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For the Fifth Centenary of the Ghetto in Venice: virtual transformations of architecture and city at the Doge's Palace

Per il Cinquecentenario della fondazione del Ghetto a Venezia: trasformazioni virtuali dell'architettura e della città in mostra a Palazzo Ducale

The first Jewish Ghetto was born in Venice five hundred years ago and for celebrating this important event an exhibition has been set at the Doge's Palace titled: *Venice, the Jews and Europe. 1516-2016*. The purpose of this exhibition was to represent the urban transformations of the Ghetto over time using digital technologies, in order to promote the understanding of the cultural heritage and let people know how much it is important to preserve, protect and enhance architecture.

Cinquecento anni fa nasceva a Venezia il primo Ghetto ebraico del mondo e, per celebrare l'importante avvenimento, è stata allestita a Palazzo Ducale una mostra intitolata Venezia, gli Ebrei e l'Europa. 1516-2016*. Lo scopo di questa esposizione era di raccontare le trasformazioni urbane del Ghetto avvenute nel tempo avvalendosi della potenza comunicativa offerta dalle tecnologie digitali, in modo da promuovere la comprensione del patrimonio culturale presso il pubblico ed estendere il più possibile la consapevolezza di quanto sia importante conservare, salvaguardare e valorizzare il bene architettonico.*

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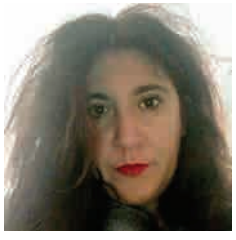

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key words: Ghetto, Venice, Virtual, Representation, Media

***parole chiave**: Ghetto, Venezia, Virtuale, Rappresentazione, Media*

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1. INTRODUCTION

After the League of Cambrai the political and social situation of Venice and its domains pushed many Jewish families to seek fortune in their capital. It was March 29th 1516 when, responding to public concern, the Republic decreed that the Jews had to live together occupying a specific area of the city that should have been closed at midnight [1]. With this law the first Jewish Ghetto in the world was officially born and after five hundred years, to celebrate this important event, an exhibition has been set at the Doge's Palace, it is titled *Venice, the Jews and Europe. 1516-2016* (June 19th – November 13th, 2016).
The exhibition, an initiative of the Committee for the 500th anniversary of the Ghetto in Venice, has been also organized with the support of the Civic Museum, the Jewish Museum of Venice, and David Berg, Venetian Heritage, Ugo and Olga Levi, Gladys Krieble Delmas and Save Venice Foundations. The curator, Donatella Calabi, relying on the experience of Studio Azzurro, wanted to create a virtual journey through time, made possible by the works of art (paintings, original documents and multimedia material) through which the visitor focus on the vertical architectural development of the Ghetto and its social composition. The exhibition is linked to everyday life and related to the cultural exchange between the Jewish minority and the city. In particular the digital outputs, available through the multimedia installations, have been realized by the experts of representation and the historians of architecture and city coming from the University of Padova and the Faculty of Architecture in Venice (IUAV).
The academic cooperation between these two institutions is not new, it started in 2010 thanks to an international research project titled *Visualizing Venice* (www.visualizingvenice.org), which also includes the participation of historians of architecture and visual studies coming from Duke University (NC, USA). The purpose of this research project is to spread out the urban transformations of the most significant places in Venice over time, using the communicative power of digital technologies, promoting the understanding of the cultural heritage among the public and extending as much as possible the awareness of the importance to preserve, protect and enhance architecture. Until now, the history of Venice has been studied by historians of architecture and city through the pages of books, but in *Visualizing Venice* and, specifically for the Ghetto project, the contribution of representation – that goes from digital survey of the metric data to 3D virtual models stratified over time, from the analysis of the architectural surfaces to their transformations – has led to an innovative approach that can bring out unusual findings on the lagoon city, promoting its culture in an engaging and scientifically correct way.
The Venetian exhibition is organized according to a path, formed by 11 rooms in Doge's apartment; any room corresponds to a specific section of the exhibition that follows a chronological order. For this important event the experts of representation of the University of Padova – Department ICEA (Civil Environmental and Architectural Engineering) – with the other members of *Visualizing Venice* and Studio Azzurro, have surveyed (laser scanner survey followed by a photogrammetric one) the Ghetto for the acquisition of a clone of the reality, considered an essential starting point for the virtual modeling of the buildings in their transformations, as well as a scientific basis for the comparison of reality with the documentation and historical maps [2]. The outcomes (point-clouds, video, BIM models, geo-referenced maps, projections, visualization of architectural and urban interpretations, elaborations of images, etc.) have been displayed in the Rooms 4 and 8, but they can be also experienced through a multimedia application called *Ghett/App*, that can be downloaded using a common device; this app is dedicated to the visit *in situ* of the Jewish Ghetto. Rooms 4 and 8 differ from the others because they have two *site-specific* technological devices, composed by horizontal and vertical surfaces, which receive the projections and videos; they are linked to interactive and touch-sensitive sensors, with which the visitor can relate directly and be guided towards an experience of the augmented reality. These installations, designed with Studio Azzurro, want to reach an artistic communication that ranges from technology and digital culture. According to a definition that the Lombard producers offer of their work; our scientific outcomes, created through the virtual reality, produce inside the Doge's Palace two *video-environments*; this term emphasizes the close relationship between the video, the physical environment and the viewer (LaRiCA 2006, 17).

