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From historical maps to digital technologies: the visualisation of the Venetian Ghetto's history

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Summary: During the last decades, the development of new digital technologies improved research methodologies as well as furthering historical iconography and cartographic representation studies. Moreover, the multidisciplinary approach based on different disciplines of knowledge (history, cartography, computer graphics and sciences) enabled the development of new digital tools for the preservation of and access to the cultural heritage.

During the last year, the Cartography and GIS Lab of the Iuav University of Venice has been involved in the development of an exhibition entitled *Venice, the Jews and Europe (1516-2016)*, designed by the VISU research's group with the collaboration of the MuVe Foundation and the Jewish Community of Venice, to be hosted at the Ducal Palace of Venice. The project offered the opportunity to study the history of the Venetian Jewish Community in a new perspective: cartography was used as a fundamental tool for analysing the urban transformation of the Venetian Ghetto over time.

The present paper introduces some of the case studies displayed in the Ducal Palace exhibition. Working with heterogeneous data from different sources and epochs required an information management tool with the ability to relate data together. Since the beginning of the research, a Geographical Information System (GIS) was employed in order to manage metrical and geographical data in their evolutions in space and time. Thanks to this procedure, it was possible to analyse different historical phases of the Venetian Ghetto and to study the volumetric development with the 3D reconstruction of digital urban models.

Moreover, the project offered the opportunity to test different means of communication: multimedia and interactive installations were planned in order to disseminate knowledge to the general public. In particular, video animations and 3D mapping on a prototyped model allowed to dynamically describing the history and the urban transformation of the Venetian Ghetto.

Introduction

In 2016 took was the 500th anniversary of the first Jewish Ghetto in Venice. In this occasion several national and international institutions supported the research around the Venetian Ghetto case study that has led to a number interesting arguments. Starting in 2013, the Department of Innovation and Technology of the Veneto Region funded the VISU research on the *Urban space visualization*.

In view of the 500th anniversary Donatella Calabi, who studied for long the city history and also the Ghetto area (Calabi, 1991), together with a group of historians and the team of the Iuav Laboratory System, guided by Francesco Guerra, devoted a significant part of the VISU research project to reanalyse and visualize the Ghetto urban space during its different historical phases. The very next archival investigation brought in light a number of new documents. Those historical data, taken from the written sources, thanks to the new technologies have been visualized and made accessible to a wide audience. The results of this research have been the *files rouge* of the international exhibition *Venice, the Jews and Europe (1516-2016)* that took place in the Ducal Palace in Venice last year (Calabi, 2016).

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This research increased the idea of the deep link of sense between the social, economical and urban history of Venice and the development of the Ghetto area. Now, the historiographical debate on the significance of Ghetto has opened to debate supporting different point of views, sometimes opposite.

What we proposed here, is the idea of the Venetian Ghetto as part of urban strategy of welcoming immigrants implemented by the *Serenissima* Republic. The *Serenissima* offered to the newcomers several guarantees, but at the same time practiced over all the foreign and religious communities a more or less strict surveillance. All foreigners were valuable because of their economic activities, and the Jews especially were precious to the *Serenissima*. The long history of Venetian Jews, 500 years long, showed the deep relationships and similarities with the rest of the population, and supported the concept of the Ghetto as an integrated part of the city's history.

Since the beginning of this research, in front of the absence of iconographic documents, the historians have felt the necessity to visualize the results of the research. An emblematic example is the English historian, Cecil Roth, who by publishing the results of his studies on the Venetian Ghetto opened formally a new front in the relevant historiography (Roth, 1930). Roth first during the Twenties has sifted the Venetian archival sources. He advanced a really refined analysis of the history of the Jews in Venice under several aspects: cultural, social and political. Roth has framed the Ghetto area not only as a place of segregation, but also as the humus of the cultural blooming, thanks to the dynamic of relationship between the Jewish minority and the *Serenissima*.

