The Gonzagas' palace: architecture of time. An interactive application for the discovery of the architectural history of Palazzo Ducale in Mantua

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Abstract— Palazzo Ducale in Mantua is an emblematic case of complex architecture, in which the current configuration is the result of centuries of additions, modifications and substitutions. The understanding of buildings with such a degree of complexity is very difficult and requires, most of the time, a specialized training. Nevertheless, this understanding is also the necessary tool to recognizing the real value, not only architectural but also cultural, historic and documentary of Gonzagas' complex. This research project tries to build new forms of communication that will enable the non-specialist public to grasp the complexity of the Gonzaga palace. So it is necessary to merge the well-established languages with innovative elements that allow a clear and immediate reading. The maquette or plastic is one of the tools that best accomplishes this task. The model speaks an easy to understand language, by entrusting it to the common visual experience. Therefore, there is no need to use special regulations or specialized languages as in the architectural drawing. The plastic is also an interesting surface to represent other themes. In this case, the model allows to acquire two levels of information. At first, it is possible to recognize the shape of the architectural complex through an overall view, that of the observer the plastic, which, in reality, is accessible only by air. It appears impossible to recognize the complex in the same view of the Castle of San Giorgio along with Santa Barbara and the Domus Nova. The second content is given by light-mapping on the surface of the model. The different configurations of the Palazzo during the centuries are projected onto the plastic to let public understand immediately which building belongs to each historical period. The other communication tool that complements the plastic is the imagery. The images play an important role in the project as a form of projection; it enriches the information supplied by the plastic. In this project, we want to emphasize the extraordinary experience of the visitor to the discovery of the historical evolution of the building through a large projection on three walls. The visitor is surrounded in a virtual environment. In the center, there is the plastic and all images-movies are projected on the perimeter walls: they add details to the story of the historical development. The layout of the entire hall, the main entrance to the inside of the environment, wants to emphasize the exceptional nature of the experience and, at the same time, focus on the described elements. The third element that completes the communication project is the story-telling that implies the whole experience. Because the communication is effective, it has abandoned communication style of the documentary, embracing the metaphor of the story in the first person. Each visitor will feel guided in the visit by a well-built character and really identified. The figure chosen to accompany the discovery of the Doge's Palace draws directly to the history of Gonzagas. Rinaldo Bonacolsi, said Passerino, lord of Mantua, was killed in 1328 in a conspiracy organized by Cangrande della Scala and Luigi Corradi from Gonzaga. They latter becomes the lord of Mantua and Gonzaga will start the presence in the city. The Gonzaga have preserved the Passerino mummy in his palace, as a kind of good luck charm. The choice of Passerino as a guide allows you to tell the Palace by those who lived in life and as a "ghost". It allows to tell Gonzaga not aseptically, but rather to provide those details and anecdotes that make the story livelier. This choice also allows, even at a compositional level, greater freedom being able to move, like a shadow, over and into the palace. This form of communication, divided into plastic, images and video, and narrative, however, requires a historical base and very solid document. The story of Passerino and lived experience by the public is not a simple moment of leisure, but represents a true educational event. The multi-disciplinarity of the project is precisely recognized in the design attitude of each individual that contributed to the installation definition. This research project has been translated into reality through the realization of a permanent installation at Palazzo Ducale, which opened in May 2016

Keywords— *dissemination of architectural heritage; architectural development; 3D digital representation, 3D physical representaion*

I.   INTRODUCTION

Historical architectural heritage is a very important resource for Italy. However, it is evident that, even before the touristic and economic aspects, Cultural Heritage is a property of the citizen. To become a true common cultural background,

it is important that citizens endorse their monuments with a thorough knowledge. This operation passes through two operations. The first is the observation, through which the user can see the object and understand its historical value because of the shape, the used material, the decoration, etc. The second operation is the critical knowledge in which the subject is not studied in itself, but as the result of a historical and social context, as the work of an artist or school.

In the specific case of architecture, the knowledge process is quite difficult, for many reasons. For extended architectural heritage, a first difficult is its dimension. For the visitor it is very complicate to have a whole view of the complex. Usually they can have only a partial view of the architecture. A common example regards the visit of a palace. The visitor looks at the different rooms with their frescoes and paintings, following the visit path, but he has to make an intense effort to put together all the information to have a unique, organic, concept of the palace.