2. ROOM 4 IN DOGE'S APARTMENT

Room 4 aims to highlight the social heterogeneity of the Ghetto and its relation with the urban design as result of the cohabitation between Jewish communities, different in languages, origin and backgrounds. The architectural themes mainly concern issues related to population density, internal fragmentation of buildings, growth in height, constructive peculiarities (reduction of the thickness of the external walls, steepness and length of the flights of stairs, low height of the ceilings), but there are also questions about daily life – marked by rituals and feasts – and about business development – the loan, the medical profession, the sale of used objects, the printing (not officially permitted but tolerated) –.
After dealing with some considerations around educational, scientific and touristic issues linked to Room 4, we addressed the problem of how to strengthen the observer's innate intuition which facilitates the understanding of the abstract concepts, deciding in the end to expose the analytical content through moving images (Frascolla, 1994, p. 40). To meet these requirements, it was appropriate to design a site specific, dynamic and immersive installation as support to the works of art and to the original archival documents; it is a virtual and physical 3D set useful to clarify the changes undergone by the Ghetto over time and to identify types and distribution of crafts and religious rites. The viewer's interactive approach stimulates the senses encouraging more empirical intuition; the aim was to start in the viewer an autonomous process of understanding, led by the dynamic relationship between the human senses and the virtual 3D objects. This way the attitude of passive observation, typical of the crystallized vision of the Renaissance, is outdated by more conscious considerations of the observer (Winston 2002; Staley 2014).
Technologically the exhibition machine in Room 4 consists of a horizontal table provided of touching sen-

ISSN 1828-5961

Fig. 1. Installation of the Room 4 in the Doge's apartment.

sors, which the visitor can interact directly. This table is in part occupied by a physical model, prototyped in chalk, which represents the current state of the Ghetto. A projector, in zenithal position, casts its light on the horizontal surface of the table to show the archival documents and the explanatory texts. It also casts on the chalk 3D model the images of the urban transformations, the typologies of buildings, the dissemination of crafts and the ritual activities. A vertical screen completes the installation and summarizes the outcomes coming from the analyzes, performed on the 3D virtual models, which have been created basing on historical sources and a digital survey, concerning a period of time extending from the foundation of the Ghetto to the end of the eighteenth century. The installation focuses on itself some salient issues that are fundamental to the understanding of the urban development of the Ghetto in Venice: the indication of its perimeters, the height of its buildings, the kind and distribution of the trades, the transformation and inner organization of some private and public palaces. Given the difficulty in explaining to a generic public this kind of information, the research team of Room 4 [3] has agreed with Studio Azzurro [4], to establish an interaction between the three devices of the installation – the horizontal surface, the 3D chalk model and the vertical screen –.

The aim was to guide the viewer's gaze, synchronizing the data so that they do not overlap each other (Fig. 1). To clarify the system and the philosophy of the installation, two examples are useful: the height of buildings, that grew up much more than in the urban context for the increasing Jewish population, forced to live in an area with established boundaries –; and the insights on the most significant architectures.

In the first case the visitor must select the command HIGHTS on the horizontal table, which has an interactive device sensitive to the touch, this command activate the projector that map on the chalk model the shadows of the buildings while changing over time; simultaneously, on the vertical screen, a section of the buildings, standing like silhouettes against a symbolic sun, simulates the growth upwards following a corresponding timeline; the same symbolic sun is ideally projecting the shadows on the chalk model too (Fig. 2).

In the second case related to the architectural analysis of some private buildings of the Ghetto, the issue was rather to indicate their position on the chalk physical model and simultaneously to display the historical documents on the horizontal surface of the table as well as to show on the vertical screen the transformations of the digital model. After selecting the command INSIGHTS on the horizontal table the visitor is invited to immerse himself in a virtual walk along *Calle del Ghetto Vecchio*, reproduced by a point-cloud on the vertical screen and displayed by a virtual camera; this camera replaces the viewer's gaze stopping on the building to be examined. At the same time a red light draws the path on the chalk model (Fig. 3), while a bright white halo shows the location of the building historical documents and explanatory texts materialize on the surface of the horizontal table. After highlighting the building, on the vertical screen the point cloud fades to let the observer see the 3D virtual model that shows the transformations that have occurred over time (Fig. 4) or to explain the inside of buildings, usually characterized by a distribution of interlocking floors, typical of Jewish Venetian homes and adopted to obtain more space.

This experience outlined how much the multidisciplinary confrontation in 3D modeling has been profitable. The case of the building settled just aside the bridge in *Ghetto Vecchio* can be considered a simple,