Even if the Roth investigation was not specifically related with the urban and architectonic history of the Ghetto, he conceived the need to show the area in order to conduct visually his readers across the history of the district.

Roth during his stay in Venice met several exponents of the Jewish community among whom Gino Luzzatto, Adolfo Ottolenghi and the engineer and architect Guido Costante Sullam. To him Roth addressed a consult in the February of 1930: «*I am writing as first the history of the Jews in Venice: a volume a little bit ambitious, [...] where I do the complete picture of the Ghetto life. In order to this scope I need a detailed map of the Ghetto and of the immediate surroundings to be reproduced in the volume. Even if I were in Venice (I do not have the possibility to come for a very long time) this work would be really impossible for me. So I propose to you a Venetian, [...] lover of Veneto's things and Jewish with the hope that you will be so kind to help me. [...]*»¹

Sullam welcomed Roth's request and he conducted a research on historical maps kept at the Library of the Correr Museum. He produced a map of the three ghettos with main places of the area that became part of Ghetto's cartographic patrimony.

Building on the same cartographic research conducted by Sullam in 1930 in the Venetian archives, but aided by modern technology, the research group formed by prominent historians and experts in cartography and photogrammetry, we used the historical iconography of the area to realize a Ghetto multimedia image, integrated with different typology of contents.

The curatorial project of the exhibition, *Venice, the Jews and Europe (1516-2016)*, proposed to the research team the challenge of presenting the most complex historical contents using video to tell the Ghetto's history in a clear way to the general public.

¹ Jewish Community Archive Renato Maestro, Venice, Guido Costante Sullam legacy

Geomatic tools in urban studies and representations

The last decades witnessed an exponential growth of digital technologies, whose employment fundamentally contributed to the conservation, preservation and dissemination of the cultural heritage.

Geomatics and ICTs,² promote the analysis of complex aspects and topics from different points of view, while enabling public access to the cultural heritage thanks to the development of multi-media applications. The analysis of historical maps allowed defining the starting point for the project presented in this paper.

The most up to date geomatics techniques offer an efficient tool to answer a growing request to recovery and enhance the so called “cartographic legacy”: thanks to these tools and techniques, historical maps with their metric, semantic and symbolic contents can be digitized and further elaborated and analysed (Gatta, 2010; Ceregato et al., 2014; Balletti et al., 2016a).

The present paper suggests a methodology for the analysis of historical cartographic data through a scientific procedure for data processing and analysis, developed in support to a multi-disciplinary study of the urban evolution of the Venetian Ghetto.

The project focused on two typologies of final products: on the one hand, the development of three-dimensional models from a set of seamless historical maps, on the other hand, the video animation where the cartographic elaboration, together with high-resolution images and textual images, became the basis for a highly communicative narrative.

Once digitized, the historical cartographic dataset can be related to contemporary maps through a geo-referencing process, in order to allow further analysis and considerations on eventual spatial modifications through time. Hence, the historical maps used in this project have been geo-referenced in relation to a current cartographic reference system. Depending on the map employed, it is necessary to select the most appropriate projection system and geodetic datum: in our case, as the maps were to be geo-referenced on the urban pattern of the lagoon city, the maps were geo-referenced on the Roma40 geodetic Datum with the reference ellipsoid oriented to Monte Mario, associated to the Gauss-Boaga map projection.

The geo-referencing operations and the transforming model need to be chosen on a case by case basis; as a result, it is impossible to determine a standard procedure and it is instead necessary to precisely examine each individual case study and to act accordingly. Also, the quantity and quality of the retrieved information required the implementation of data into a Geographical Information System (GIS), in this case an Historical GIS (HGIS), where heterogeneous information deriving from different historical sources and periods could be related in a way that enables in-depth queries and analysis (Barzaghi et al., 2012; Carrion et al., 2013).