Another problem that often arises in the context of architectural heritage is related to the history of the building. Today appearance of monuments is very frequently the sum of all changes, improvements, additions and subtractions made in the course of history. So it is impossible to really understand an architecture without the knowledge of its history. At the same time, it is very complex to understand the story of an architecture with considering its background and its physical context. An effective knowledge process in fact requires that the observation and critical analysis can go hand in hand.

A third difficulty is the language used to describe an architecture. The communication is very complex because it is necessary to combine two different aspects: a high value object is difficult to describe to an audience made of many different characters ranging from the casual tourist, impassioned up the scholar. It is almost impossible to find a language that is well received by all the different characters, but it is important to find a way to reach the largest number of people. Here for language not only intent verbal form chosen to communicate the contents, but also the illustrations (pictures, graphics, drawings) with the device and to complete the word.

This research starts from these certainties. The test bed regards the project and the construction of a permanent multimedia room in the route of the museum of Palazzo Ducale in Mantova. With the support of the director of the museum, prof. Peter Assmann, in the room we tested a communication paradigm based on imagery, 3D models, both physical and virtual. This communication effort was suited for the visitors of the museum, with the aim of bringing them in the complexity of the Palace. A detail of this research concerns the composition of the working group. It is in fact a group of architects specialized in history, design, survey and modelling.

II. PALAZZO DUCALE DI MANTOVA

Palazzo Ducale di Mantova (fig. 1) is situated in the north-east part of the town, in between Piazza Sordello and the riverside of the Lago Inferiore. It is constituted by a large number of buildings, courtyards and gardens. The palace, initially made up of various bodies of buildings, found its organic shape in the first half of the 16thcentury, when it became one sole grandiose architectural complex, occupying almost 35.000 m^2. The Gonzaga family inhabited it between 1328 and 1707, when the last Duke, Ferdinando Carlo, was forced into exile. With the Austrian domain some rooms of the court overlooking Piazza Sordello were refurbished as representative rooms. After the abandonment of the 1800s, the Palazzo Ducale has been, since the beginning of the 20th century, restored and is now the site of a state-owned museum.

The historical period described in the multimedia application regards about 300 years of Gonzagas' government in Mantova from 1328, when they occupied the palace, up to 1627 when, at the death of Vincenzo II, the main branch of the family died.

The oldest buildings, those overlooking Piazza Sordello, are the Palazzo del Capitano and the Magna Domus, founded by the Bonacolsi family, who ruled Mantua in between 1273 and 1328. With the Gonzaga taking possession of the city in 1328, new buildings were added to the original group and formed what is now called the Corte Vecchia. In a vast 14th century room, Pisanello frescoed for Gianfrancesco a chivalric cycle, only discovered in the last century. Between 1395 and 1406, Castello di San Giorgio was built and, from mid-15th century and on order of Ludovico II Gonzaga, it became the residence of the family. In the south-east tower, Andrea Mantegna frescoed, between 1465 and 1474, the famous Camera Picta or Camera degli Sposi. Placed against the Corte Vecchia, the building of the Domus Nova began in 1480 but was later modified by Duke Vincenzo I (1587-1612). Not far away from the Castle of St. George, Giulio Romano built for Federico II the so-called Corte Nuova, the first core of which is the Apartment of Troy (1536-1539). Giulio was also behind the conception of the Rustica, which was then connected to the Corte Nuova by the Galleries of the Mostra, and dei Mesi, while it was Giovan Battista Bertani who designed the Courtyard of the Exhibition, in the 18th century called of the Cavallerizza.

At the death of Francesco II (1519), Isabella d'Este moved from the Castle to the Corte Vecchia, in the apartment dedicated to the widows, which comprehends some magnificent rooms amongst which the splendid Camera Granda and the Studiolo, the Grotto and the Secret Garden. In the 1580s Duke Guglielmo (1550-1587), grandson of Isabella d'Este, transformed the rooms in Corte Vecchia, built the Refectory which overlooks the Hanging Garden, and the Room of the Mirror, destined to musical use and next to the Courtyard of the Otto Facce; both spaces were designed by Bernardino Facciotto.

Around the ravelin of San Nicolò, next to the castle, Guglielmo built the Large Apartment of the Castle, into which one enters from the grandiose Room of Manto. From 1563 Bertani built the palace church of St. Barbara, even today the visual center of the palace, linked both to the Large Apartment of the Castle and to the corridor of Santa Barbara.