ISSN 1828-5961

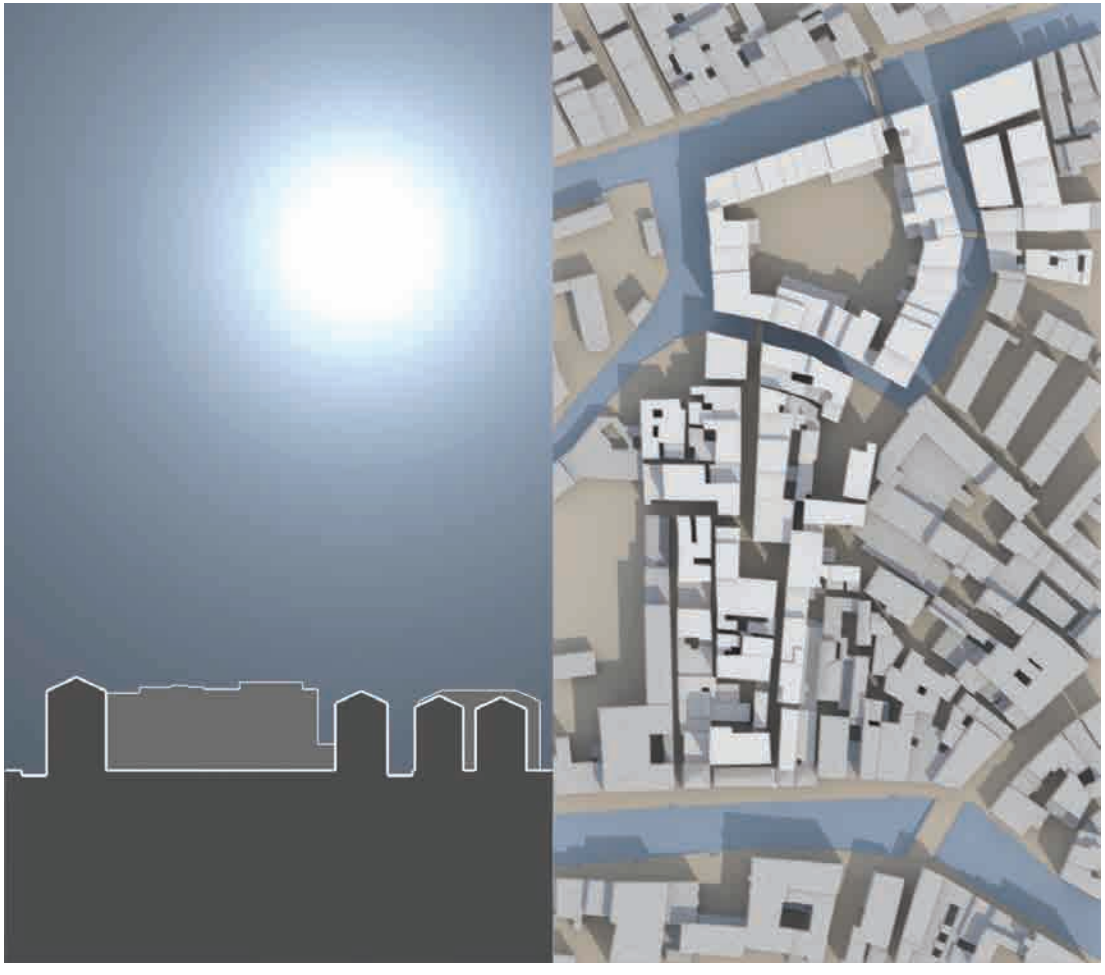

Fig. 2. Analysis of the heights of the buildings (left: section in the Ghetto Nuovo – vertical screen –; right: image of the shadows cast by the buildings on the ground – chalk model –). digital processing by P. Borin, C. Monteleone, A. Paja, F. Panarotto.

but clear, example of the problems of interpretation that occur when the researchers want to generate a 3D virtual model of architecture. The State Archive in Venice saves a drawing, dated July 12th 1767, which reproduces the facade of a building with triple lancet window and a strange structure, anchored to the palace and suspended over the Ghetto canal by poles; this hovering structure has the aim to extend in the empty space the building and takes in Venetian the name of *liagò* (Fig. 5). This drawing can be interpreted as a draft project of the façade and, because of its approximate nature, raises a question that relates to representation and specifically concerning the shape of the *liagò*. Having only an elevation and missing even a sketch of the plan, it is impossible to determine whether the *liagò* has a cylindrical shape topped by a conical roof, or a rectangular perimeter, covered by a three-pitched roof (considering the triangle of the roof in the drawing as the projection of the frontal pitch). The only way to dissolve the uncertainty in modeling the information contained in this document is to proceed over – as it has been done – by analogy, moving in the field of the architectural history. The most plausible solution – the one modelled – is the second, considering the perimeter of the *liagò* as rectangular, with a three pitched roof. The historical drawing has been mapped on the virtual 3D model to make it clear to visitors that the archival document refers to an existing building and the digital environment was not invented but reconstructed on the basis of an objective information (Fig. 6).

Room 4 has opened the door to the display of explanatory animations, establishing an empathetic contact, although virtual, between the observer and the first Ghetto settled in the world; this has been possible through simultaneous but ordered interaction between information that the eye receives and the brain processes (Wilson 2012). The collaboration between representation and history of architecture and city in this case rise a new and multidisciplinary insight about the Ghetto; the outcomes have been disseminated in an appropriate (Centofanti, Brusaporci, Lucchese 2014, 31-49) and clear way, crossing archival documents, text strings, point-clouds, virtual and physical 3D models as well as projections. The contribution made by Studio

ISSN 1828-5961

Azzurro to the spectacularization of the scientific data (Salter 2010) – pushing towards an artistic presentation of videos and virtual models with the aim to emphasize their communicative functions – this strategy has been decisive for the success of the video-ambient in the Room 4, encouraging to continue in this direction; it is significant the fact that elaborations, produced for this exhibition, can be in the future used for the management and the preservation of the architectural and cultural heritage in Venice (Centofanti, Brusaporci 2012, 1-10).