Although multi-disciplinary collaborations in the humanities are gaining momentum, at least in Italy, GIS platforms are still slightly exploited. With this said, we are not prompting the GIS as an alternative tool for historical research, rather we would like to stress the value of complementary methodologies in support to the more traditional ones. In this direction, geomatics can offer a support for different kinds of analysis such as, precisely, historical studies (Gregory et al., 2007; Rinaudo et al., 2007; Gatta et al., 2016).

The GIS technology offers great advantages for the documentation and preservation of the cultural heritage; the in-depth understanding of a phenomenon, particularly in the architectonic and cartographic fields, require a thorough knowledge of the past; databases and GIS allow to

² Information and Communication Technologies

elaborate and analyse acquired data, to share researches and information in digital format, hence enabling future elaborations.

The multi-disciplinary approach of this project allowed to better analysing a complex case study, such as the Venetian Ghetto; from this viewpoint, historical cartography, together with archival sources such as written text and drawings, acted as a starting point to analyse transformation occurred through time.

The data acquired through archival research has been organized in a platform structured on the basis of typological relations, allowing further queries and re-elaborations; the platform used in the present project has been ArcGIS by ESRI, both for the geo-referencing phase and the bi-dimensional processing of data (ArcMap) as well as for the three-dimensional modelling (ArcScene).

From historical maps to city models

In the framework of the exhibition dedicated to the fifth centenary of the foundation of the Venetian Ghetto, a pivotal role has been ascribed by the representation of its urban and architectural features over time. In particular, one of the aims of the research was to offer an insight into the history of this important settlement created by the Republic in 1516, focusing on the way it grew within itself, on its architecture, the social makeup, as well as on the crafts and trades and its material life. The Ghetto represented a city within the city, as has often been pointed out, an area which was completely self-sufficient and autonomous. Within its precincts, Jews of different nations gradually established the social and economic structures vital to community life. On this basis, the research wanted to uncover the urban transformations, as well as the everyday life activities developed within the area. For this reason attention has been devoted not only to the principal buildings that characterized the settlement (in particular the five synagogues), but also to the overall urban fabric, to the relationships existing between its buildings and open spaces, between public and private sites, as wells as between interior and exterior spaces. The goal of this project has therefore been to address these questions through a hypothetical reconstruction of the site's changes and layerings over time based on the information derived from cartographic and archival sources.

Despite the importance of this particular settlement within the city, our understanding of how it looked over time and how it functioned is still somewhat limited. This is the result of a lack of any substantial iconographic documentation for this specific part of the city. Unlike the significant quantity of textual documentation covering the long period of existence of the Ghetto, little remains today at a level of its representation to describe the configuration of the area. Apart from a few 19th century maps of the city, the visual memory relies mostly on some technical drawings produced by the various magistrates of the Republic during the regular inspections of damaged buildings. In addition, today there is a lack of incontrovertible material evidence. The significant interventions made between the 19th and 20th centuries make any close reading of the urban fabric problematic.

In order to trace changes over time, the first step of the research project was the systematic collection of all archival sources, whether textual or visual, that could delineate any urban or building transformation. This content had been classified into ten significant periods representing points in the Ghetto's evolution over time. They have been analysed working backwards in time, starting with the present day and going back until the establishment of the Ghetto (the chosen reference points were 2016, 1913, 1842, 1808, 1797, 1770, 1739, 1712, 1661, 1516).

Among this documentation, the three historical cadastres of the city (Napoleonic 1808-11; Austrian 1838-42; and Austro-Italian 1867-1913) were particularly important because they enabled us to understand major interventions into the urban fabric. Indeed, the Napoleonic cadastre was fundamental for determining the appearance of the Ghetto a decade after its abolition, before significant restoration activities took place. Moreover, it was instrumental for mapping the social life of the settlement. Its *sommario* (the document that lists the owners and their property's extents) provided the full list of families living in the area. This documentation has been subsequently linked to the register of residents made by Saul Levi Mortera between late June and early October of 1797, in order to reconstruct the status of the Jewish Ghetto before the opening of the gates.

