can become a vehicle for cultural (and touristic) use of the Heritage. As knowledge derived from a common base the *PALLADIOLibrary* is also intended to be enjoyed by multiple users: scholars, professionals, students, museum visitors, simple city-users.

The core application of *PALLADIOLibrary* is a complete 3D web geo-database where 3D models support a complex IS, named *Andrea Palladio - 3D geodatabase* (AP3D) (F.I. Apollonio, C. Corsi, S. Baldissini, & M. Gaiani, 2010) (Figure 4), which includes:

1. 3D digital models representing as-built and serve as a metaphor of the observed objects, allowing a direct and semantic knowledge of the data (Gaiani, 2000);
2. 2D textual and iconographic materials provided by the CISAAP Scientific Board;
3. development of a new web-based architecture that allows multi-user customized access from different platforms, using standard guidelines (Gaiani, 2003).

AP3D arises from the consideration that the knowledge entered in IS has to be associated to suitable retrieving techniques, i.e. they must provide access only to all those documents of a collection relevant to the user.

To satisfy this requirement consistent and systematic descriptions and appropriate classifications, especially for visual materials are needed.

The problems that arise, and to which a solution has been provided, therefore concern:

- the representation of complex documents, such as multimedia and rich media;
- the access to the documents (and therefore the problem of recall and precision, i.e. the ability to retrieve entirely and only the relevant documentation).

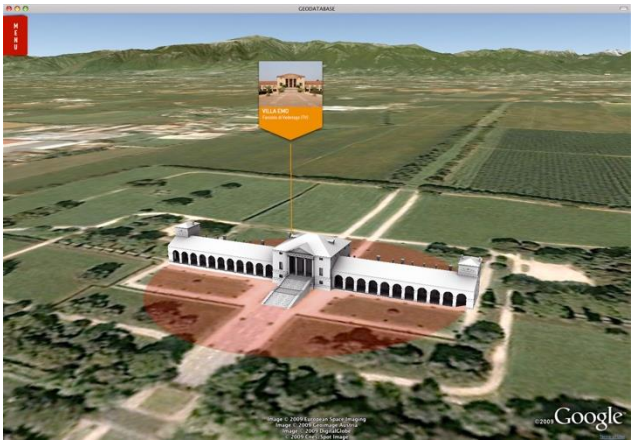

Fig. 4: Virtual solutions to know the real: *Andrea Palladio - 3D Geodatabase.* The 3D model of villa Emo in Fanzolo.

Dealing with urban systems, it is clear that geospatial systems based on 3D models and 3D visualization and interaction are eventually a rich solution capable not only to give solution to these problems, but also to create new perspectives for analysis and research, management and communication.

A first prototype was developed in 2008, at the University of Bologna (Gaiani, 2008), borrowing the interface and data organization structure of the CD-ROM *Andrea Palladio – Le Ville*. This first version of AP3D improved the CD-ROM interface through a new solution based on Google Earth. The approach for the development of the application comes from visual computing, has a strong architectural knowledge representation and is deeply rooted in the philosophy of GE, which turns the role of the Web browser into an application to visualize maps as content (Jones, 2007). The application was therefore a complete three-dimensional geo-database on a web platform in which 3D models were integrated into an extensive Palladian IS.

The choice of Google Earth as the engine for information organization and visualization is motivated by many reasons, including the ability to show images with a resolution of less than one square meter and their constant updating and increase in resolution. Furthermore, the platform not only allows information to be viewed, but it also allows the individual user to enter additional information that can be shared with other users around the planet. Touristic information about Palladio villas, e.g., or logistic information will be added with no cost directly from the different actors who play a specific role in the Palladio's work management and also from communities. This feature is particularly important, because it makes the geodatabase open to future additions and implementations, allowing all scholars to freely add contents without having to rewrite the source application or involve a webmaster, and thus favors a rapid progress of related studies.

