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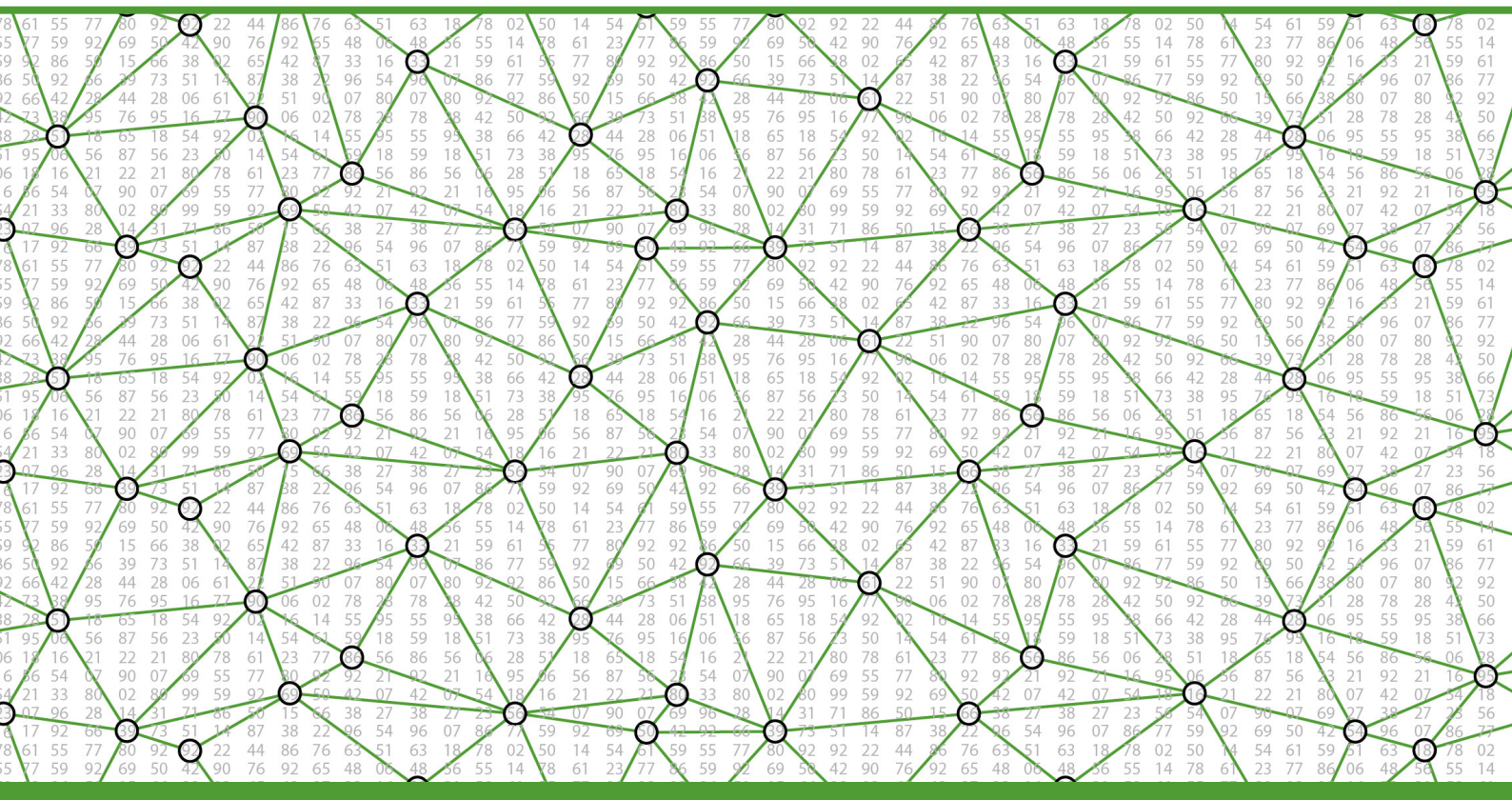
25 April 2024