In the first years of the 17th century Duke Vincenzo I (1587-1612) commissioned the architect Antonio Maria Viani the renovation of a wing of the 15th century Domus Nova by Fancelli, which he had chosen as his residence with entrance in

the atrium of the Archers. The loggione on the Cortile d'Onore, housed the ducal collection of paintings but was soon closed and converted into a gallery, which has become since the late 18th century the Gallery of the Mirrors. Duke Vincenzo I also commissioned the Gallery of the Metamorphoses, where the collections of natural and artificial marvels were placed. The rooms, dedicated to the four elements, overlook the garden, originally called of the Pavilion, then of the Semplici.

Fig. 1. the architectural complex of Palazzo Ducale in an aerial view

In the Domus Nova, Ferdinando Gonzaga (1613-1626) commissioned the so-called Apartment of Paradise, and the 'Scala Santa' (1615), which recalls the one at the Lateran in Rome. In 1627-28 the Gonzaga art collections were sold by Vincenzo II to the King of England Charles I Stuart to handle the economic difficulties of the dukedom. In 1630 what little remained of the artworks in Palazzo Ducale was sacked by the Lansquenets sent by the Emperor Ferdinand II to remove Carlo I Gonzaga Nevers, whose politics were too close to France's [1, 2, 3, 4].

Color	Years	Gonzagas
	1328-1444	Luigi, Guido, Ludovico I, Francesco I, Gianfrancesco.
	1444-1484	Ludovico II, Francesco I
	1484-1540	Francesco II, Federico II
	1540-1576	Francesco III, Guglielmo
	1576-1587	Guglielmo
	1587-1630	Vincenzo I, Francesco IV, Fernando, Vincenzo II

In order to do the simplification, which is necessary to foster the comprehension of the complex, the 3 century period of Gonzagas was split into 6 temporal steps, corresponding to the biggest increase of the whole palace. This subdivision, which is functional to the narration, allowed to put in evidence the captains, marquises and dukes who mostly worked for the grew of Palazzo Ducale. A short list of the period and its corresponding Gonzagas is given is Tab 1.
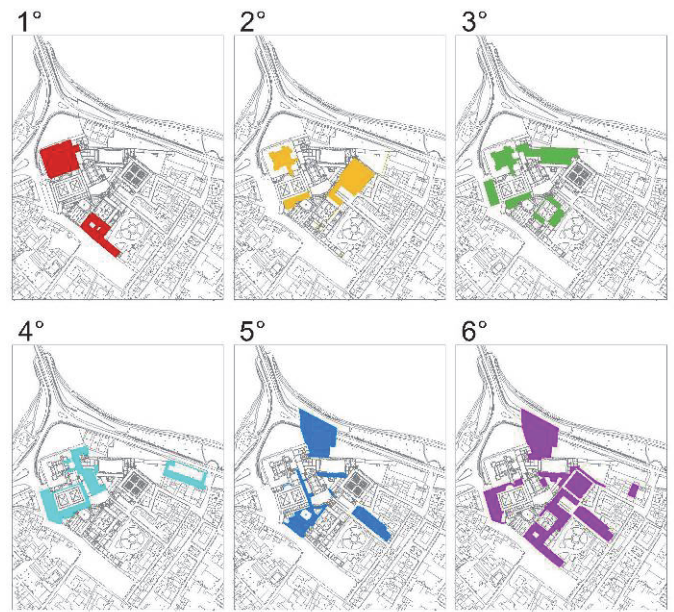

Fig. 2. The 6 historical periods with the new architectural developments for each period

III. THE CONCEPT

As mentioned in the introduction paragraph, the purpose of this research was to find an appropriate way of communication to tell the complexity of a fine architectural complex and its historical evolution to a wide audience. The proposed solution consists of several elements that try, together, to provide an answer to the previous question.

The first element of this solution is the 3D model. The choice of the three-dimensional model is not the result of a trend in the field of Cultural Heritage, but the choice of a well-defined language of communication that does not need any filter or scientific skill in order to be understood. Since antiquity the architectural model is one of unequivocal representation and much used tool. It constitutes a document of the project, like drawings and sketches, but it has the ability to be immediately understood by every person. For this reason, it has functioned as a liaison between specialists (architects, surveyors, engineers, builders in general) and the customer [5]. The strength of the three-dimensionality is that it requires the user less imaginative effort to understand how architecture is made. Other forms of representation as the drawings in plan, section and elevation, while being very precise and comprehensive, requiring an effort of interpretation for non-experts.