The iconographic sources were digitized and then geo-referenced with Esri's program Arcmap on the city's technical map base. The cartographic data of the "Comune di Venezia" (ITB) has been used as the vectorial system of reference, based on the Roma40 geodetic Datum. The above-mentioned cartographic data has the 1:2000 nominal scale, while in the historical centre of Venice reaches a precision of 10 cm, generally associated with the 1:500 scale.

A series of tests have been produced in order to choose the most suitable global plane transformation, according to the map's typology; the most used has been the affine transformation. This type of transformation uses the first order polynomial function applied to control points, with the subsequent application of a least square adjustment. The transformation has global value.

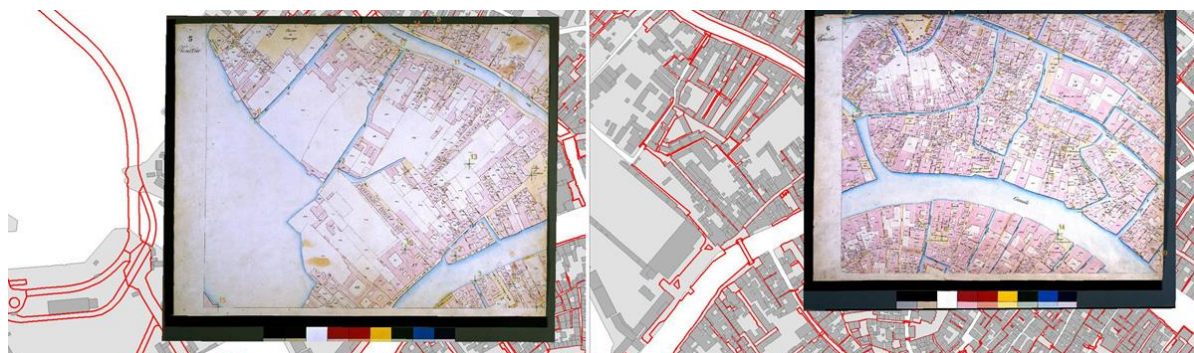


Figure 1. Two georeferenced maps of the Napoleonic cadastre with respect to the actual cartography.

The new images were interpreted and redrawn in layers (islands, canals, buildings, and walkways), working backwards in time and constantly comparing the data obtained from the previous historical phase.

For the former centuries characterized by the lack of documentation with such characteristics, the research has mainly focused on textual sources, but later implemented also by partial maps and drawings. One of the most effective instruments for assessing properties and income was property surveys (*catastici*). Divided by district (*sestiere*) and then by neighbourhood (*contrada*) or parish, these systematic field surveys were ordered by the magistrates responsible for city finances (*Dieci savi alle decime*) contemporaneously with the general censuses (*redecime*) deliberated by the Venetian Senate in 1661, 1711–3 and 1739–40. Filling in part the documentary gap in graphical terms, this documentation gave us an invaluable account of the architectural growth, the development of the floors, as well as of every building solution adopted to meet the urgent demand for space. Thanks to this particular attribute dataset, information related to the height of the buildings or to their uses (residential or commercial activities) has been associated with the

GIS shapes derived from the iconographic sources. This systematic procedure has allowed us to physically compare buildings over time.