REPRESENTATION CHALLENGES

New Frontiers of AR and AI Research for Cultural Heritage and Innovative Design

edited by

Andrea Giordano
Michele Russo
Roberta Spallone



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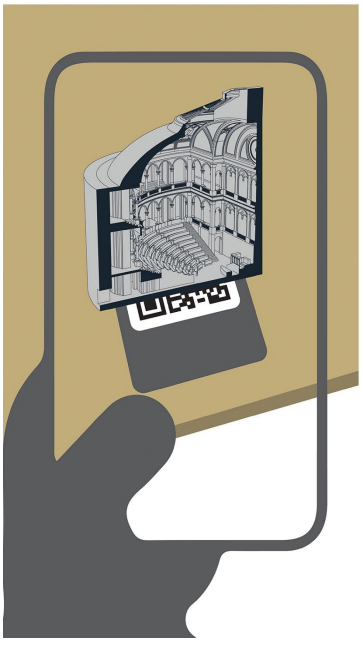
AR for Demolished Heritage: the First Italian Parliament in Turin

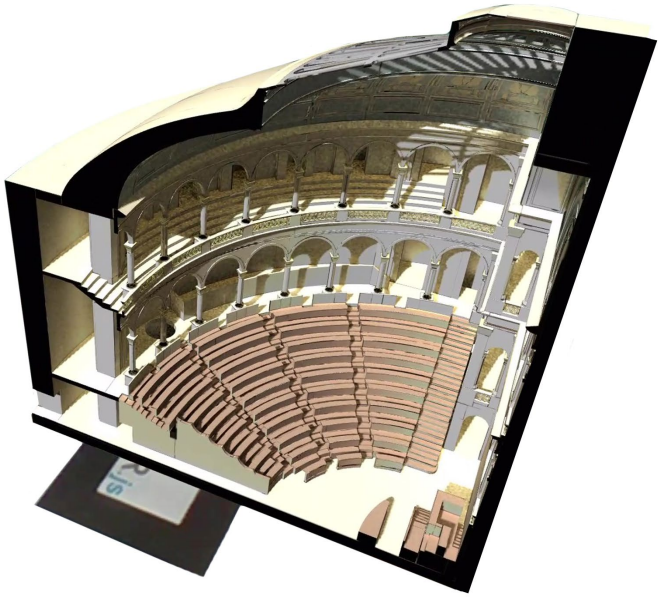
Fabrizio Natta
Michele Ambrosio

Abstract

This research presents a study of reconstructive digital modelling and AR application on the chamber of the First Italian Parliament located in the courtyard of Palazzo Carignano in Turin.
The study carried out in cooperation with the Direzione Regionale Musei del Piemonte, based in Palazzo Carignano, focuses on a building that no longer exists, a part of the demolished heritage that only remains in documents, archive drawings and historical studies.
The research that led to the creation of a 3D model began through a process of analysis and study of historical documents, consisting of both descriptive sources and various drawings of the architecture. The type and graphic characteristics of the sources influenced the degree of accuracy of the reconstruction, just as the type and mode of communication of this heritage affected the reconstructed digital model itself.
Through the use of AR applications, the model is to be represented and visualised in its design space, to be integrated into a larger and new virtual museum.

Keywords
demolished heritage, 3D reconstruction, archival sources, augmented reality, virtual museum.





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The Temporary Chamber of the Italian Parliament