Moreover, a 3D model responds to another need which is very strong in the case of Palazzo Ducale. A scale reproduction of reality, as well as allowing the understanding of space, full and empty, built and opened, allows indeed to represent a very complex element through simplified forms. The analogy with cartography is really evident: the simplification implemented by the 3D model allows you to read a greater area and to focus on key points. The extent and complexity of Palazzo Ducale, enclosed in a rectangle of about 220 m x 300 m, doesn't allow the visitor to have a comprehensive view of the entire building.

The three-dimensional model instead allows, indeed encourages, this vision.

As a tool for communication, it is used here in two ways as in the virtual exhibition about the Pyramid Complex of Senwosret III [6]. There are a physical 3D model and also a digital 3D model. The first one is used to identify, from time to time, the elements of the palace in different periods, the second to show some details.

The second element of our solution is the choice of a language made mostly of images. In this choice, the predominance of imagery on words in terms of immediacy and capacity of involvement was decisive. As projected map, the imagery enriches the maquette with new information, trends and issues. Large images and projections also envelop the user in a specially designed space to allow the visit become an immersive experience. The layout of the entire hall and the main entrance in this environment want to emphasize the exceptional nature of the experience and, at the same time, focus on the elements described.

The last element to complete the communication project is the story-telling that implies the whole experience [7]. In order to have an effective communication, the style of the documentary was abandoned and it was substituted by a first-person narration. Every visitor feels driven to visit from a well-defined and identified character.

The figure chosen to accompany the discovery of the Palazzo Ducale is a real character of the story of Gonzaga. Rinaldo Bonacolsi, said Passerino, lord of Mantua, was killed in 1328 in a conspiracy organized by Cangrande della Scala and Luigi Corradi from Gonzaga. The latter became the lord of Mantua and Gonzagas started their presence in the city. The Gonzagas have preserved the Passerino mummy in their palace, as a kind of good luck charm. The choosing Passerino as a guide allows to tell the Palace by those who lived there and remained as a "ghost". It allows then to tell Gonzagas not aseptically, but rather to provide those details and anecdotes that make the story livelier. This choice also allows, even at a compositional level, greater freedom being able to move, like a shadow, over and into the palace.
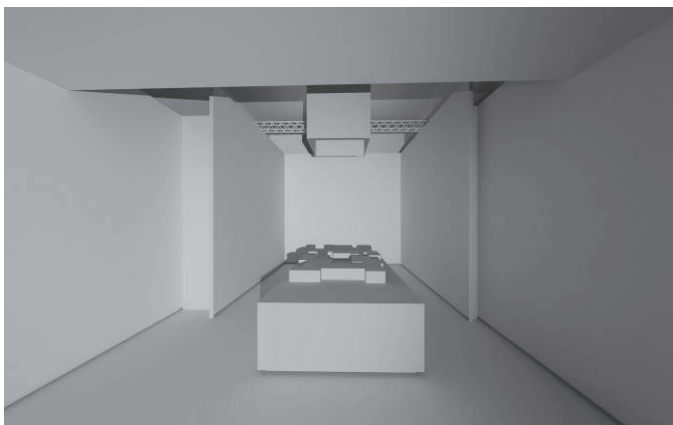

Fig. 3. the project of the room

This form of communication, made of maquette, images and video, and narrative comes from a historic base and very solid documents. The content of dissemination required careful analysis and a verification process. In addition, it was necessary to survey and detailed documentation of the Palazzo Ducale architectures both for the construction of physical and digital model that accompanies the video, the historical explanation of evolution.

IV. THE PROJECT AND ITS CONSTRUCTION

By transferring the above described concepts, the design of the room at the has provided a one-to-many interactive application for the beginning of the tour. It was required to combine the visit of individual tourists with the ones of school groups. So it was decided to allow a single user to interact with the system, making his interactions and choices visible to all.

Once the user comes in the room, through the portal which indicates the start of the new venture, a wall representation draws his attention. The drawing of a human figure, portrayed from behind turning to you, introduces the figure of Passerino Bonaccolsi: the spectrum that will lead visitors through the rooms of the palace. The design traits not well defined and the choice of representing the figure according to the style of the painting "La cacciata dei Bonacolsi" by Domenico Morone allude immediately to the characteristics of Passerino.

Fig. 4. Photos of the multimedia room

Then the visitor can stay in front of the large model representing the Ducal Palace with its context (paragraph IV.C). The physical model is open on three sides and in the last one there is a 32" touch-screen as user interface. Through this interface the user can decide which historical period to visit.