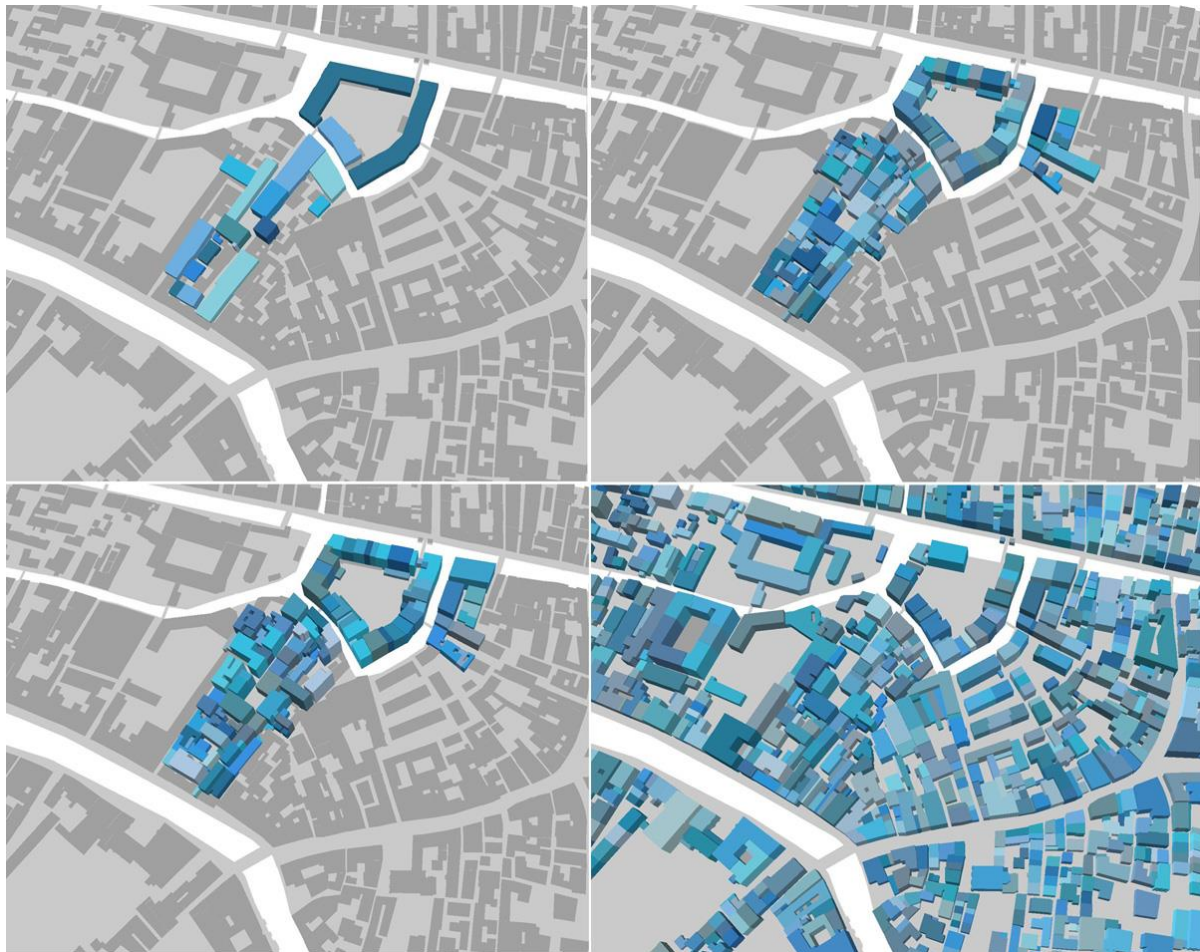


Figure 2. Some of the most significant formation of three ghettos (from the top: 1516, 1661, 1797, 2016).

The next step in the research workflow was to create the three-dimensional models, which were drawn on the basis of the two-dimensional maps and information from other historical sources (in particular thanks to technical drawings mentioned, and archival data). Later these representations were associated with the economical data provided by the historical tax sources. In particular, attention was focused on mapping the several shops (second-hand clothiers sellers, bakers, greengrocers, and butchers) and commercial activities (banks), but also places such as inns and hospitals for the poor, which once characterized the life of the Jewish settlement. This enabled us to create particular ‘thematic’ maps and models thanks to which we could look simultaneously at the architectural and social aspects of the Ghetto, as well as experience the history of this past place in all its complexity.