In 1861, inside the courtyard of Palazzo Carignano, a parliamentary chamber was built in honour of the proclamation of Turin as the capital of Italy. The building, designed by Amedeo Peyron, an architect and engineer specialising in railways, was built in just three months from the end of 1860 as an extension for the building of the Chamber of Deputies of the Subalpine Parliament, which needed new space.
The semicircular chamber made of wood, iron and glass – in the courtyard of the then 17th-century C-shaped building – was only used for a short period; the new dynamics of the State have brought first to the change of Capital and, later, the new architectural requirements of the Palazzo Carignano complex led to the demolition of Peyron's building in favour of a reversal of Guarini's building to close off the courtyard.
Through the consultation of bibliographical sources such as printed texts and newspapers of the period, it was possible to retrieve various information, both regarding the structure of the chamber and its decorations. Using the archives and libraries in the Turin area, it was possible to trace the iconographic and documentary sources that made it possible to reconstruct the events that took place during the construction and the period immediately afterwards.
The chamber is set on a main structure of half circumference with a maximum height of 24 metres. The decoration project is of Lombard order, formed by a wide gallery composed of 21 arches, "very high for the diplomatic and state corps stands, the public, journalists and ladies"[1].
The schedule for the construction of the chamber was very limited. The construction was divided into two main parts, on one side the framework and on the other all the ornamental apparatus, the furniture and all the accessory works. Since the framework was the fundamental part, it was given the highest importance, also because the stability of the building depended on it. In little more than a week from the start of construction, the materials for the building were brought to the site, together with the drawings in the builder's hand.
In order to make the construction of this structure possible in such a short time, a technique of assembling the parts was used, which were specially created in various workshops in the surrounding area. Each piece was placed in the designated spot in such a way that "...the building appeared as a single unit, with no need for retouching. So that by 18 February 1861, when the King had called for the opening of the new Chambers, everything was in place"[2].

Fig. 1. Illustration relative to the session of March 14, 1861 in the First Italian Parliament. *L'Esposizione di Torino. Giornale ufficiale illustrato della Esposizione Internazionale delle industrie e del lavoro,* 15 gennaio1910, n. 1.

The chamber was inaugurated on 18 February 1861 with 443 deputies present. On the right of the throne were Umberto Prince of Piedmont and Amedeo Duke of Aosta, while on the left, in the gallery, the entire diplomatic corps (Fig. 1).
"The work, as reported in the newspapers of the time, was splendid and praised throughout Europe; it was also reproduced in numerous lithographs. It covers five years of extremely rich parliamentary activity, a crucible of the intelligence of the best men of our *Risorgimento*. The last sitting was on 28 April 1865"[3].

Working Methodology

The introduction of digital tools has made it possible to generate reality-based virtual models, which represent a complete tool for information synthesis and support in the understanding and analysis of Cultural Heritage. Through the integration of the sources, the study of the context and of the single artefact, it is possible to achieve the virtual reconstruction of 3D models of architectures that no longer exist, useful for proposing new historical-interpretative evaluations and virtual recontextualization.
The aim is to achieve a solution that is consistent not only with the data collected, but also with the iconographic and bibliographic sources and knowledge of the site [4].
In order to achieve scientific and academic rigour in projects of this type, it is essential to prepare the documentary bases in which the entire work process is collected and presented in a transparent manner: objectives, methodology, techniques, reasoning, origin and characteristics of the research sources [5].
This pipeline and the outcomes of the work presented were the subject of Michele Ambrosio's Master's Thesis (Supervisor: Roberta Spallone, co-authors: Sergio Pace, Chiara Teolato, Fabrizio Natta, Valerio Palma).