The first AP3D solution, however, proved to be limited because the display area of the sites and 3D models were partly reduced by textual lists and other graphics. In 2009, during the permanent exhibition in Villa Poiana at Poiana Maggiore (Baldissini & Gaiani, 2011), a second version of the interface was arranged (Figure 5). This version minimizes the presence of graphics elements on the screen (e.g., the list of works is a pull-down side panel), which allows the user to have a better feeling of immersion in the Veneto landscape and to focus on the building that is centered in the view.

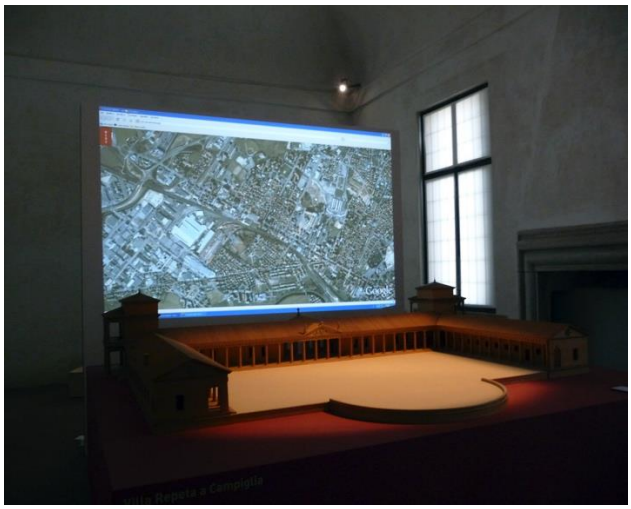

Fig. 5: The second version of AP3D at Villa Poiana in 2009.

Finally, the current version, used at the Palladio Museum, uses a different concept of the system interface/interaction, which is split on different devices.

Today, through AP3D, *PALLADIOLibrary* is accessible from more areas of the Palladio Museum. In particular, in one of the rooms at the Palladio Museum a multimedia station has been set up for the visitors in order to access the geodatabase (Figure 6). The Veneto region with its orography and satellite view provided by Google Earth is projected on a large screen, while users can interact and explore through a touchscreen tablet allowing to search among the Palladian works and historical materials and all the iconography collected (Baldissini & Gaiani, 2014).

Fig. 6: AP3D in action at the Palladio Museum. Photo by Filippo Romano, courtesy CISA AP.

The most important feature characterizing AP3D is the ability to provide a comprehensive representation of an architecture whose complexity can hardly be explained by means of textual documents or pictures.

The added value of AP3D, compared to the text-based approach, is given by the inclusion of the buildings in their environment, allowing users to discover unknown relationships between the villas and the environment, to evaluate their architectural occupancy and to quickly access a complex system of information that was collected by several extensive studies over the years.

From a technical point of view AP3D is organized as a typical client-server architecture that has components on both sides and is organized as in Figure 7, including:

- A relational database;
- A 3D model repository;
- An iconographic documentation repository;
- A web structure aimed at the hosting of plug-ins generated by the server, which also includes the client-side processing logic;
- A local client that includes a web browser and GE plug-in;
- A client-side interface for showing and describing specific contents;
- An Internet connection for accessing 3D maps of the analyzed area.

Data are stored in an Relational Database Management System (RDBMS) managed by MySQL. Each record relating to a building is connected with many other ones, linked to the correlated images (drawings, photos, surveys, book pages) and to the associated 3D models.

The user interface is a key point of the project since it is completely different from the usual information visualization on a web browser, with a 2D window that organizes different type of information.

The Graphics User Interface (GUI), which is made of a combination of HTML forms and KML/KMZ models, lets the user to control the different operative modes to select specific inputs, to check the current state and to surf inside the applications.