After choosing the historic stage, the physical plastic is illuminated by a vertical projector to make clear which part of today's Palazzo Ducale was existing at that time. At the same time, on the three sides of the room, a short movie is projected. After the movie, the user can choose to navigate in a 360° panoramic of one of the halls of the chosen period (Hall of Pisanello, Camera degli Sposi, etc) or to move to another period to discover other pieces of the history of the Palazzo Ducale.

A. 3D Digital Model

The digital model of Palazzo Ducale was created by hand modelling in a CAD environment. It is necessary, however, highlight that it shares with the maquette the same documentary base, necessary for the true representation of the architectural complex. The model is based on a survey of all the exterior of the Palazzo Ducale. The survey is the result of more than 10 years of continue collaboration between the Gonzagas' palace with Politecnico di Milano. Only few missing parts were digitally acquired on the occasion of this project.

The survey was carried out by laser scanners (Leica HDS 6000 and HDS 7000) and topographic support. Some parts of the model were also built from a photogrammetric survey carried out to document the state of the bell tower of Santa Barbara after the earthquake of 2012 [8].

In the construction of the digital model some problems became relevant. The first question to be solver was whether to model the Palazzo Ducale as it is today, or build many models to highlight the different situations in each historical period. There is a good documentation for some parts and it would be possible to reconstruct, at least virtually, the missing part. But in most of the building, the graphic documentation is very lacking and the only textual documentation does not allow an adequate level of reconstruction. The architectonic scale of the reconstruction (1:100) also would require a good level of detail.

For example, referring to the first historical period, 1328-1444, the only existing parts of the complex were Palazzo del Capitano and Magna Domus in the south-west and Castello di San Giorgio in the north-east. We don't know the situation of the space between these two parts: it could have been a space with housing space, or a vacant lot or even fields. The first iconographic representations of Mantua date back to the fifteenth century (frescoes of Palazzo della Masseria in Mantua and a map of the Verona area, Carta dell'Almagià) and their large-scale does not provide sufficient information to allow appropriate virtual reconstruction chosen application.

The virtual reality has a fundamental role in virtual museums and application because it can give indications of what is no longer present and visible [9]. It is necessary, however, deal with the virtual reconstruction process like any study and analysis process, paying attention to both the available documentation, both at the stage of data interpretation [10,11]. The reconstruction must indeed be documented through metadata and paradata. In the case of this research, the available documentation does not, in our opinion, reach a reconstructive proposal likely. It would be necessary, moreover, to address the issue, which should be deepened, about the difference between an architectural reconstruction and a reconstruction in archeology. In archeology the few traces that often come down to us, the lack of the original context and the temporal gap allow greater freedom in the reconstructive hypothesis. Instead, in architecture the reconstructive hypothesis often concerns some specific parts of a building and it compares very closely with the real context. The observer is then brought to read together what is real and what is virtually reconstructed. Not always the use of different

graphic devices manages to make the different reliability of the two different objects (real and reconstructed). For example, the placement of an opening in a wall, although represented in a suitable manner as to make grasping the hypothetical nature, it does provide information incontrovertible: the window existed and that determined the appearance of the building, its facade. Doubts can remain about window quality, its decorations, but the user feels secure this presence.

According to all these observations and the available documentation, the choice was to offer the viewer only today as-built situation. In this way it is more difficult to imagine a different hypothetical state, but it immediately allows the viewer to navigate the different architectures of the palace and understand the temporal development. It remains clear, however, that it would be appropriate to explore the theme of the virtual reconstruction of lost parts of the Palazzo Ducale.
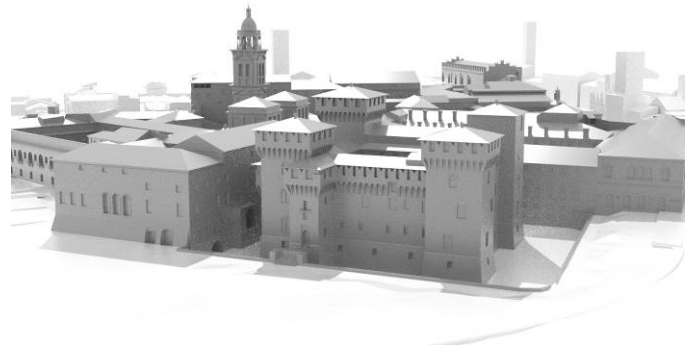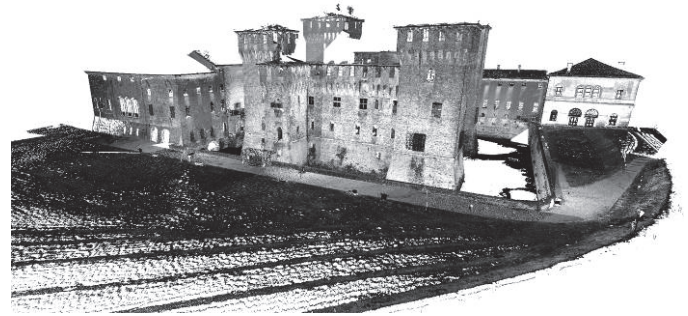
Part of the original pointclouds (above) the 3D digital model (below)