3. ROOM 8 IN DOGE'S APARTMENT

"L'anno 1797 segna la caduta della repubblica [...] L'apertura del Ghetto è tra gli episodi che riecheggiano nelle adunanze della nuova municipalità. Il 13 luglio 1797 se ne offre un breve resoconto tra gli applausi e il giubilo dei presenti: le porte che separavano gli ebrei dal resto della città furono rimosse dai loro cardini, trasportate nel campo del Ghetto Nuovo, calpestate e infine bruciate. Una «verde pianta» fu innalzata nello stesso campo a simboleggiare l'albero della libertà, segnando un nuovo destino per i cittadini lì residenti e per quella parte di città". With these words Alessandra Ferrighi introduces the contents exhibited in Room 8 at the Doge's apartment; this section is titled 'After the Ghetto' (Calabi 2016, 401) [5]. The multimedia installation takes the viewer to a critical reading of the historical documents, integrating the iconographic material with 3D models and video that facilitate the understanding of the critical conclusions. Also in this case representation, with the support of new technologies, plays a crucial and leading role, giving a new graphical look to the archival records. It, while preserving its scientific rigor, addresses to a less experienced audience, allowing a wider dissemination of the outcomes. The media files, summing up all the urban and architectural vicissitudes of the Ghetto from the beginning of the nineteenth century till the second world war period, are the instrument to test and control the data, useful to the preservation of the architectural heritage, representing also the principal communication link between the interpretations of the historians and the experts of representation and a new Cultural Tourism.

The virtual reconstruction, produced for the exhibition at Doge's palace, involves the whole area of the Jewish Ghetto in its three temporal variations settlement (Old, New and Contemporary) and reveals not only the transformation of this area, but also the architectural changes of its most emblematic buildings. The three canonical dimensions, associated to representation, are implemented by a fourth one: the time. The choice to represent, with a virtual 3D model, boundaries and buildings, in a specific historical period, can be considered a preamble to the architectural story: in fact, if on the one hand a clone of the reality crystallizes the geometry in a particular moment, on the other hand, it facilitates the visual comparison with the transformations that took place during the centuries. The link is the 'time', reified by a sequence of snapshots of the digital model taken from the same center of projection, pointing the forms that characterize a precise time of the Ghetto of Venice while changing over time.
Dealing with this kind of virtual models, it is unavoidable to face a series of problems that arise during the interpretation of archival data, the same happens when the information is transferred from a two-dimensional support (floor plans, elevations and sections) to a 3D configuration. The comparison of the three historic cadasters – appropriately referenced with GIS technology: Napoleonic (1816), Austrian (1838) and Italian (1886) ones – made it possible to extrapolate some thematic maps useful to analyze a series of anthropogenic interventions, that have shaped the Ghetto as it appears today. In particular, comparing the geo-referenced maps, it is possible to recognize the configuration of perimeters, roads and waterways, but, above all, to distinguish the more recent buildings from the lost volumes or to recognize those that maintained a constant presence in the area; however, in some cases, they present some structural or configuration changes. The digital reconstruction in a BIM environment not only considers all these aspects, querying the most recent maps, but integrates the planar and spatial information with objective data obtained through a digital survey of the Ghetto, that made us able to model the elevations of the most significant buildings that face along *Calle del Ghetto Vecchio* or *Campo del Ghetto Nuovo*.

Fig. 3. The projection of the path with a red light on the chalk model (see the white halos on the buildings studied in detail).

ISSN 1828-5961

Fig. 4. Historical reconstruction coming from an archival document of a building in Campo del Ghetto Nuovo (left: mapping of the drawing on the model – vertical screen –; right: image of the path and the location of the building – chalk model –). Digital processing by P. Borin, C. Monteleone, A. Paja, F. Panarotto.

So the 3D model constitutes the starting point to which we have applied the methodology for the study of architecture established in *Visualizing Venice*. This academic approach articulates back in time collecting the changes on a clone of the reality representative of the *status quo*, this strategy has provided unpublished outcomes. The 3D digital model changes over time basing on the interpretations of historical documents, integrated with objective data, so that it leads to an innovative display of the transformations; this virtual experience is much more immersive for the audience and makes clear the understanding of the three significant historical moments of the urban and architectural layout of the Ghetto.

The *storyboard* of the video, agreed with the members of *Visualizing Venice* and Studio Azzurro, aims to the interaction between the visitor and the multimedia material. This is why we have used a touch-screen technology with which the user is able to decide by himself the data that he wants to query. The video opens with a fire burning, that evokes the destruction of the Ghetto gates: this historical episode has a dual symbolic meaning, indeed, if on one hand the fire destroys the limits to the area, on the other, it metaphorically allows the elimination of cultural barriers, giving back the citizens the land subtracted, and starting the peaceful coexistence between the Jewish minority and the majority of Catholic Venetians. Symbolically this episode removed the boundaries, and the observer can decide how to continue the story simply touching one of the options that appears on the interactive screen; he becomes responsible for the development of his own knowledge. The available alternatives are dictated by the ability of the visitor to query thematically and chronologically the archival and media documentation about the New, Old and Contemporary Ghetto. In each section it is possible to view a video produced by a virtual camera, that replaces the observer's eye; it starts from one zenithal view of the *status quo* and moves inside the Ghetto (Fig. 7): this simple device provides the visitors a comprehensive view of the Ghetto in reference to the urban context and made it possible to switch from the overview to a single architectonical reality. Indeed, the final position of the camera frames a representative building to show the changes over time starting from the Ghetto at the current situation and

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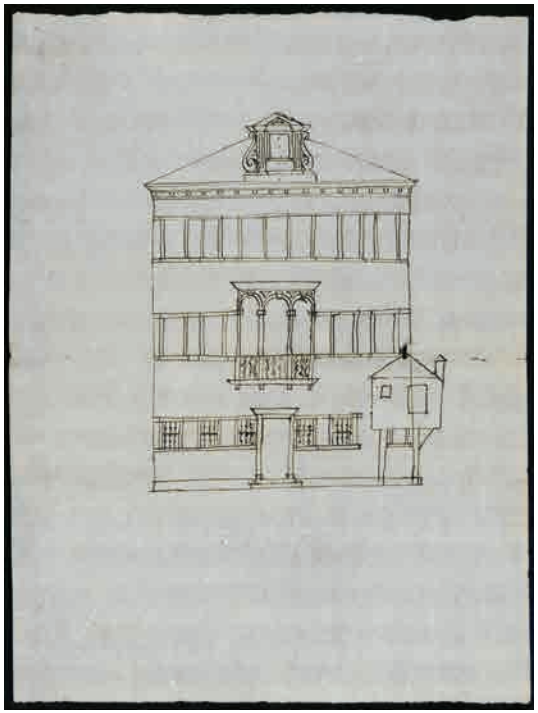

Fig. 5. Building in Calle del Ghetto Vecchio, July 12th, 1767, Archivio di Stato di Venezia.