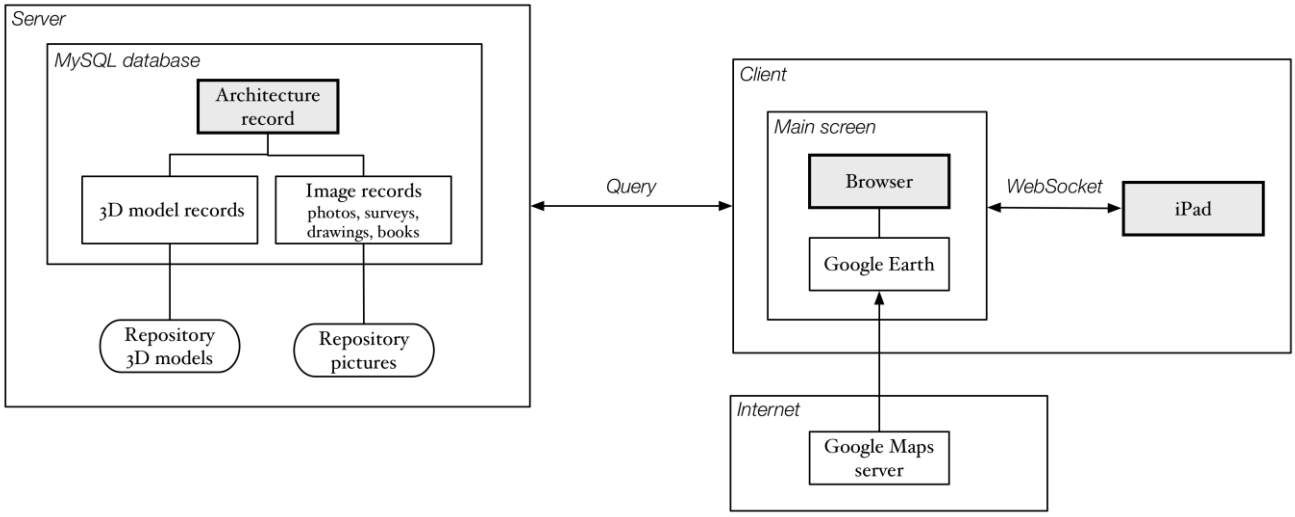

Fig. 7: Geodatabase IS organization in the Palladio Museum version

These tasks can be performed through four modules (the menu and the working area at the top of the screen; the complete view of the urban system or/and the site where the building is located; the browser; the numerous windows that can be opened in GE as a virtual table) while the several queries available lead to additional information regarding the object of interest or they let to search artifacts that meet specific requirements.

These queries accommodate two important interaction modes because the user can access environments and objects in the same 3D space

