An immersive experience for the room with agrestic paintings in Carditello (CE)

Alessandra Pagliano
Annalisa Pecora

Abstract

The present paper focuses on the pictorial decoration in the room with agrestic paintings, also called "Libreria", attributed to Jakob Philipp Hackert and Domenico Chelli, at the first floor of the main building of the Royal hunting lodge of Carditello, in San Tammaro (CE). Painted and built architectures are skilfully connected to let the observer to believe that he is in the presence of a space other than that of the simple wall envelope, the form and dimensions of which are in fact transcended thanks to the illusory architectures painted. Thanks to the possibility offered by the laser scanner and/or photogrammetric survey, it is possible to investigate case studies in this field of research with even greater accuracy, since the 3D model obtained makes it possible to have the actual disposition of the painted shapes on the wall and/or roof surfaces, but also makes it possible to verify the observer's actual perception thanks to the appropriate placement of digital cameras that simulate the *in situ* experience, thus immersing the observer in the designed perspective illusion and at the same time being able to reveal perspective tricks and spatial relationships.

Keywords
Virtual reality, Photogrammetric survey, painted architectures, Chelli, Hackert

The painted pavilion vault in Carditello, detail of the frescoes.

doi.org/10.3280/oa-832-c169

Introduction

The physical-figurative relationship between architectural built space and pictorial space is one of the research themes that has always been deeply explored by the drawing disciplines, to be able to understand and reveal that complex alchemy of theoretical and practical aspects that, thanks to linear perspective, are able to alter the perceived spatiality of architecture, by simulating decorations and depths that are not present along the built surfaces. Painted and built architectures are skilfully connected to let the observer to believe that he is in the presence of a space other than that of the simple wall envelope, the form and dimensions of which are in fact transcended thanks to the illusory architectures painted. In the last years, digital technologies and platforms have started to merge the physical and virtual environment. Thanks to the possibility offered by the laser scanner and/or photogrammetric survey (figs. 01, 02 , 03), it is possible to investigate case studies in this field of research with even greater accuracy, since the 3D model obtained makes it possible to have the actual disposition of the painted shapes on the wall and/or roof surfaces, but also makes it possible to verify the observer's actual perception thanks to the appropriate placement of digital cameras that simulate the in situ experience, thus immersing the observer in the designed perspective illusion and at the same time being able to reveal perspective tricks and spatial relationships.

Fig. 01. The painted pavilion vault in the room with agrestic paintings in Carditello.

Fig. 02. Photogrammetric survey and 3d model of the painted pavilion vault with high-definition texture of the frescoes.

Digital survey, both laser scanner and photogrammetry, provides the creation of Digital Twins (DTs), which are dimensionally accurate 3D digital models, with high-definition textures, that can be used as an accurate simulation of the physical space, allowing also detailed inspections of material traces of past transformations. Therefore, the Digital Twin of a cultural artifact represents an active and dynamic entity not just a mere copy of the asset, as it can activate new methods of using the data collected both in the analytical phase of research and in the subsequent phase of communicating its data. The survey, the interpretation and the digital reconstruction of heritage places and objects by means of digital models allows the research to set a new plurality of objectives, combining the need for scientific speculation with the construction of new linguistic paradigms for the fruition and communication of general public.
The relative possibilities arising from research activities in terms of adoption of relevant forms of representation can be indicated as follows:

- becoming levels of representation connected to the process of data collection through 3D laser scanning and photogrammetric processes;
- remote consultation of the survey phases and interrogation of the metric, configurative and figurative dimension;
- elaboration of the three-dimensional model and bidimensional and three-dimensional representative elaborations according to different semantic levels;
- representation of the state of art in terms of consistency and conservation;
- reconstructive hypothesis of the original state and function of the archaeological assets in case of current configurations strongly damaged by collapses and transformations;
- elaborations for the fruition of the goods through the adoption of systems that engage both immersive virtual reality (VR) and augmented reality (AR).
- Virtual tours through 360° spherical photos and videos.