Fig. 6. Historical reconstruction coming from the archival document of the building in Calle del Ghetto Vecchio (left: mapping of the drawing on the model – vertical screen –; right: image of the path and the location of the building – chalk model –). Digital processing by P. Borin, C. Monteleone, A. Paja, F. Panarotto.

ISSN 1828-5961

displaying its conditions referred to the three cadasters (Figg. 8-9).

4. HIERARCHY OF ARCHITECTURAL DATA AND NEW COMMUNICATION TOOLS

3D models, created for the representation of the history of a place, consist of geo-referenced entities and, more often, these three-dimensional reconstructions of the architecture are associated to a virtual geographical system (GIS) in which the buildings are located thanks to common spatial coordinates (Dore, Murphy 2012, 369-376). We approached the work on the exhibition titled *Venice, the Jews and Europe. 1516-2016* as a natural extension of the international project named Visualizing Venice. This work has the aim of creating a system that allows us to analyze and visualize the historical transformations of a place. The work refers to the area of the Jewish Ghetto in Venice and proposes to represent its architectural peculiarity, both at urban and architectural levels (where historical documentation is available). For the development of our system, considering this prime purpose, we decided to introduce, beside the three spatial coordinates (x, y and z) that manage the geometry and position of the objects, a forth coordinate: the temporal dimension. In the adopted GIS and BIM systems, the capacity to manage a multiple type of information, that virtually represent the characteristics of a building, is intrinsic; the same happens for all kind of data that form a heterogeneous system of multidisciplinary computerization. The management of the temporal phases in BIM/GIS systems allows to define the presence of an object in the created virtual spatial-temporal space, linking to every modelled element a level of creation and demolition. So, assigning to every element two temporal coordinates (the beginning and the end), inasmuch as these parameters are inserted in a relational structure with other objects, a simulated condition of change is generated, both at urban and architectural level. To realize this system, we adopted a historical documentation that covers the whole development cycle of the Ghetto.
As previously described, the management system of the GIS graphical information is linked to the modelling of the building BIM since many years (Mingucci, Muzzarelli, Bravo, Garagnani 2013, pp.11-12). The system, created for the exhibition at the Doge's Palace, implements the same kind of structure and collaborative interaction between the two tools. The GIS and BIM system adopt a common methodology of information management and partly refer to common data, but they are implemented at a different level of detail, involving the geometries as well their contents. This is why the methodological structure is composed by a complex system of management of multi-scale information and, for this reason it is fundamental to identify which is the information to transfer from one tool to the other, as well as to evaluate the relative scale of conversion (Fig. 10). The territorial elements, that compose the urban scale of the GIS (such as rivers, roads, squares – or for Venice canals, *calli* and *campi*) and buildings that are reported in BIM, change their shape saving the same spatial-temporal conditions within the system. The change from one environment to another is not only constituted by a conversion of two-dimensional objects in three-dimensional ones, the acquisition of the third dimension provides more value that make us able to reach a specific understanding within the context of touristic divulgation as well as to formulate a correct evaluation of the contents to assign to the elements; for example, in the representation of the Ghetto at urban level the visualization of the architectural elements such as window frames are not interesting.
The two systems GIS and BIM work well if they are adopted separately, but present several drawbacks when connected. These problems are mainly due to the scale of conversion and to the data transfer. What we can be consider a further development is the implementation of a standardized and automated procedure within the system that manages the communication between the two systems. The reason is that much of the information that can be referred to the Ghetto in Venice are still manually inserted. In such improved scenery, the creation of an automatic feature would allow to modify a parameter in the two systems at the same time. This challenge can be managed today externally by a relational database that would guarantee an easy interaction between the two standards, encoding the information in each system (CityGML, IFC). To make a concrete example of such an approach, we can consider the data related to the heights of the gutters, utilized in the creation of the three dimensional models of the Ghetto buildings: this data is contained in the *Carta Tecnica Comunale*, managed by a GIS system and transferred to the BIM environment. If the value of a parameter is modified in the BIM environment, the corresponding parameter in the GIS system is automatically modified. For this exhibition the 3D models have been developed as a bidirectional and reversible system of automatic communication between the two informational environments.
The necessity of reproducing the reality both of the present and the past, with the purpose to make the visitor comprehend the transformations of the urban fabric of the Ghetto, has driven the development of our virtual environment. The conceptualized digital world does not intend to simulate the real spatial-temporal conditions but is shaped as a sort of super-reality, characterized by physical conditions, managed with the criteria formulated by the expert that has conceived the system. This way, the tool is shaped with added features that allow the visitor to perceive a totally new experience. An example of such augmented reality is the possibility (offered to the visitors of the exhibition at Doge's Palace) to visualize virtual points of view, obtained by paths that would not be followed in the real world (such as a bird's eye-view).
The generated virtual environments (spatially correlated) are two: one is the point-cloud of the Ghetto, the second is the three dimensional models of buildings. Architecture and urban space are created by the combined GIS/BIM systems (Fig. 11), adopting a temporal coordinate that allows to manage the changes over time. Such virtual environments are audio-visual tools for divulgation, configuring themselves as virtual guides. Indeed, it was important to filter and to canalize the information, considered as relevant for the communicative purpose.
The 3D models of the Venice Ghetto are configured as a composed container of a substantial amount of data. This constitutes a remarkable value compared to the typical instruments adopted by the historians of the city and architecture. However, this can present some