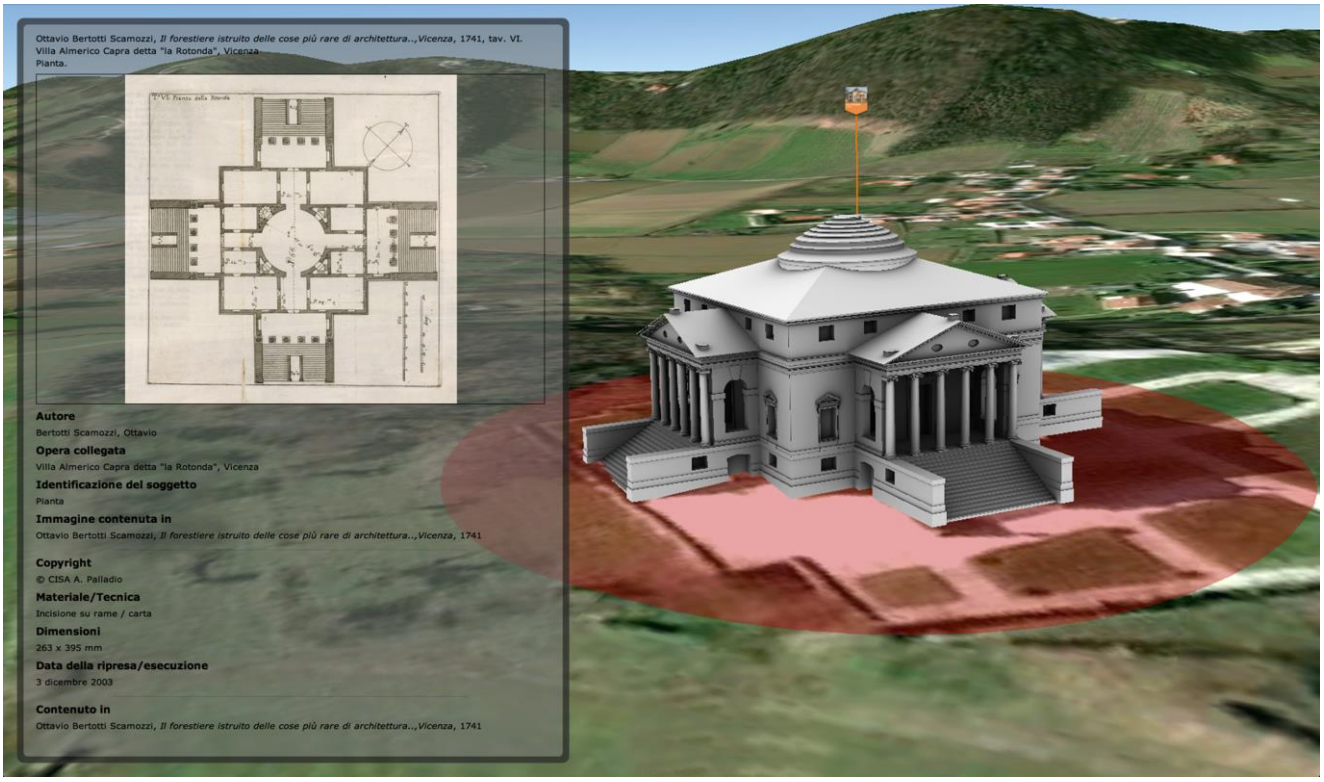

Fig. 8: *Andrea Palladio - 3D Geodatabase.* Interface with descriptive card of a table of a treaty.