We intend to build an innovative "digital twin" representation model serving the enhancement of its "physical twin", with the aim of engaging emotionally visitors into the knowledge process. In particular, the researches applied in the *quadratura*'s field field profitably take advantage of the digitalization of the processes: the icasticity of digital images and the digital

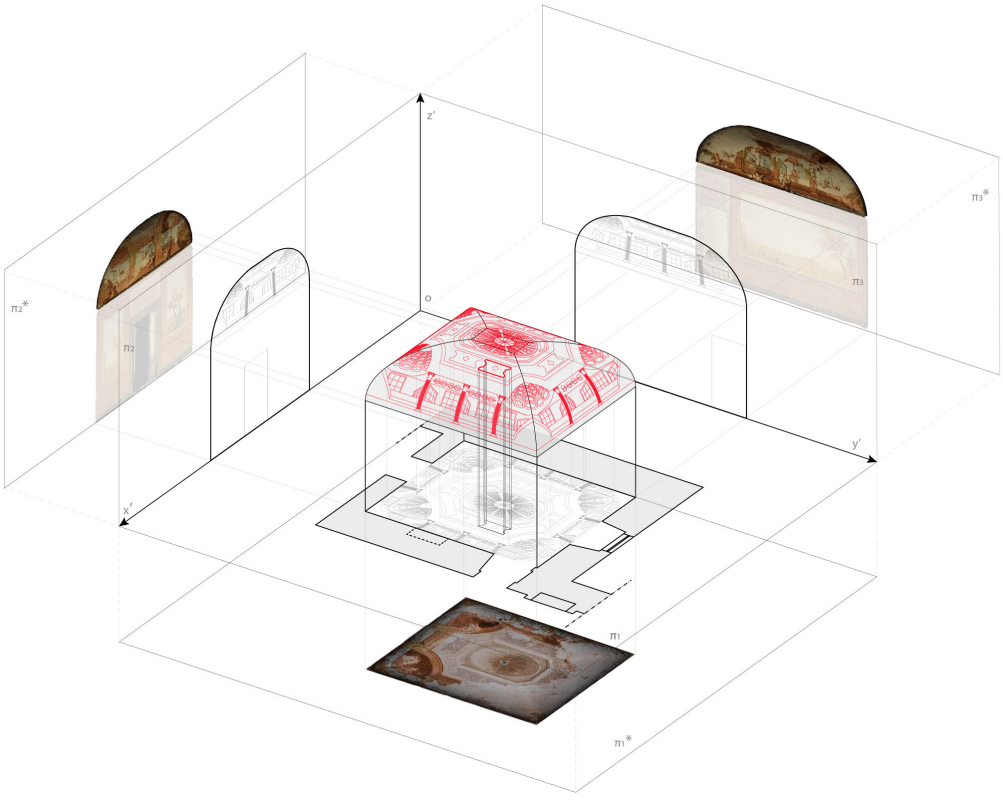

Fig. 03. Geometries of painted architectures on the cylindrical pavilion vault. Axonometry.

visualization technologies could make more transparent and accessible both the perspective illusion of painted architectures both the physical space's shape. In the case of painted images, the digital contents can overlap, highlight, trace, reveal tricks and dissonances, to integrate the spatiality perceived in presence by the observer, enriching it with the awareness of the geometric rules at the base of the illusory perspectives and with the possibility of also entrust animations, audio and video with the narrative expansion of the story represented in the painting, thus generating new modes of interaction with the perceived space.

The case study: the room with agrestic paintings in Carditello

The Real Tenuta di Carditello, in San Tammaro (CE, Italy), is a hunting lodge, built for king Ferdinando IV di Borbone in 1787 by the Francesco Collecini architect. The central building, also called Palazzina Reale, contains, on the first floor, several frescoes and painted vaults. The present paper focuses on the pictorial decoration in the "Sala dei dipinti agresti", also called "Libreria", attributed to Jakob Philipp Hackert and Domenico Chelli. The wall paintings, by Hackert, represent views of the surrounding naturalistic environment, one with the view toward Caserta showing the royal palace and another one toward Napoli with the Vesuvio. According to the illusionary feature of the room, Hackert painted the vertical walls like open windows, framing perspective views of the surrounding landscape, according to the real directions, only altering some dimensions for artistic purposes. In the room of agrestic paintings, the pictorial theme is structured on several levels of depth giving life to an articulated architectural complex illusorily represented on the ribbed surface of a pavilion vault (Cioffi, 2020). The *architectura picta* dialogues with the physical one starting from the impost level of the vaulted roof and, from here, accompanies the observer's gaze towards the central motif of the representation through the pillars of an open gallery (fig. 01). The paintings adorning the pavilion vault, collaborate with the physical space to generate the illusory effect of an architecture that crosses its own boundaries (fig. 04). In Carditello, the represented space and the physical one are closely related, the one influencing the other, linked together by the geometric layout of a common perspective setting (fig. 05). There is a privileged point of vision in the environment that coincides with the centre of the conical projection of the perspective; the artist conditions the drawn perspective to the choice of this point which assumes the role of a privileged point of view for the viewing of the scene. When the observer's eye coincides with the vantage point, the perceived image overlaps the projected one and, therefore, the illusory effect reaches the maximum level of realism, but the perspective image maintains its recognizable characteristics even from other observation points accessible inside the room. In the centre there is an elliptic dome surrounded by mixtilinear geometries together with phytomorphic festoons. The false dome is fully perceived from the vantage point, in a slightly off-center position with respect to the physical environment. From this point of view, the surface breaking effect appears realistic defining a continuity between the physical and the depicted space so that the viewer feels himself involved into a deceptive space due to the perspective continuity among paintings and visual perception of built shapes. The painted composition is animated by a theory of winged cherubs that interact with the architecture and with other figures linked to Dionysian themes and nature, aiming to communicate the naturalistic vocation of Carditello. The "immersive" intent of this painting is declared by the telamons turning their gaze towards the observer, as well as some of the cherubs lying on the balustrade. The composition of the painted space is, in fact, strongly conditioned by Chelli's experiences in designing stage setting for theatre.