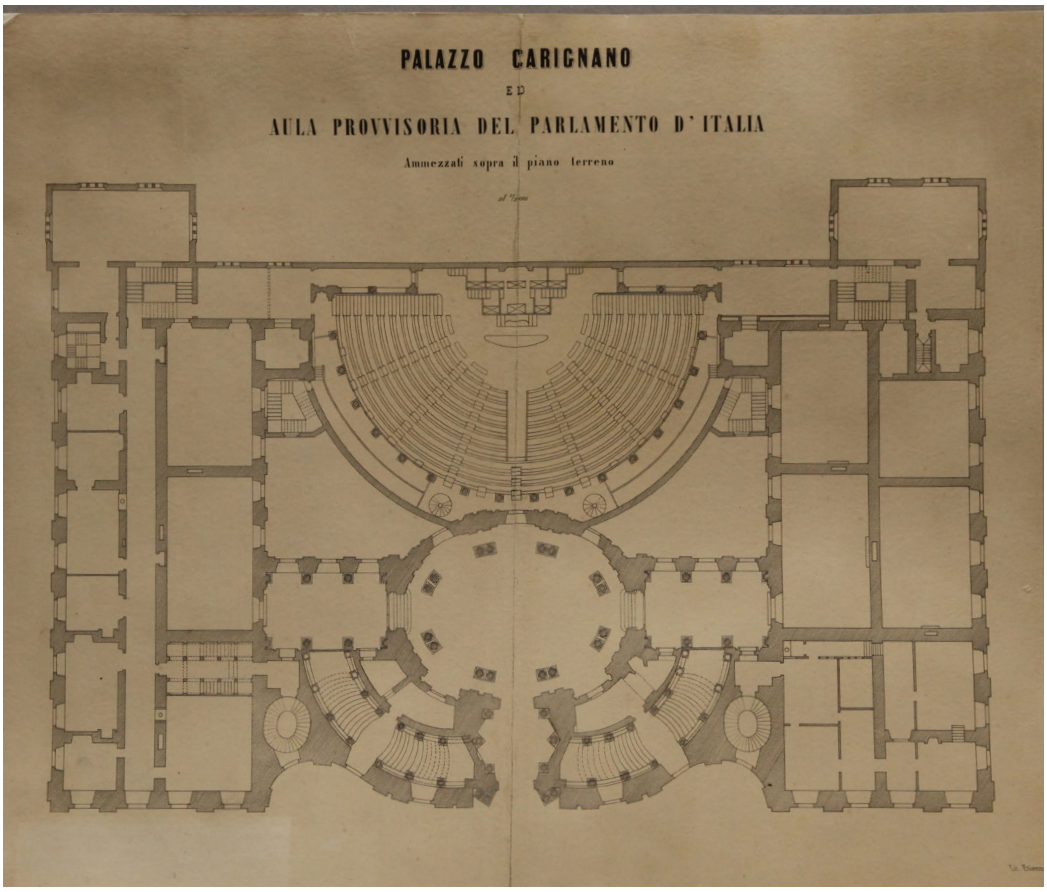

Fig. 2. Temporary chamber of the Parliament of Italy. Mezzanines above the ground floor. Risorgimento Museum.