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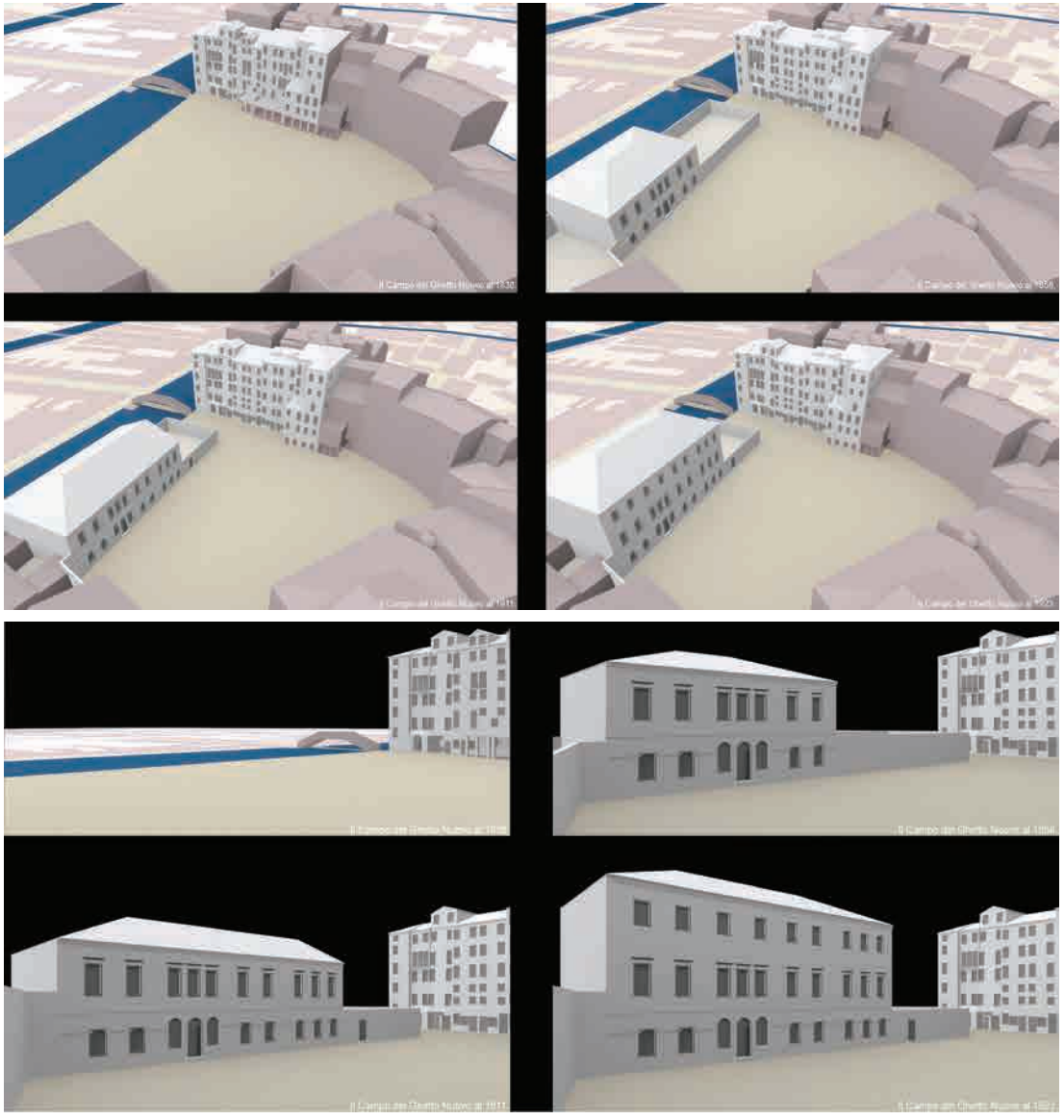

Fig. 7. Map of the Jewish Ghetto. Current situation, in evidence the buildings of the Ghetto Nuovo and their transformations. Digital processing by P. Borin, I. Friso, A. Paja, F. Panarotto.

Fig. 8. Campo del Ghetto Nuovo. Main changes from 1838 to 1911. Digital processing by P. Borin, I. Friso, A. Paja, F. Panarotto.

Fig. 9. Campo del Ghetto Nuovo. Main changes of the Casa d'Industria Israelitica from 1838 to 1911 and the eastern buildings. Digital processing by P. Borin, I. Friso, A. Paja, F. Panarotto.

ISSN 1828-5961

drawback, considering that the average user does not have the capacity and the knowledge to organize and correctly comprehend the information autonomously. This is the main problem to afford in a traditional museum and the phenomenon is even amplified by the great amount of information produced by new digital technologies (Giordano 2015, pp.48-51). The videos, realized for Rooms 4 and 8, are then composed by guiding paths that move along 3D BIM/GIS models. These models guide the visitor within the virtual space in the understanding of the cultural heritage.