Re-drawing the architectura picta

Initially, an orthophoto of the vault on each projection plane was developed importing the mesh of the photogrammetric survey into Rhinoceros. The images thus obtained were proportioned in the same scale of the vector model in order to set the height and position of the point of view for the construction of the illusory perspectives. This is fixed at a height of 1.70m from the floor, aligned with the centre of the painted dome, due to its central symmetry geometric scheme.

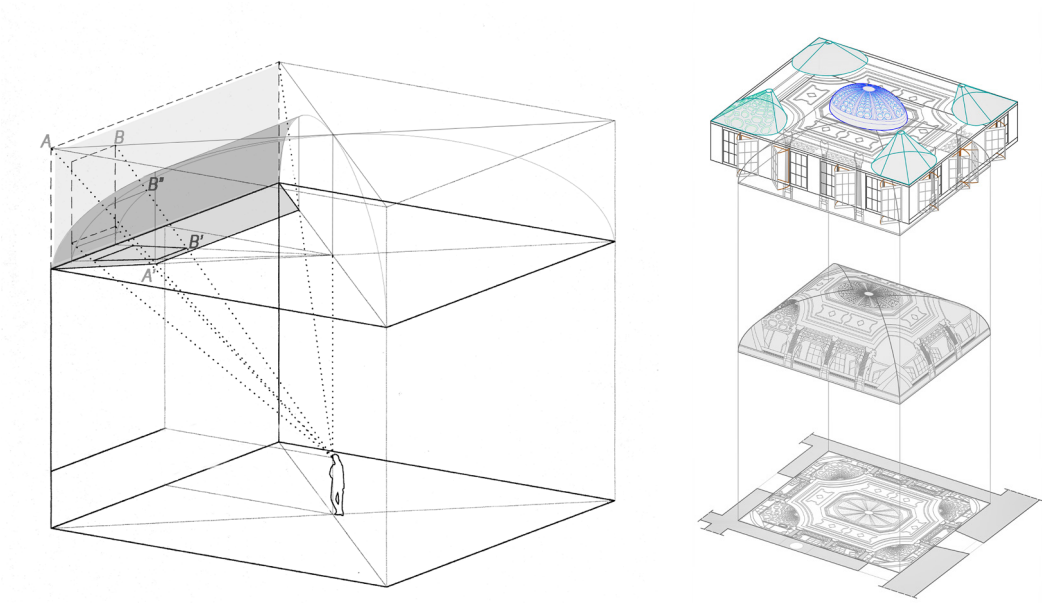

Fig. 04. A geometrical scheme for painting on a vaulted surface an illusory vertical wall.

Fig. 05. Reconstructive hypotheses of the painted architectures.