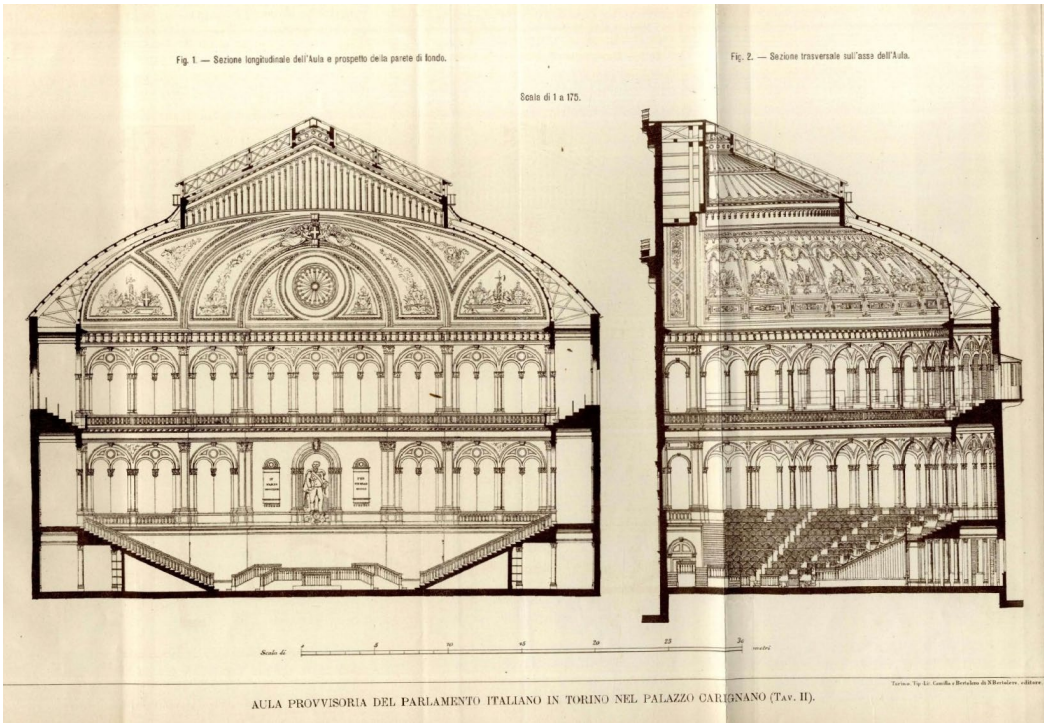

Fig. 3. Sezione longitudinale dell'Aula e prospetto della parete di fondo; Sezione trasversale sull'asse dell'Aula. In *L'ingegneria civile*... (1898), XXIC, 9.

The entire process leading to the digital reconstruction was mainly based on the definition of an objective, namely a reconstructive modelling of a building of which there is no longer any trace. The methodological procedure was developed first of all on the knowledge of the state in which the chamber was built before it was dismantled. The understanding of the structure was the action that started the process of knowledge of the work protagonist of the reconstruction activity. The process was carried out by researching archive documents relating to the building, including, in particular, an in-depth search for some of the drawings made for this project (Figs. 2-3).

Through the examination of bibliographic sources such as printed texts and newspapers of the period, it was possible to find out various information about the structure of the chamber and its decorations. Thanks to the consultation of archives and libraries in the Turin area, it was possible to go back to the iconographic and documentary sources that allowed the reconstruction of the events that took place during the construction and the period immediately following.

During the research, several views and illustrations were found that were fundamental for modelling the object of study and the main ones are presented below. The documents found in the Museo del Risorgimento were identified thanks to these sources: "A copy of Peyron's drawings for the temporary chamber was donated by the family to the local Museo del Risorgimento"[3]. "All the drawings used to make the temporary hall were requested and sent without exception to Rome, where they were normally used for the study of the temporary chamber in Montecitorio, which, in terms of shape, size and detail, reproduces those of the Turin temporary chamber"[2].

The next step was to catalogue and organise the sources in such a way that the reconstruction could be made transparent by linking the modelled elements to the documentary apparatus, which formed the basis of the research and was updated as the research process continued.

The data found was sometimes not completely consistent; the drawings in scales varying between 1:100 and 1:200 are in fact probable reproductions of the originals and published after the dismantling of the building. The integration of the missing data has been obtained through the comparison of the solutions compatible with the functionality of the parliamentary hall and the dimensional information of the architectural elements represented and/or physically surveyable.

Every source allowed the reconstructive modelling process and to make explicit an architectural and symbolic heritage of a particular historical period of our Country.