Another choice regarded the modelling of only the external part of the palace, leaving all internal. It was due to a time constraint (there was the time needed for the survey and modeling of all interior spaces) but also to a design choice (the visit of the interior would be too dispersive and would distract the user's attention the entire complex).

Finally, we had to deal with the management of the large amount of detail. The point clouds were made with an average resolution of about 5mm, but the whole model could not keep the same resolution. On the one hand such a level of detail would have be useless as it was expected only a virtual flight on the complex and not a detailed observation of the individual

buildings. Moreover, modeling all the elements would have required the use of a mesh model of the entire complex (unmanageable) or the hand-modeling of all the elements would provide nevertheless a very heavy model.

As for the materials, it is chosen not to characterize the digital model with the actual materials for various reasons. First, the role of the digital model is to index: a three-dimensional index to understand, compared to the whole of Palazzo Ducale complex, which are the component parts: Castello di San Giorgio, Palazzo del Capitano, etc. Textures and colors would have made it more difficult this reading.

B. 3D physical model

Palazzo Ducale physical model is in scale 1: 300 and its size is 1.60 x 2.00 m. This scale of representation has allowed to obtain a maquette with suitable dimensions for the exhibition room and with the right degree of detail for the comprehension of the Palace architecture.

Fig. 5. The process for the construction of the physical model: orthophoto from laserscanner, facade drawing and semplification.

In designing the model was essential to make an overall abstraction of the area: the context is made up of pure solid volumes to represent the density of the environment, the urban morphology and heights while the Ducal Palace complex is detailed in the description of architectural elements of the facades according to the representation scale. Existing cartography has been used as a base for the ground and topography lines; Palazzo Ducale facades were drawn from orthophotos extracted by using Pointools point cloud software.

The materials chosen for the model are functional to specific semantic and technical choices.

The wood was used to represent the existing context: an essence for topography lines and water (painted glossy black) and another essence for the environment buildings. Both species have a natural finish in order to absorb light, not to reflect it. For Palazzo Ducale complex an opaque translucent Plexiglas was the best choice for the light-mapping because of its light diffusion property inside the volumes; it's also possible to read clearly the design of the architectonic elements. engraved on the material surface.

All the Ducal Palace facades are drawn in CAD and then engraved and cut with a laser cutting machine (fig 6, 7).
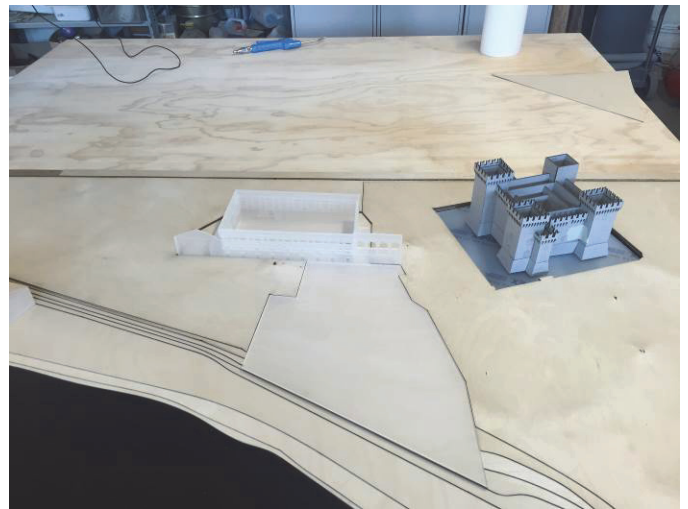

Fig. 6. Assembly of the maquete on the cartographic base.

C. Video content

The short movies, coordinated with the projection on the physical model, are projected onto three walls that determine the space around the model, according to the choices made through the touchscreen.