Figure 3. Social structure of the Ghetto in 1661.

New technologies for the development of museum cognitive itineraries

The exhibition *Venice, the Jews and Europe (1516-2016)* were imagined as a museum display with a strong disseminative character. This fact poses several levels of criticality when choosing the best communicative meter to be employed, in order to enable access to the documentary heritage by the widest sectors of the general public. In order to convey a more effective narrative, it is necessary a strong collaboration between diverse disciplinary sectors and a reconsideration of the communication techniques.

The traditional display, comprehensive of artworks and masterpieces, has been placed side by side with itineraries based on multi-media, even interactive, intended as a support to the display

narrative; for this reason, each exhibition room has been equipped with electronic systems and devices, monitors, touch screens and interactive devices.

Another main issue conditioning an exhibition focused on historical research-based themes is represented by the presence of documents of a high semantic value, which, nonetheless, risk appearing self-referential and of a limited communicative power. To this end, the two following paragraphs attempt to stress the mutual interplay between historical materials and museum storytelling language required to enable a memorable visitor experience.

The interactive multi-media communication, developed during the present project, aims to attract visitor attention, in order to place him/her at the centre and as integral part of the dissemination and learning process implicit in the exhibition's itinerary.

Therefore, visitors do not stand as simple and passive viewers of documents and objects previously selected, instead, they are empowered to interact with the displayed documents, previously and conveniently digitized or materially replicated in order to preserve the originals.

For the Ducal Palace exhibition, two different multi-media applications have been produced, where maps played the role of narrative aid for the dissemination of historical contents; first, "*Exoduses Communities Ghettos*" maintained a broader geographical focus explaining Jewish migrations and the development of the Italian and Venetian Ghettos, while the second contribution "*Venetie MD*" shows the existence within the North Adriatic city of different foreign communities, among the others the Jewish community, stressing once again the cosmopolitan character of the Venetian town.

Exoduses Communities Ghettos

A prerequisite to clearly describe the establishment of the Jewish quarter in Venice lays on the ability to delineate, through a simplified narrative, the historical, political, social and cultural events producing the migrations and subsequent settlement of several Jewish families in Venice and Europe. In this direction, animated maps and, particularly, historical atlas representative of different time-frames were used to produce a video recounting the main circumstances urging the first nucleus of the Jewish community to settle in the lagoon.

One of the main issues was represented by the selection of the relevant cartographic documentation to be used as a support for the historical account; following a thorough research, Spruner, published in 1888, made the choice for the historic-geographic atlas. The atlas contains numerous plates depicting Europe and Italy in different historical periods. Spruner's atlas was chosen because it allowed exploiting formally coherent maps for the chosen three sub-themes (exodus, communities and ghettos). Actually, each of the sub-themes had a different geographical focus, while the atlas offered a highly representative cartographic coverage for different periods and geographical areas.

The exhibition chapter, *Exoduses*, takes on the account of the main migration flows characterizing the International Jewish community following political and natural catastrophes, such as the Black Death, the Crusades or the Spanish and Portuguese banishments dating respectively to 1492 and 1497; this section displays the main Jewish migrations between 1000 and 1600.

The second chapter, *Communities*, sheds light on the existence of original Jewish nucleus settled in the Venetian mainland since Late Roman times, and how they have been successively joined by other communities, often bearers of different languages and rituals (such as, for example, the Ashkenazim or the Sephardim). This section shows the presence of the Jewish communities in the northeastern portion of the Italian peninsula between the 10th and 19th century.

The last section, *Ghettos*, is voted to describe the situation in central and northern Italy after 1516, attempting to highlight the different behaviours adopted towards the Jewish communities by the main Italian States and “Comuni”, documenting the establishment and closure of the Jewish ghettos and quarters in the pre-unified Italian peninsula.