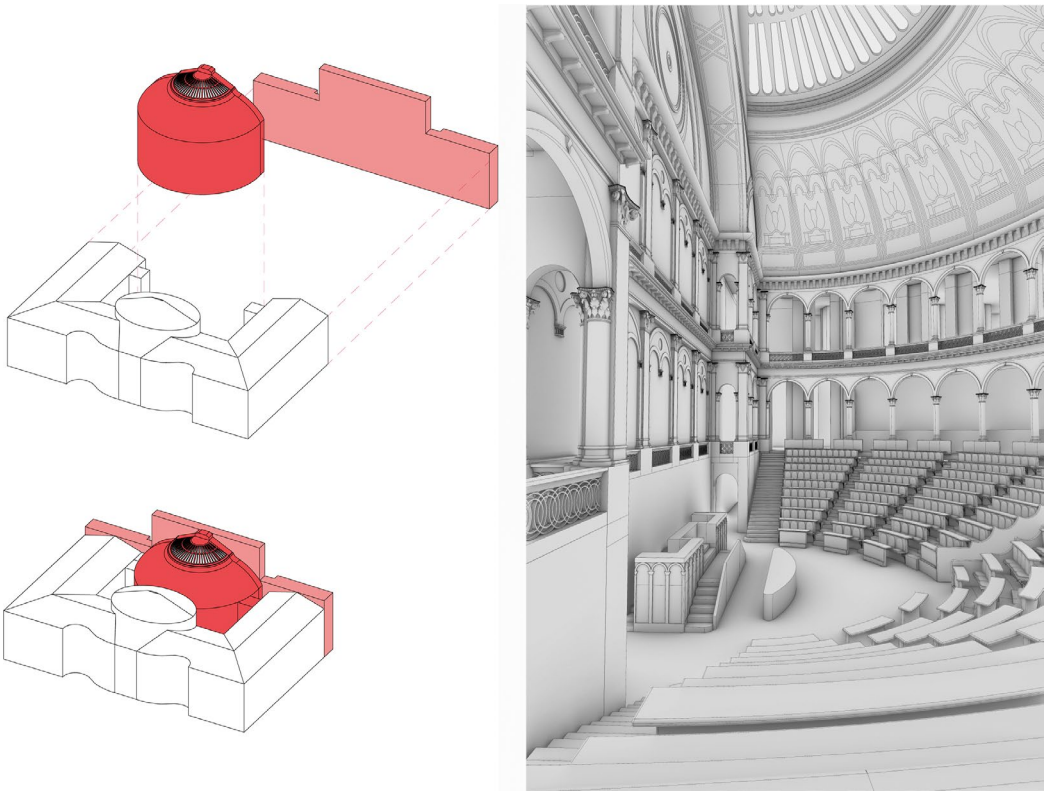

Fig. 4. On the left Schematic drawing of Peyron's work on 1860's Palazzo Carignano (Editing: M. Ambrosio); on the right Clay render of the temporary chamber (editing: M. Ambrosio).

Digital Reconstruction of the Temporary Chamber

All the sources were digitised using AutoCAD software. The redrawing process allowed for further analysis of the documents and verification of connections and inconsistencies between the various archive sources. The digital drawings produced form the basis of the three-dimensional modelling process of the work.
The modelling phase aims to generate, through the use of the software Rhinoceros, a virtual object that is the translation of the result of an investigation.
In an initial phase, a conceptual model was created, in order to concatenate the dimensions of the various elements, such as parallelepipeds with dimensions equal to what would later become a column with a capital. With regard to the decorations, reference was made to the iconographies found, although for some elements it was necessary to search for analogous elements with known and documented solutions or elements, in order to allow for their modelling (Fig. 4).
As for the coats of arms on the vault, an investigation was carried out into their origin, which led to an inspection of the still existing Subalpine Parliament where the coats of arms are still located as evidence of the destruction of the temporary chamber.
Once the modelling process had been completed, it was possible to move on to the rendering phase. The first task was to set the views and thus the relative proportions of the images to be exported. Immediately afterwards, attention was paid to the general lighting, which was configured with the model still without materials so as not to have reflections generated according to the different properties of the components.
The choice of camera positions within the Rhinoceros software was based on a careful analysis of iconographic archive documents. In fact, many of the main views have been set up by referring to drawings after the period of construction of the chamber, in order to allow a comparison with the past. The other views, on the other hand, were the result of a process that tends to enhance the main elements on which the modelling was based.
It was decided to leave almost all the renderings produced in conceptual style, except for one, which was compared with one of the iconographies. The materials were assigned in