5. CONCLUSIONS

The approach for studying the Ghetto in Venice demonstrate that it is possible to go far beyond the limits of space and time thanks to ICT (Information and Communications Technology). New technologies make us able to create 3D models full of data useful for the dynamic analysis of urban and architectural transformations, enclosing categories like time, sound, and so on. The wide range of possibilities offered by digital tools, used for the exhibition *Venice, the Jews and Europe. 1516-2016*, overlaps the 3D models considered like platforms on which it is possible to load not only the formal datum but also many other information, organized and selected for the visualization and dissemination of the Cultural Heritage (Brusaporci, Centofanti, Continenza, Trizio 2012, 315-322). But it should be noted that an accurate and interactive description of a building or an urban area does not necessarily lead to the understanding of the historical reasons that have influenced changes over time. The technologies – similar to pencil, ruler and compass of the past – became at Doge's Palace a powerful means of knowledge, because the produced digital models are based on the readings of the historians of architecture and the experts of representation. The intersection between these two disciplines produced a unique development of synthesis, through which the experienced researchers tried to delete in the virtual world the redundant data that usually can be find in the original documents or in the existing reality, to vehicle the essence of the message. This important work has been carried always maintaining as ultimate aim the historical roots that have influenced the architectural and urban transformations.

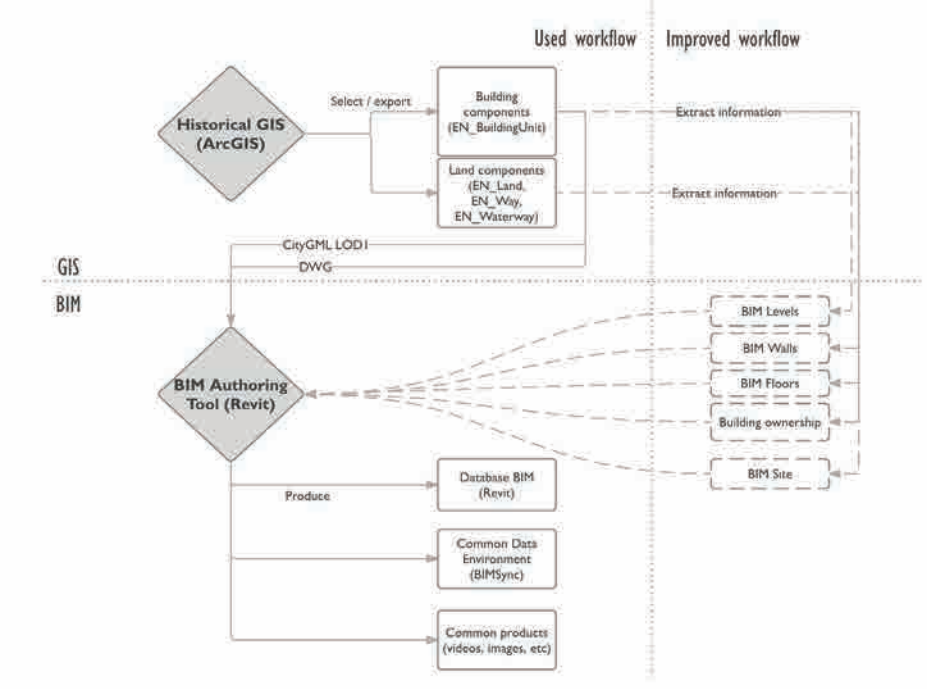

Fig. 10. Organization Model and BIM workflow. Scheme by P. Borin.

One of the most innovative aspect of the digital technologies, for the exhibition at the Doge's palace, is the consciousness that the speculative thought of scholars cannot express completely if, for adapting itself to the two-dimensional world, that normally characterizes the historical documents, it gets rid the body and, consequently, the 3D perceptions. The sense of this work is to overcome the idea of cognitive functions, crystallized exclusively on language and still images. New digital drawings, animations and models, contribute to a mental representation of a three-dimensional space that is no longer static, but based on the action, although it is just a virtual dynamism. When an observer is forced to a confrontation with the 2D world of documentary abstraction many securities weaken. In this sense augmented and virtual realities are an extraordinary help for scholars and visitors, because they generate an immaterial space, able to thin the distance between abstract and concrete world, enhancing the relation between the original documents in the museum and the video. This strategy of representation presses the observer to reconnect the narrative references involving the real world as well as its artificial interpretation (Studio Azzurro 1999).

The historical and urban transformation over time, dynamically expressed, act as facilitators of scientific – also complex – concepts, dipping the user in simulative virtual activities that stimulate the sense of movement, the only one able to anticipate what is going to happen in the reality (Haydn 2013). It is now established that the cognitive faculties have been refined thanks to the

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movement, according to evolutionary processes related to the dynamic perception of the world, that push the observer to adapt its behavior to an environment in perpetual motion. This attitude of thinking, which measures and outlines the movement, does not just act as the initial basis of thoughts but follows them in their development through the representation of the objects immersed in the imagined space (Berthoz, 1998; Negrotti 2012). When in the Renaissance Leonardo compares the world of representation with that of writing, claiming the supremacy of the image over the word, he comes to consider the communicative skills of painting as a mute poetry, because images are able to touch the senses and to make known the facts at a glance. Conversely, he defines poetry a blind painting, that is, a mental image formed created listening to the slow succession of words (Leonardo da Vinci 1982, 16). Today drawing and representation walk with history of architecture in all phases so that the traditional dichotomy that sees the opposition between painting (representation) and poetry (writing/history) is finally overcome, because the 3D modeling of architecture and the city allows us to generate real speaking images in a virtual multidimensional and always changing world.