The design of the lacunars and their depths, in fact, is symmetrically repeated referred to the centre, denouncing the artist's aim to set the vantage point in a barycentric position. However, since this point does not coincide with the real centre of the room, the whole pictorial layout is asymmetrical, with a greater deviation along the longitudinal direction. To recover the illusionary space's dimensions, the painted vertical supports were projected from the vantage point towards four ephemeral vertical planes set along the wall perimeter, as an upward extension of the walls of the room. The traces, obtained by intersecting the visual rays with the section planes, have highlighted some inconsistencies between the drawn architecture and the surveyed one through an inverse projective method. The heights of the columns' top, which in the two-dimensional representation are aligned along the same generatrixes of the roof vault, assume different heights in relation to the different distances they have from the centre of projection. Therefore, the pillars along the shorter walls are lower than those in the longitudinal direction and with different heights between the two short sides, as a result of the asymmetry of the representation (fig. 06). This deviation from the architecture spatiality strengthens the perspective coherence of the painted layout, due to perceptual realism. The author, therefore, chooses to deviate from the logic of three-dimensional architecture to be guided, in his compositional choices, by the perspective rules and thus obtain the illusory effect of depth. Referring to these considerations, the pillars on the long sides are taken as a reference (between which the difference in height is minimal) and the plan of the roof attic is set on the respective capitals. The figures laying on this plane were obtained by projecting the shapes painted on the vault from the centre (PV), up to the intersection with the vertical plane. With the same procedure, was drawn the dome's base ellipse, which becomes the generator of the rotation surface for the dome. On the elongated semi-ellipsoid surface, prospectively overlapped to the dome represented on the pavilion vault, the two-dimensional scheme of the lacunars was projected. In the same way, the octagonal lacunars design of the corner niches was reconstructed. Their envelope is attributable to a conical surface with a multilinear directrix which, in the corners, follows the wall perimeter (fig. 07). This shape was obtained by analysing the geometries and the progressive reduction of the octagons. The windows are set along the perimeter of the attic; their spatial perspective restitution is obtained, once again, by intersecting the visual rays (conducted by the centre of projection) and the vertical surfaces where the windows drawings lay (fig. 08). With the aim of comparing the so obtained structures, derived from the pictorial complex, and the real built space, a philological reconstruction was developed, building a second 3D model, removing the gaps between the heights of the pillars and rectifying the curved profiles due to the artist's corrections (fig. 09).

A virtual tour to narrate the painted scenes

The perspective illusions created on the pavilion vault are at the center of the VR narration. The virtual tour is not limited to focusing attention on decorative details, but it aims to communicate the relationships between painted and physical architecture. The objective of the drawing methodology in VR is, therefore, to reveal the illusory game put in place by the artist in simulating a different ceiling surface from the physical making the comparison between the two different legible partialities. To highlight the geometric theme, in the initial phase, the scene consists of a schematic render obtained as a panoramic picture of the vector 3D model. Initially, in order to guide the gaze in the direction of the vault, we act on the lighting levels, leaving only the top area in light and the rest of the room in dim light. The general lighting is restored while the animation starts tracing the main geometric lines shaping the pavilion vaults and then the painted scene gradually take place back to the surface of the vault. During this passage, the shifting of the point of view allows appreciating the difference between the pictorial architecture and the real one. This displacement is necessary because the point of view placed in the centre of the room coincides with the projection centre of the illusory scene painted in perspective. If taken as an observation point, a visual coincidence occurs between the two graphic apparatuses (fig. 11): the two-dimensional one and the spatially reconstructed one.