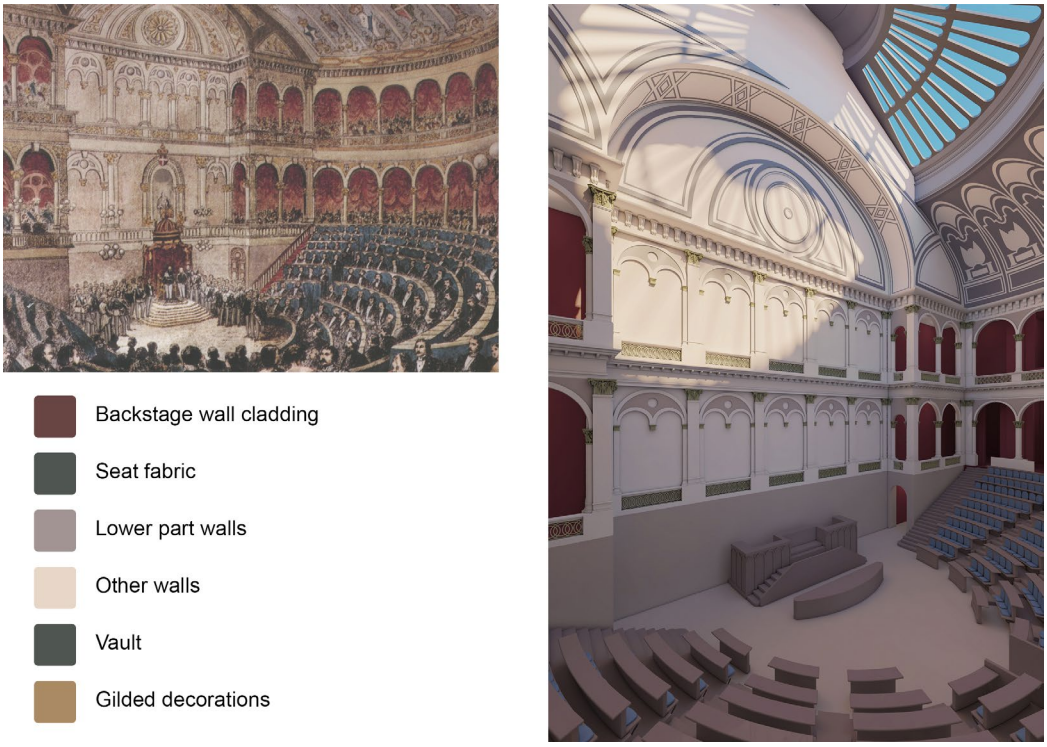

Fig. 5. On the left View of the interior of the temporary chamber during the inaugural assembly, colour lithograph based on a life drawing by Poirel; on the right Render of the temporary chamber (editing: M. Ambrosio).

the post-production phase in Adobe Photoshop. Using the eyedropper command, it was possible to create solid colour masks, which were superimposed on the conceptual render. Thanks to this procedure it was possible to reproduce what was an iconographic source, but graphically reworked through the process of three-dimensional modelling (Fig. 5).

The AR Model Application

Augmented reality requires tracking of the real environment in order to superimpose the virtual contents on the views framed by a camera. Tracking is achieved through visual techniques (based on camera images). There are two main methods: marker-based or markerless tracking.
The first adopts a camera, visualisation algorithms and easily recognisable landmarks positioned indoors or outdoors. These fiducial markers could be passive (printed markers) or, in less common cases, active (infrared emitters). The second, on the other hand, tracks the position of the camera, detecting and recognising geometric features in the real environment to establish correspondences between the coordinates of the 3D world and the 2D image. This approach can provide realistic tracking of the camera pose in real time.
In the case of the temporary chamber a passive marker approach was chosen, as the realised design is more suitable for a printed marker. The model used for the realisation of augmented reality was sectioned longitudinally. Initially, the heaviest meshes had to be greatly simplified in order to make the model as weightless as possible, allowing for a fluid visualisation. Once the cleaning procedure from Rhinoceros was completed, an export in COLLADA file (*.dae*) was carried out, which was then imported into the Blender software.
The objective was to implement a process of "texture baking", in order to create a texture that contained all the materials present in the model, as well as the lighting of the scene and therefore the existing ambient occlusion. A first difficulty was to gather all the same materials, which due to the export from Rhinoceros were differentiated for each single object present. The solution to this problem was found thanks to the use of a script created specifically to insert within each material code a node capable of displaying the UV map that would be created.