The videos, which last about 2 ½ minutes, briefly tell some important elements for each historical period through the words of Passerino. The structure of each video is:

a) Virtual-flight on the Palazzo Ducale digital model. The buildings of an historical period are highlighted with a color. The same color is used both for the projection on the model and in the interface of touch navigation. At the end of the virtual flight some labels help to recognize the building blocks of that historical period (fig. 8):

b) narration through iconographic documents of that historical period;

c) 3D-animation to highlight the room where you can make interactive navigation;

d) fade out to the interactive navigation system.

From the technical point of view for each period it is a video size 5760 x 1080. The resolution is due to the use of three full HD projectors. Given the three walls, arranged at a right angle, it was opted to use the central part of the video as the main screen to the story, while the sides for less important details.
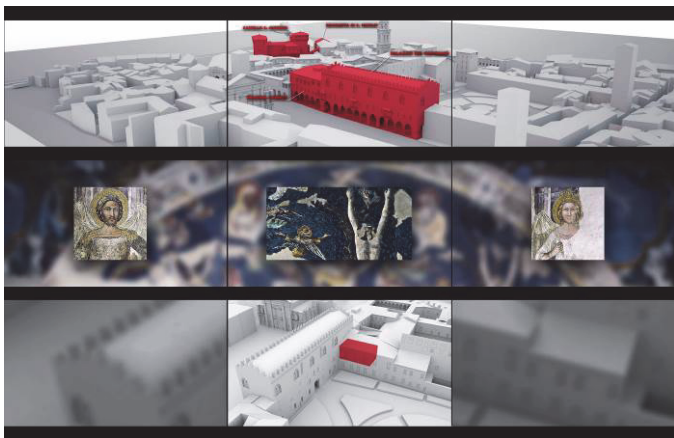
Fig. 7. Some screenshots from the video of the first period: (above) 3D render as a), (middle) an example of the use of iconographic sources as in b), (below) the location of the room with interactive navigation as in c). The division of the view in three parts is only to understand its structure.

D. Interactive exploration of the most famous rooms

At the end of each period, the user has the possibility of virtually navigating some of the most famous rooms. In some cases, the rooms represent very important masterpieces such as the Camera degli Sposi and the Room of Pisanello. Camera degli Sposi, for example, can be visited only for 5 minutes to preserve the frescoes and to guarantee the access to all visitors. In such a way, the possibility to see virtually the room without any time limit is a big advantage for citizens.

In some other cases, the rooms that can be virtually explored, are close to the public (Zodiaco room in the castle). In this way, the interactive navigation allows to discovers some hidden part of the palace. The user interface is very simple and well-known so the user can move in the virtual space by moving his fingers on the touch screen and zooming in and out with buttons (fig.8).
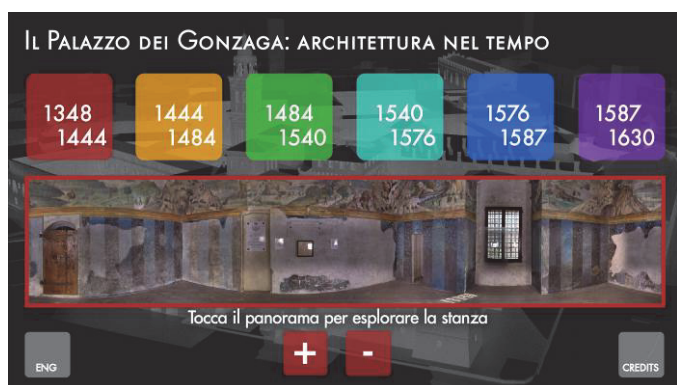

Fig. 8. User interface of the system, during the interactive exploration

The 360° spherical panorama (48000 x 24000 pixels) of the six room was done by a photographic acquisition at high resolution, using the Rodeon motorized panoramic head. Some lighting problems, backlights, required a manual correction to obtain good results.

E. User interface

The user can interact with the multimedia system through an interface on the multi-touch monitor. The interface, in English and in Italian, allow the user to choose the historical period of interest. The choose can be governed by the age, but also by the name of the Gonzagas described in each period. Once the visitor selected the period, he can follow the video or skip to the interactive part.

F. Exhibition arrangement

The multimedia application occupies a well-defined space inside the museum tour of Palazzo Ducale. It occupies a whole room although of reduced size (approximately 9 m x 5m). But it is especially interesting to note that the room is located near the beginning of the museum route. Its location is the result of a careful design decision that is intended to facilitate the visit to the palace. At the beginning of his route, in fact, the visitor can now dwell on Palazzo Ducale complex and can learn to distinguish the different component parts, thus making the next most "conscious visit". The Politecnico di Milano team wanted to emphasize this aspect by creating a specific area.