The video animation has been realized with state of the art software for digital images processing; in addition, a set of textual and image contents, deriving from historical and archival sources, have been added in order to enhance the animated maps. Maps, images, and textual contents have been conveniently organized so as to capture visitors’ interest and to follow them through the narrative display.



Figure 4. One of the historical atlas used for the exemplification of the migration flows in the section Exoduses.

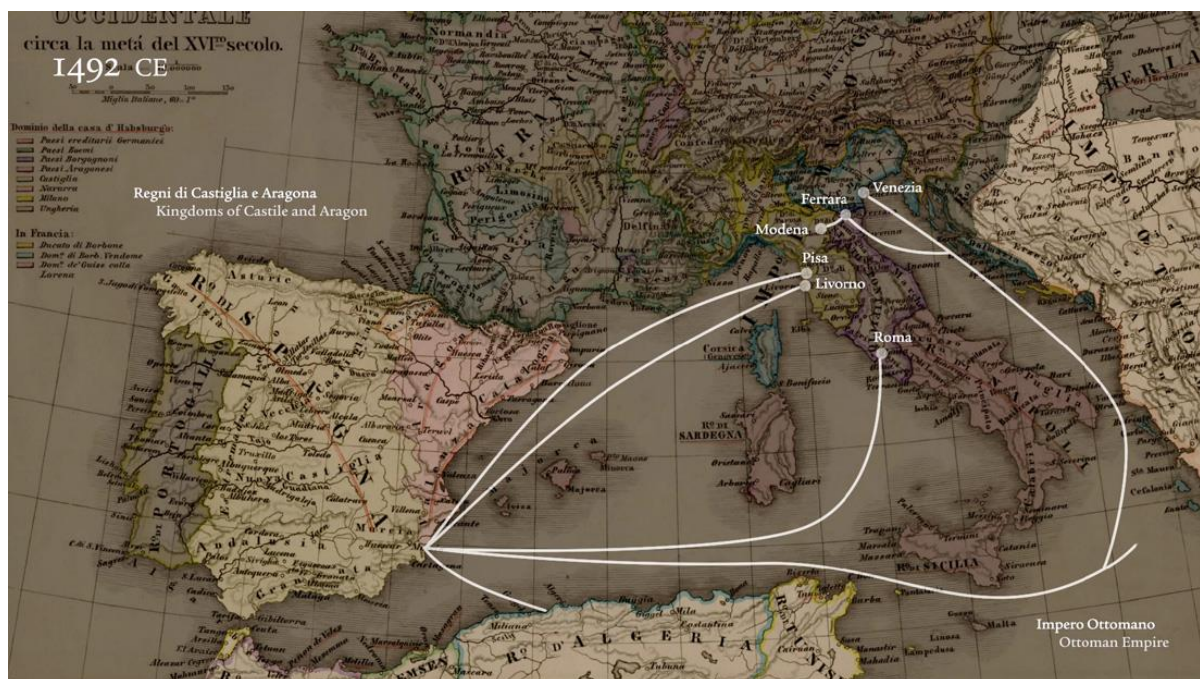


Figure 5. Video images relating to the sections Exoduses.



Figure 6. Video images relating to the sections Communities and Ghettos.

The development of the video *Exodus Communities Ghettos* shows the potential role of cartographic documentation in supporting information deriving from historical research.

In conclusion, the broad cultural heritage field represents a receptacle for the broadest, transversal, and diversified set of competences; here, cartography could play an essential role by allowing diversified knowledges and competences to converge, enhancing the final product.

The Venetie MD by Jacopo de' Barbari

The descriptions and information available in the historical map, acquire added value thanks to multimedia applications that integrate an array of varying data and information. The methods used to process digital images guaranteed broader accessibility and enjoyment, even by non-specialized users, to the contents of the priceless documents (Guerra et al., 1999; Balletti et al., 2016b).