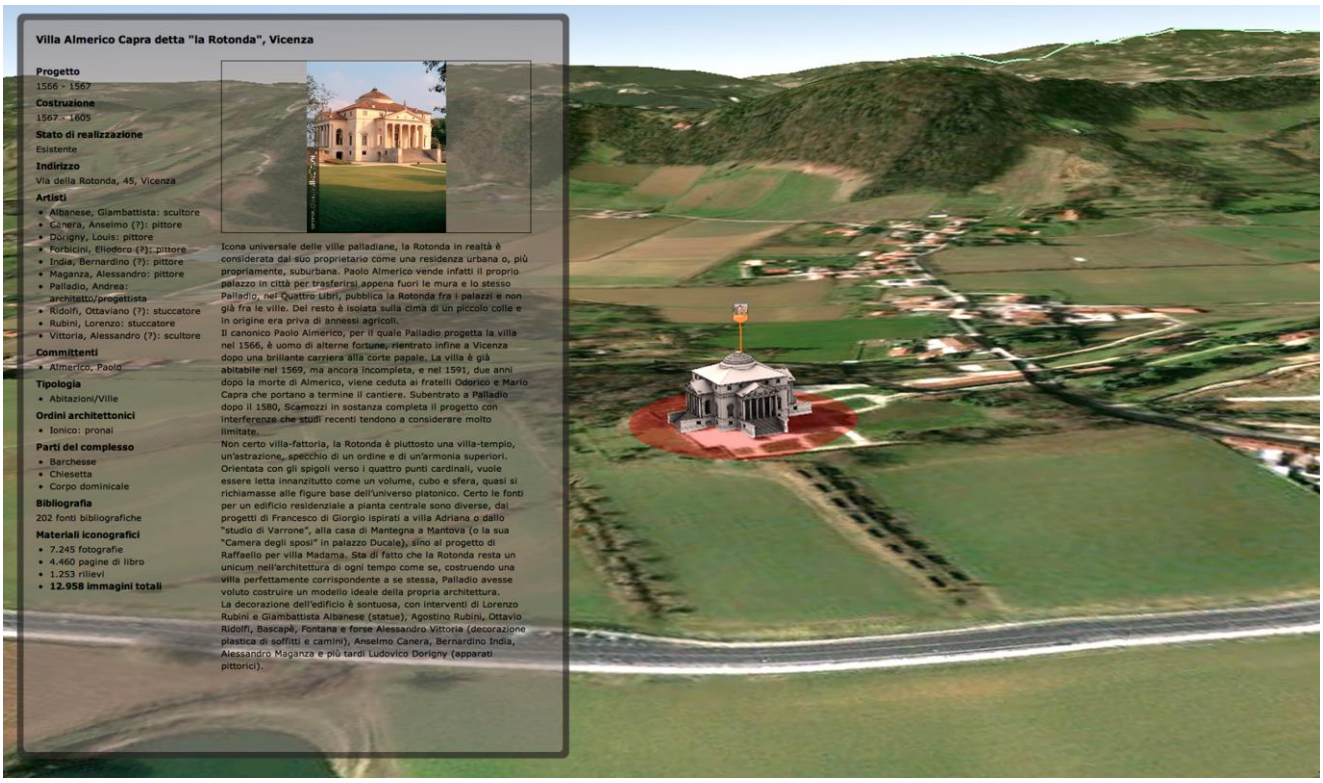

Fig. 9: *Andrea Palladio - 3D Geodatabase.* Interface with descriptive card of the building.

and, through GE, can select pages that contain other types of information (Figures 8-9).

3. *Analog & digital representation: two different faces of the same coin*

Born in Padua in 1508, son of a miller, Andrea di Pietro was not trained as a painter, like Bramante, Raphael, Peruzzi and Giulio Romano, or as sculptor, like Sansovino and Michelangelo, but as stonecutter in his native city and in Vicenza (Ackerman, 1972) (Burns, 1975) (Puppi & Battilotti, 2006) (Beltramini, 2008) (Beltramini & Burns, eds., 2008). Despite the name of 'architector', with which he was entitled for the first time in 1540, Palladio was not a king of liberal arts.However, he based his fortune on the ability to virtualize in few simple graphic patterns a complex and articulate way of constructing and authoring the real objects. This sophisticate technique allowed him to become the most influential and best-known Renaissance architect.

Its representative ability was in fact at the base of the reasons of its great success, comprising an original wide architectural production, with evident stylistic features and morphemes that have entirely connoted an era and a geographical area; a simple and clear theoretical construction exposed to a widely diffused text (*The Four Books of Architecture* first published in Venice in 1570, but with countless reprints and translations) and able to provide a system that can be easily replicated in space and time with few variations linked merely to regional phenomena and instances (Gaiani & Slossel, 2011).

As the title of the eminent Howard Burns essay *The creation of a systematic and communicable architecture* well clarifies (Burns, 2000) this system allowed Palladian architecture to be a subject of great interest in the first age of computer graphics and of the information digitalization.

The famous paper *The Palladian grammar* by Bill Mitchell and George Stiny (Stiny & Mitchell, 1978), fully explains the fact: "In this paper a first attempt is made to recast parts of Palladio's architectural grammar in a modern, generative form. The rules of a parametric shape grammar … that generates villa ground plans are specified. In many cases these rules are direct translations of Palladio's explicit canons of design; in others they

are based on examples of villa plans in the *Quattro Libri*. The grammar so defined generates the main features of most of Palladio's villa plans as drawn in the *Quattro Libri*."

A single common thread, consisting of an efficient and full of signifiers virtual system, seems to link the Palladio's design drawings, his treatise that together with the Sebastiano Serlio's previous one, introduces a real 'typographical revolution' aiming to communicate the architecture through the printed pages of a book, and finally the *PALLADIOLibrary*, also a virtual system allowing the knowledge of reality, of its way of being and of change and base of its management. How much it will be able to produce results, like old paper systems, is not known. Only history will provide us with an answer, but this, as we all know, has long times ....

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