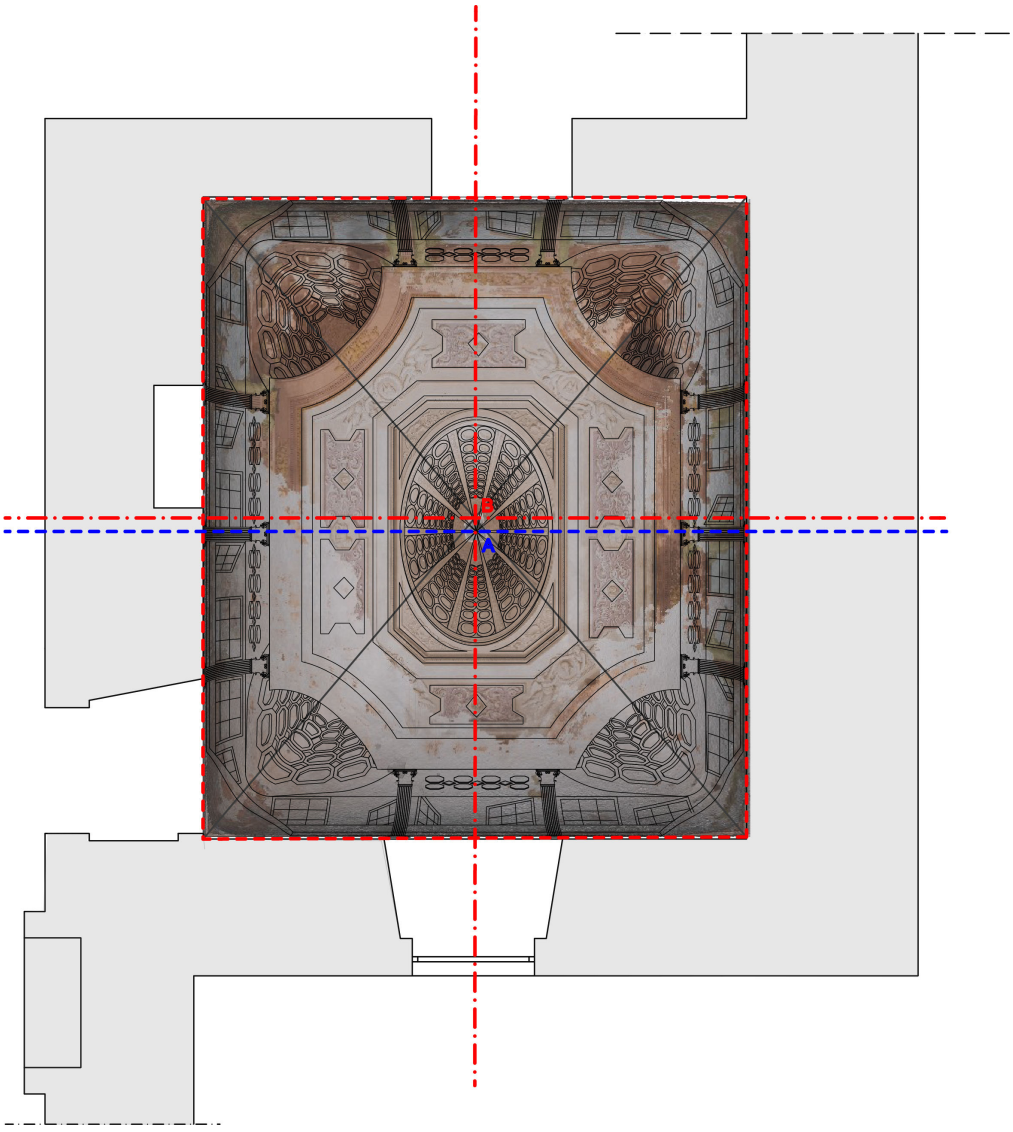

Fig. 06. Comparison between the centres of the depicted and physical architecture. Orthographic projection.

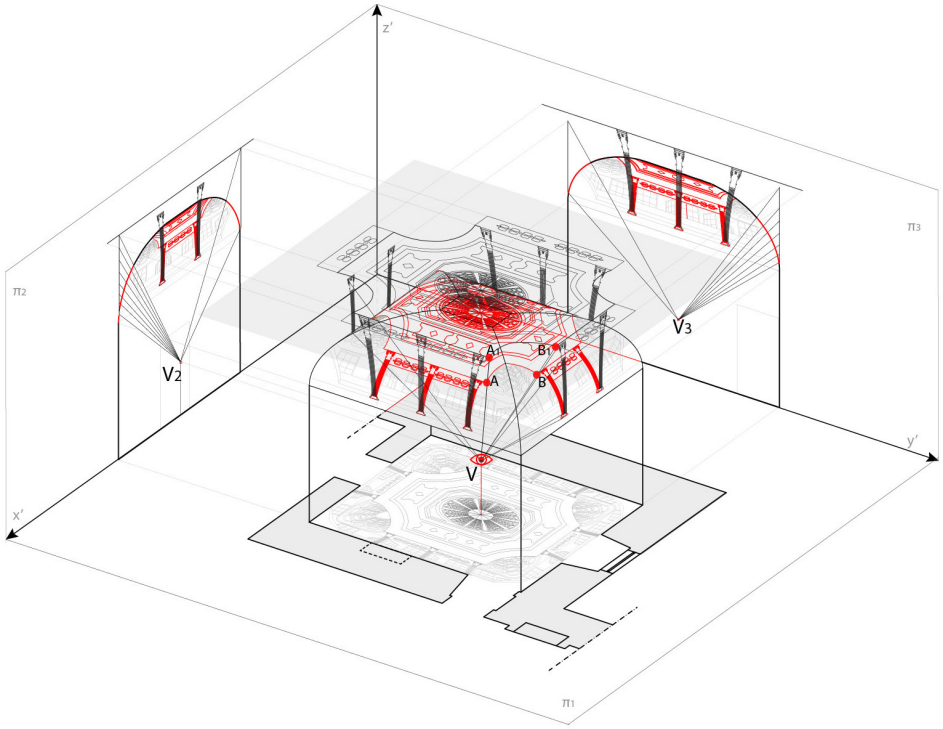

Fig. 07. Painted pillars on the pavilion vault and their 3d shape.