Fig. 9. The portal-entrance to the multimedia room

The portal (fig. 10) on the corridor of Passerino configures the entry into a different world where the user, accompanied by Passerino, has a chance to see Palazzo Ducale from a new point of view, through the 3D model. This feeling of novelty, of exclusivity, is due not only to the forms, but also to colors and used materials. Inside the room, the gloom invites to immediately focus on two elements: the representation of Passerino (in front of the entrance) and the maquette (in the center). A carefully designed system of lights allows you to move easily in the room, whilst maintaining the hierarchy of the different elements.

Technically, the architectural intervention worked to realize a correct lighting of the room, by some plasterboard walls to cover the windows. The same walls are used as projection screens around the maquette. In the center there is the maquette which has no any case in order people can look directly the model.

The design of projection was quite complex because of the necessity of a big projection area and, at the same time, the

requirement for people to move all around the maquette. As in fig. 11, we decided to use two aluminum truss structures. One truss with only a projector is used to map the maquette. The second one, on the other side of the maquette, has three short-lenses projectors for the projection on the walls.
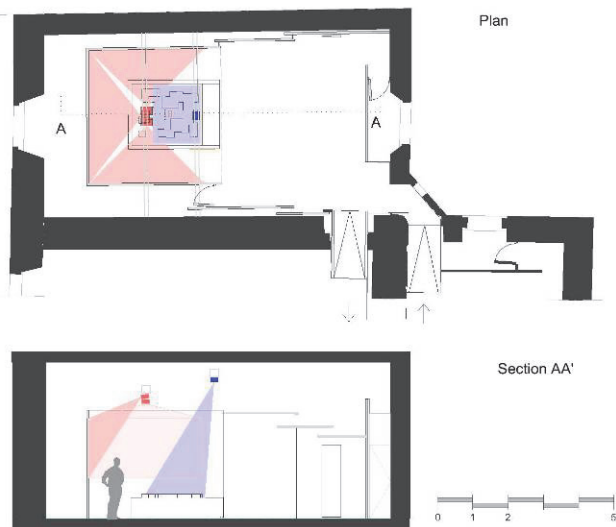

Fig. 10. Plans (above) and section (below) of the room, with the position of maquette, trusses and videoprojectors. In red the projector for the wall-video, in blue the one for model mapping

V.   CONCLUSIONS

This multimedia exhibition (fig. 12) allowed to verify the potential of 3D models, virtual and physical, as a communication tool. They confirm their immediacy in the process of knowledge of Cultural Heritage.

Respect to the original project, after the installation of the system, some changes have been made to improve the usability for users. In particular, in order to foster the work of tourist guide, it is possible to skip the videos and to arrive immediately to the interactive part. This allow the guides to describe the historical development of the palace with their own words, but to use the light-mapping on the model as a didactic support. The possibility to explore some rooms in a digital way is very useful for some cases, as Camera degli Sposi, where the physical visit has some time limit to meet the high number of visitors. The users can explore the virtual panorama and look at all the details of the frescoes.

The collaboration between the different disciplines has led to a joint project that involves not only multimedia but also the user's approach to interactive room and his stay in the same room. For this reason, a similar approach is very advisable.
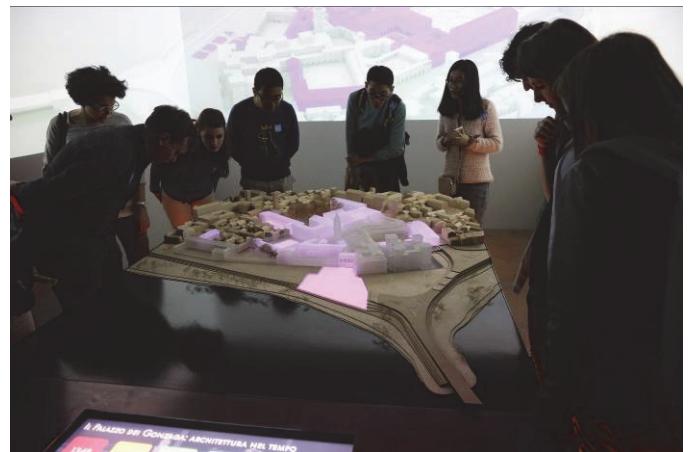
ACKNOWLEDGMENT

Fig. 11. Visitor all around the maquette

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