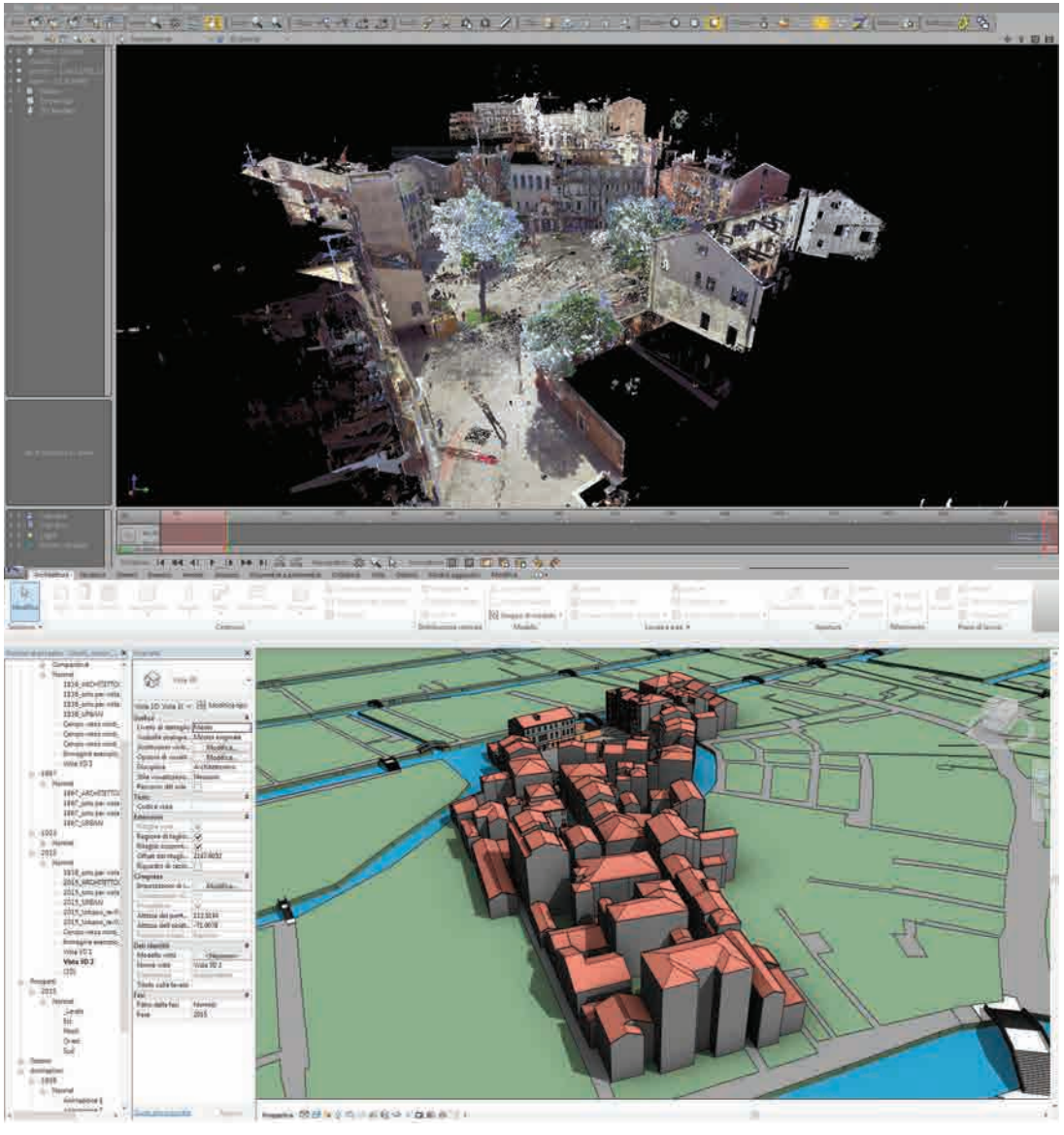

Fig. 11. Virtual environments of the models and video management. Digital processing by P. Borin, F. Panarotto.

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NOTES

Cosimo Monteleone wrote paragraphs 1, 2 and 5; Isabella Friso wrote paragraph 3 and Federico Panarotto wrote paragraph 4.

[1] ASVe, Senato terra, reg. 19, cc. 95r-96r; cfr. Calabi D., Venezia gli Ebrei e l'Europa. 1516-2016, Exhibition catalog (Doge's Palace, Venice June 19th-November 13th 2016), Venezia: Marsilio 2016, pp. 104-109.

[2] A. Paja, Il passaggio di informazioni per l'interpretazione e l'analisi urbana e architettonica. Rilievo e modellazione del Ghetto Nuovo di Venezia, Degree Thesis in Architectural Engineering, University of Padova, a. y. 2015-2016; supervisors: A. Giordano, A. Ferrighi, correlator: P. Borin.

[3] The archive documents and historical content of this installation have been delivered and formulated by Ludovica
Galeazzo, Postdoctoral Associate in History of Architecture at Duke University; while the analysis of archival drawings, the 3D virtual models of the point-cloud, the animations and the digital reconstructions are by Paolo Borin, Federico Panarotto and Cosimo Monteleone.

[4] the members of Studio Azzurro that designed the exhibition and that technologically collaborated in its realization are: Leonardo Sangiorgi, Olivia Demuro e Matteo Tora Cellini.

[5] Alessandra Ferrighi is researcher of History of Architecture at IUAV in Venice; the production of the 3D virtual models, the animations and the reconstructions displayed in Room 8 are due to Paolo Borin, Federico Panarotto e Isabella Friso.

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