The animation of the bird-eye-view of Venice allows to navigate through the city as it was in 1500 when the famous map was created by Jacopo de' Barbari. The map is unquestionably an important reference for the period. Moreover, the decision to create the interactive version of *Venetie MD* (Map of Venice) is due to its remarkable semantic and symbolic content, further emphasized by the virtual tour of the city. The tour allows the viewer to immediately focus on buildings and areas of specific interest, showing the presence in the city of Jewish and other communities.

The animation illustrates the foreign communities main residential and commercial centres, as well as the Venetian “contradas” where Jewish presence prior to the creation of the Ghetto has been confirmed. The area of the *Geto Nuovo* (the copper foundry), where the Jewish people who decided to settle in Venice were compelled to live in 1516, is also clearly visible.

Starting with the high-resolution view, obtained by assembling the individual sheets composing the map, some details were modified and highlighted using image digitalization, graphics, and video editing software.



Figure 7. Images of the final animation showing the existence of foreign settlements in Venice.

The decision to animate even those irrelevant elements from a cartographic point of view - such as, for example, boats - was prompted by the desire to represent the context and climate of a merchant city strongly conditioned by winds and the sea in its defensive and trading facilities, as well as by the desire to make the multimedia content lively and dynamic. Finally, since the map is a bird-eye-view of the city, there was no requirement to model buildings in order to narrate the city's three-dimensional space. Instead, the animation simply made direct use of the geometric and semantic contents of Jacopo de' Barbari's perspective.

The creation of different working layers in the image processing software and their subsequent animation helped identifying, on the one hand, the existence in Venice of different foreign communities and, on the other hand, to localize the urban areas where the Jewish community lived prior to 1516.

The final display of the video animation consisted of an interactive table placed in the second room of the Doge's apartment; some graphic effects, such as the didactic scroll or the sliding arrows connected to the tactile sensors, have been included in a second stage by the museum curators and, particularly, by the Milanese firm *camerAnebbia*.



Figure 8. Image of the final animation of *Venetie MD* showing one of the areas where Jewish settlements have been confirmed for the period prior to 1516.

Conclusions

Starting from historical maps and their contents, the research has analysed some aspects related to the urban transformation and development of the city. The research has identified a specific case study, while the main theme has been scrutinized on the basis of two main aspects: a first one based on a technical-scientific scrupulousness and a second one more focused on the dissemination and promotion of the acquired knowledge.

In detail, on the basis of historical cartographic and archival data, the project focused on the application of analytical and comparative tools in order to define a standard methodology for studying urban transformations through time.

Geomatics and digital technologies allowed examining in detail urban modification undergone in a specific area of the city of Venice, contemporaneously analysing the volumetric variations, which took place over a long-time span, by means of three-dimensional models of the analysed built area.

In a society mainly characterized by visual communicative means, the cartographic document represents a sharp and easily perceptible medium, even for non-expert users. Therefore, maps need to be understood as a highly relevant didactic vehicle, a tangible tool for an in-depth analysis of the landscape and of its diverse representations through time.

The present project also well integrates in the wider research field of *Digital Humanities*, which attempts to promote cultural and artistic heritage through new representative ways provided for by a profitable connection between humanities and computer sciences.

The steady confrontation and continuous collaboration between disciplines allowed to design and produce a multi-media narrative able to offer a new opportunity to access information, as a supplementary instead of substitutive tool for the design of museum displays.

It is clear how the proposed experience does not exhaust the potential analysis in urban studies, it instead offers the opportunity to propose new ways and perspectives: although geomatics techniques promote a scientific approach to data analysis and interpretation, they require a complementary integration of different knowledge and competences in order to fully understand and interpret analysed data.

The considerations proposed, further stress and underline the relevance of data sharing, in order to allow the exploitation of the acquired knowledge in other case studies, even in other research aspects and field. In this process, the concept of accessibility to a shared knowledge base is essential, enabling and integrating different competences and disciplinary approaches, heading towards the acquisition of better results and products able to become strong cognitive and disseminative tools.

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