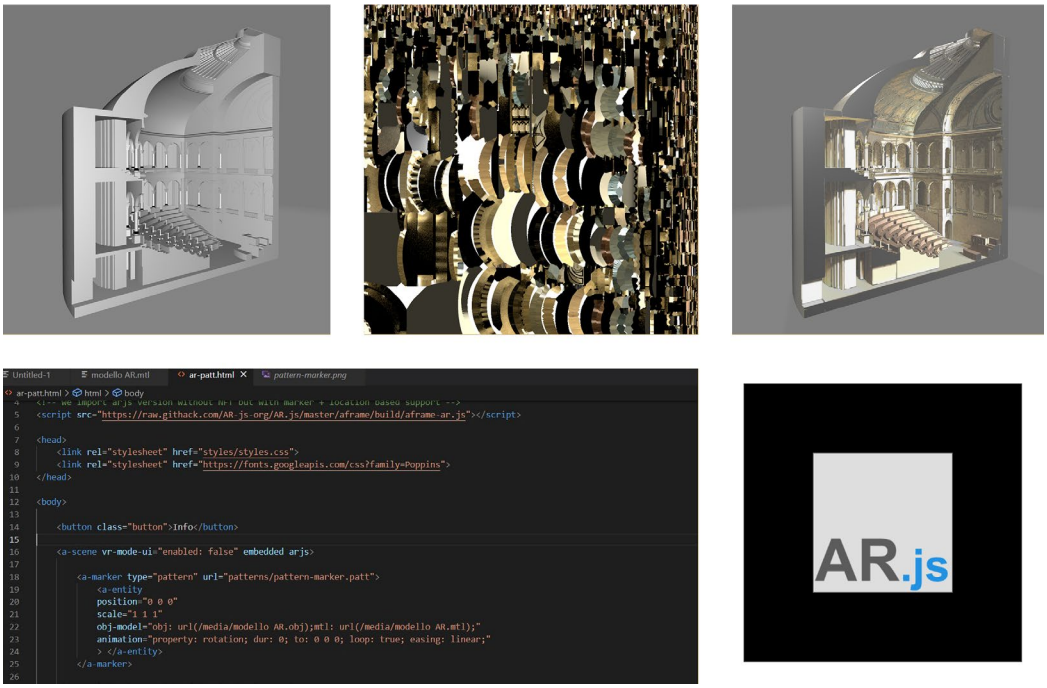

Fig. 6. On the top Texturing process for the temporary chamber sectioned model (editing: M. Ambrosio); on the bottom Project setup with Visual Studio and AR.js script (editing: M. Ambrosio).

Thanks to this process it was possible to create a unique texture.
The model was then exported in *.obj* format, which automatically generates a support file for the definition of materials (*.mtl*).
For the realisation of the AR application, the AR.js software was chosen, i.e. a library in Javascript language, which works through a web page. It is a free and open source (FOSS) project, AR.js allows AR functions to be developed with anchoring and tracking systems based on an image target.
In this case, no application was created, but the work was done on a local web page, using a target image to which the model is anchored. Visual Studio Code, a source code editor, was used to create the code in Javascript. The work was based on the import of the files obtained in the previous steps (*.obj* and *.mtl* files) and the definition of certain parameters (Fig. 6).

Conclusions

The case study, can lead to interesting developments in the filed of Culturale Heritage enhancement and immersive tourist experiences.
This study is in close relation to the cultural heritage and museum context. The working methods and objectives chosen have interfaced with the need for new forms of communication of heritage and security of personal spaces that the new global dynamics have brought.
The temporary chamber of the Italian Parliament in 1861 left a void in the courtyard of Palazzo Carignano. Unfortunately, the demolition of the chamber in 1865 left few traces of the building and thanks to the process of three-dimensional modelling, a model was drawn up to digitally represent the temporary chamber by Amedeo Peyron.
In order to make the experience complete, simplified with established pick-up and tracking points, the project can include tags with which to indicate different points of interest, specific information from the decorations and construction data of this temporary chamber inserted in a lively new digital context.
This research has been approached with the always open idea of a possible implementation, both with improvements regarding the geometries that make up the three-dimensional model, and all the representative apparatus regarding the prototyping of the visualisation of this reality (Fig. on the front page).

Attributions

This article was written by Fabrizio Natta in the sections *The Temporary Chamber of the Italian Parliament* and *Working Methodology* and by Michele Ambrosio in the sections *Digital Reconstruction of the Temporary Chamber* and *The AR Model Application*, finally sharing the *Conclusions*.

Notes

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