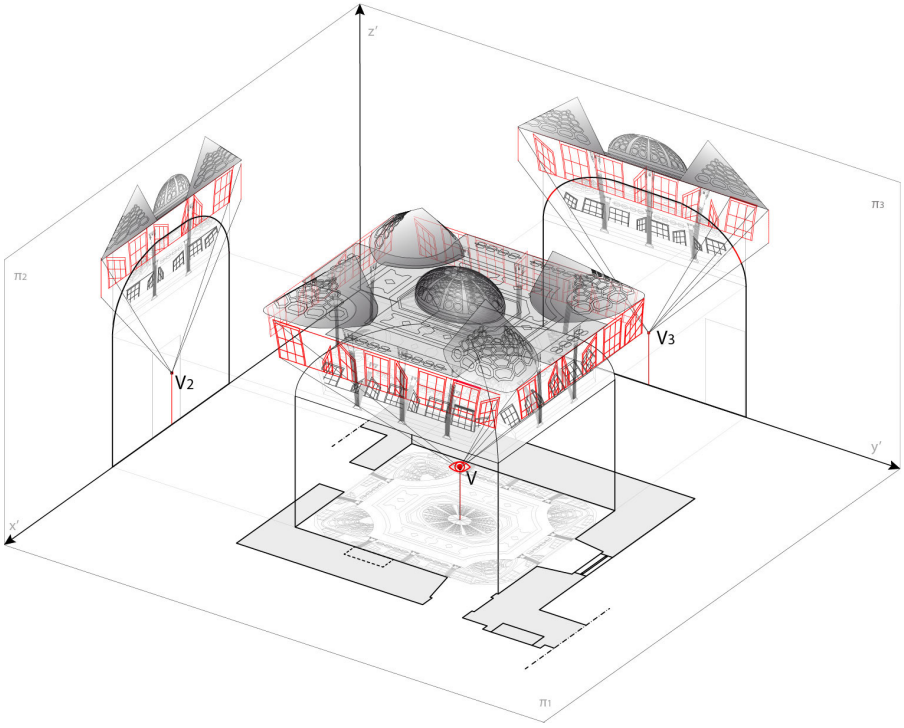

Fig. 08. Geometric reconstruction of the architectures painted on the pavilion vault. Axonometry.

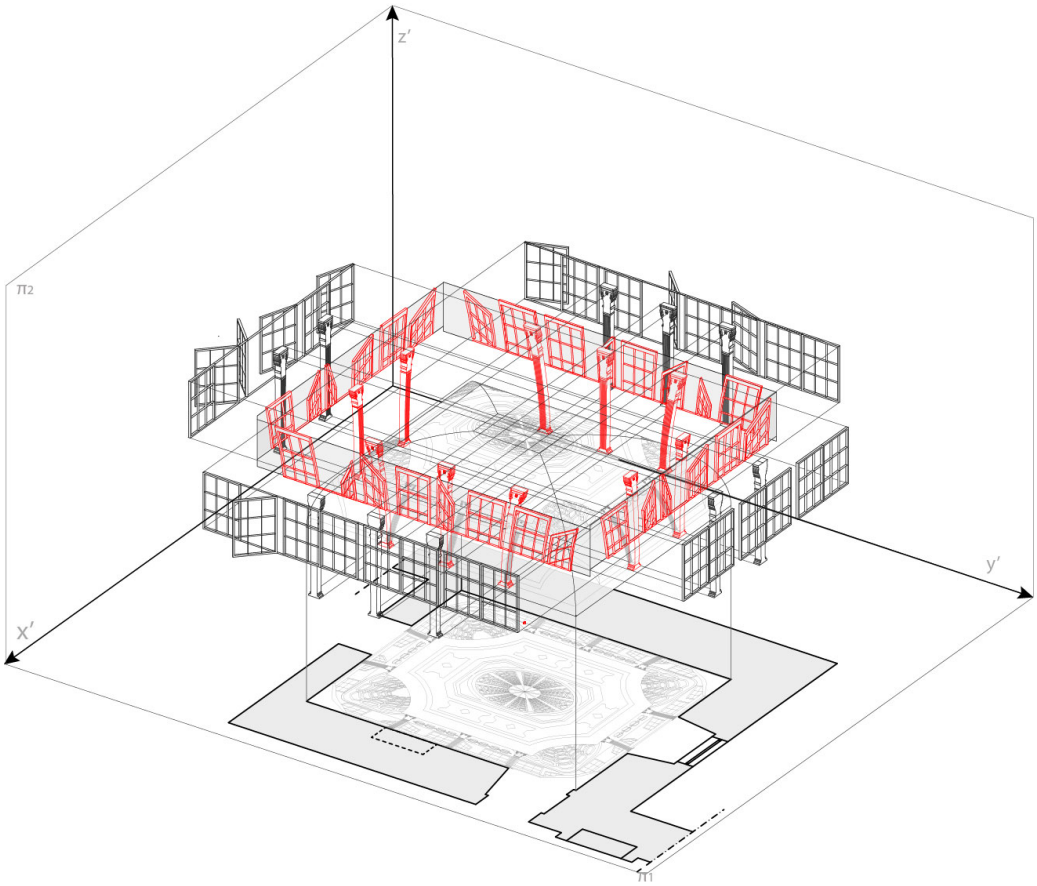

Fig. 09. Reconstructive model of painted architectures. Axonometry.

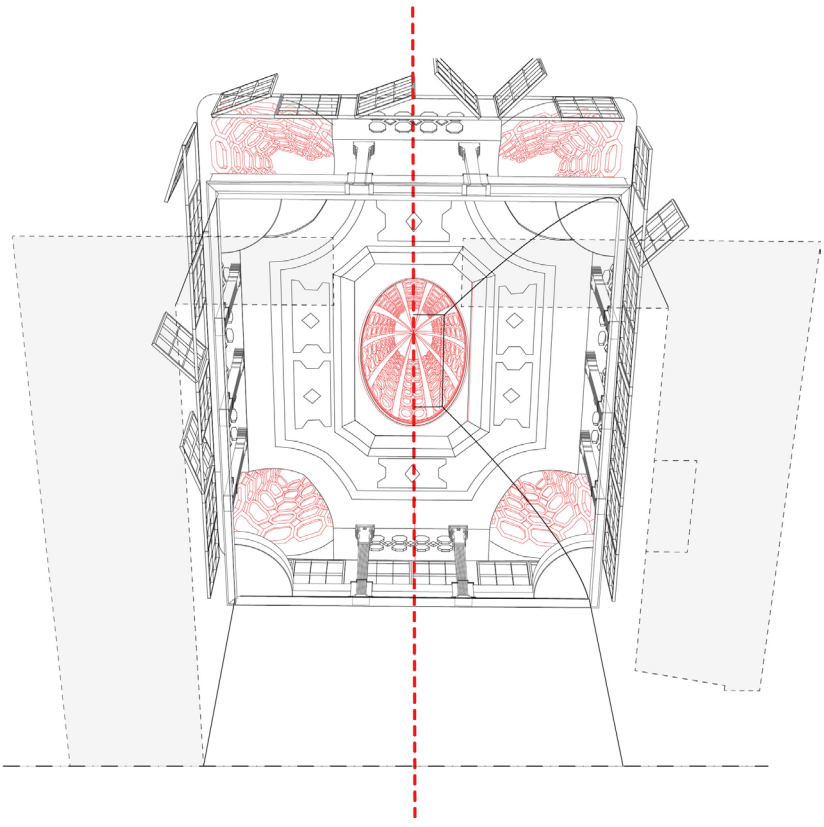

Fig.10. Reconstructive model of painted architectures. Perspective view.

Once the new vantage point is reached, it is possible to appreciate the spatiality obtained thanks to the 3D graphic modelling, while the wireframe scheme gradually dissolves (fig. 12). Once the geometric phase is completed, the synthetic image of the vaulted surface, gradually, is replaced by its image in its realistic aspect. After a few moments, some of the depicted subjects start short animations, with the aim of amplifying the communicative power of the represented theme. In particular, the subjects of the animations concern: some putti who fully express the painting bucolic concept and the telamons, whose gaze turned towards the observer gives strength and coherence to the illusory structure, calling the user to feel part of the representation. In the final stages, the synthetic 3D model integrated with the realistic image of the vault, slowly gives way to the whole realistic representation of the entire room.

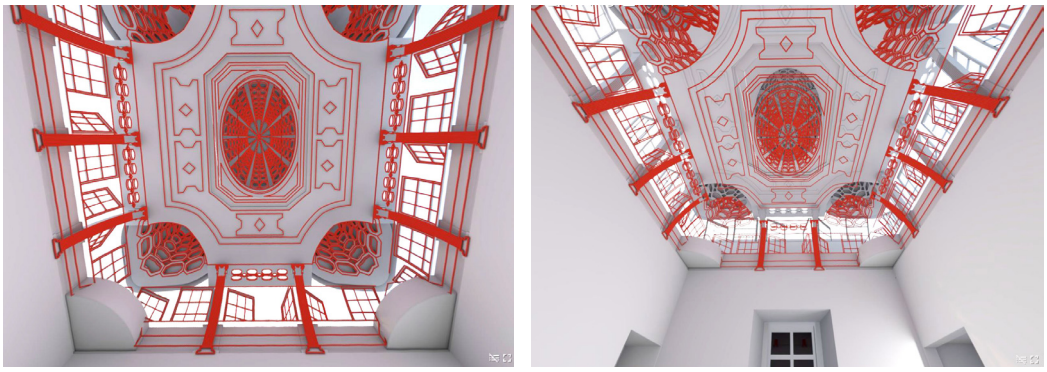

Fig. 11, 12. Perspective from the vantage point of view and from a generic one.

Acknowledgements

The authors would like to thank Gina Ferraiuolo for collaborating to the photogrammetric survey. Alessandra Pagliano is the author of the first two paragraphs, Annalisa Pecora is the author of the last two paragraphs.

References

Bartoli, M. T., Lusoli, Monica. (2015). *Le teorie, le tecniche, i repertori figurativi nella prospettiva d'architettura tra il '400 e il '700. Dall'acquisizione alla lettura del dato*. Firenze: Firenze university press.

Bonatto, D., et al. (2016). *Explorations for Real-Time Point Cloud rendering of natural scenes in Virtual Reality*. International Conference on 3D Imaging (IC3D), pp. 1-7.

Cioffi, R. (2020). Nuovi dipinti di Domenico Chelli: scenografo, pittore, architetto fiorentino e massone. In *Napoli Nobilissima,* settima serie ed., pp. 51-66 .

De Felice, P. (2009). *Il Real Sito di Carditello. Un'area da conoscere e valorizzare*. Maddaloni (Ce): La Fiorente.

De Rosa, A. (2016). *Quadraturismo in exergo. Immaginario proto-proiettivo nelle pitture murali prospettiche*. In Ciammaichella, M., Bergamo, F., (a cura di). *Prospettive architettoniche dipinte delle Ville Venete della riviera del Brenta in provincia di Venezia,* Roma: Aracne editore, pp. 48-52.

Eleftheriou, O. T., Anagnostopoulos, C. (2022), Digital twins: A brief overview of applications, challenges and enabling technologies in the last decade. In *Digital Twin* 2022, 2:2 < https://doi.org/10.12688/digitaltwin.17581.1 > (consultato il 2 aprile 2022).

Marino, M. F. G., (2020). Illusione e prospettiva nell'architettura dipinta di Domenico Chelli. In Bertocci, S., Farneti, F. *L'architettura dipinta: storia, conservazione e rappresentazione digitale. Quadraturismo e grande decorazione nella pittura barocca.* Firenze: Didapress, pp. 389-40.

Migliari, R. (1999). *La costruzione dell'architettura illusoria*. Vol I. Roma:Gangemi.

Migliari, R. (2014). Le Prospettive architettoniche: un ponte tra arte e scienza. In Valenti, M. (a cura di). *Prospettive architettoniche. Conservazione digitale, divulgazione e studio*. Studi e Ricerche, Vol. I, Tomo I, pp.1-4. Roma:Sapienza Università Editrice.

Pagliano, A. (2002). *Come l'apparenza adegui il vero e spesso ancor sovrasti,* Venezia:Cortina.

Authors
Alessandra Pagliano, Dipartimento di Architettura, Università degli Studi di Napoli "Federico II", alessandra.pagliano@unina.it
Annalisa Pecora, Dipartimento di Architettura, Università degli Studi di Napoli "Federico II", annalisa.pecora@unina.it

To cite this chapter: Pagliano Alessandra, Pecora Annalisa (2022). An immersive experience for the room with agrestic paintings in Carditello (CE). In Battini C., Bistagnino E. (a cura di). *Dialoghi. Visioni e visualità. Testimoniare Comunicare Sperimentare. Atti del 43° Convegno Internazionale dei Docenti delle Discipline della Rappresentazione/Dialogues. Visions and visuality. Witnessing Communicating Experimenting. Proceedings of the 43rd International Conference of Representation Disciplines Teachers*. Milano: FrancoAngeli, pp. 2724-2733.

Isbn 9788835141938