FROM ARCHIVES OF LOST ARCHITECTURE TO AR. CANONICA'S FARMHOUSES FROM THE XIX CENTURY TO THE PRESENT DAY

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The tangible and intangible traces of our heritage are the means for reconstructing the image of our history; in the context of today's technological advancement VR and AR are pivotal tools for reconstructing and narrating this reality. The pervasiveness of 3D reconstruction, however, requires reflection: how do we validate the products of these techniques within a broader scientific society, and how do we consider reconstructions of our heritage appropriate? In the case study here presented we will deal with the reconstructions of some rural complexes in the Park of Monza that no longer exist because they were demolished in the last century; these rural buildings had been built with specific functions to support the park and the life of the royal palace, which had lost their reason to exist when the productive life of the court had ceased. However, the hand that had built them had left several realizations that have come down to us, making the digital reconstruction with a strong hypothesis of verisimilitude.

INTRODUCTION

In this paper, we will address the methodological utilization of archival images and historical documents as materials for the reconstruction of some no longer existing historical heritage building and its context. Additionally, we will explore how the logical structure of these reconstruction processes can be validated. The archival image heritage of our Cultural Heritage has historically served as the foundation for the philological reconstruction of a heritage that no longer exists, as well as for the dissemination of its historical and educational contents. However, the coherence of reconstructions from archival images, as well as from historical narrative documents, and their validation, is still far from being conclusively established (De Luca, 2021).

The reconstruction of a building that no longer exists involves elements of creativity, while scientifically addressing issues related to scale, measurement, materials, uses, and the accuracy of previous surveys (Aubergel, 2021). Reconstructions of our past can therefore give rise to various interpretations; reconstructions, not only from a geometric standpoint, can lead to the dissemination of outright falsehoods (Piazzoni, 2020).

The epistemological debate regarding the implementation of virtual reconstructions is currently in its early stages. The literature has begun to systematically address these issues, starting with archaeological reconstructions, and progressing to Renaissance reconstructions (Apollonio, 2016), as well as in more recent works (Opgenhaffen, 2020). Currently, the debate is expanding to include computational calculation techniques and artificial intelligence (Croce, 2023), as well as the use of machine learning techniques (Croce, 2021) as tools to support reconstruction hypotheses or interpret existing artifacts (Spallone, 2020).

However, alongside scientific experiments, driven by the opportunities provided by digital survey and modeling tools and market returns, virtual reconstructions

have also captured the interest of other sectors. Virtual reconstructions have become part of tourist and museum routes, as well as in the realm of edugames (Mac Millan, 2019) or standalone video games. In this way, freed from the specific scientific coherence requirements of the academic world, virtual reconstructions have softy permeated culture with alternative images and models that may not necessarily align with historical contexts. Consequently, a world of digital copies has emerged, not necessarily coherent but ready for reuse in the digital domain, thereby spreading potential misinformation.

THE STATE OF THE ART IN RECENT RESEARCH

A common ground for defining the domains of disciplines related to digital reconstructions can be synthesized from their capacity to comprehend, understand, and utilize images or models. This includes the ability to learn and teach through images or models rather than textual content (Munster, 2020).

In this context, 'visual digital humanities' encompass research modalities that pertain to both the consumption and production of images and models, rather than textual content. In recent years, European research has dedicated efforts to this topic through projects of varying scales related to 3D modeling in Cultural Heritage, primarily focused on the 3D dimension derived from digital survey data of existing entities. Projects such as *INCEPTION*, *3DIcons*, and platforms like *DARIAH* (Digital Research Infrastructure for the Arts and Humanities.) are indicative of an open debate between analysis procedures and models to be validated through complex workflows and methodological standardizations.

Simultaneously, other projects such as *Time Machine* (Time Machine Europe-Adding a new dimension to the past) facilitate the interpretation of multiple historized documents and sources of different origins to reconstruct databases of

Fig. 1 Bassorizzi, 2023. Reconstruction image of the relationships between historical data, current state, and reconstruction hypotheses.
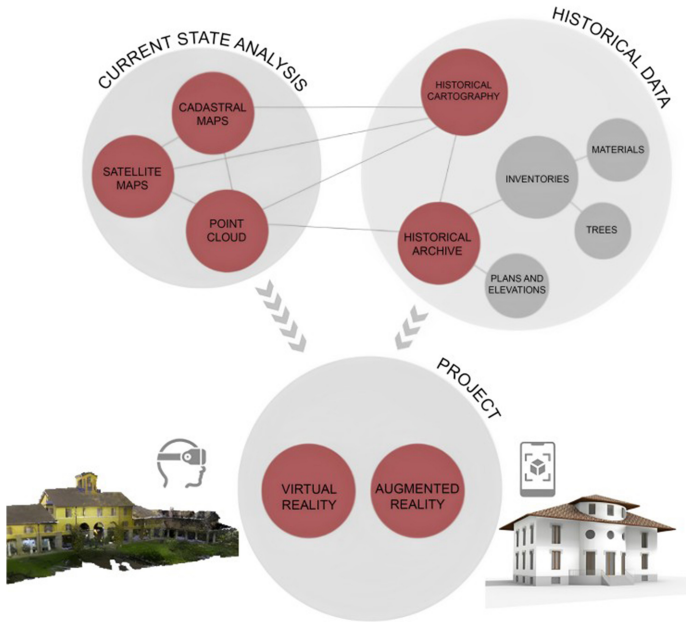
objects and scenes that no longer exist. This involves merging the vanished past with updated digital technologies, creating a digital information system designed to map economic, social, cultural, and geographical evolution over time. In this process, digitization remains the initial step in a series of data extraction processes from historical documentation, which includes segmentation and comprehension of documents

THE CASE STUDY

The history of Villa Reale begins during the Austrian reign of the 18th century when Empress Maria Theresa of Austria commissions architect Giuseppe Piermarini to build a summer residence for the archducal court of her son, Ferdinando d'Asburgo-Este, from 1771 choosing Monza as the location of a symbolic link between Vienna and Milan. Between 1777 and 1780, the Villa and its Gardens are constructed, characterized by neoclassical rationality and formal taste, respectively; the

Monza Park and the adjacent park of the Royal Palace are the result of a series of projects aimed at establishing royal gardens and a vast green lung, beginning in the year 1771. These endeavors were initiated by Grand Duke Ferdinand of Habsburg himself, initially assisted by Piermarini.

Over time, the park projects witnessed the evolution of green design concepts, initially following the principles of the French garden and later adopting the English style, under the guidance of architect Luigi Canonica.

Later on, Following Napoleon's coronation as King of Italy in 1805, Viceroy Eugène de Beauharnais establishes his residence in Villa Reale and proposes transforming a vast area north of Monza, abundant with particularly rich and diverse vegetation, into a Park. The Napoleonic intent is indeed to transform the Park into a hunting estate and a model productive company, rather than a simple leisure garden for the courtiers.

The inception of Monza Park unfolds as a protracted, articulated, and intricate process, primarily due to its

Fig. 2 Masterplan of Monza Park by L. Canonica 1815, State Archive.
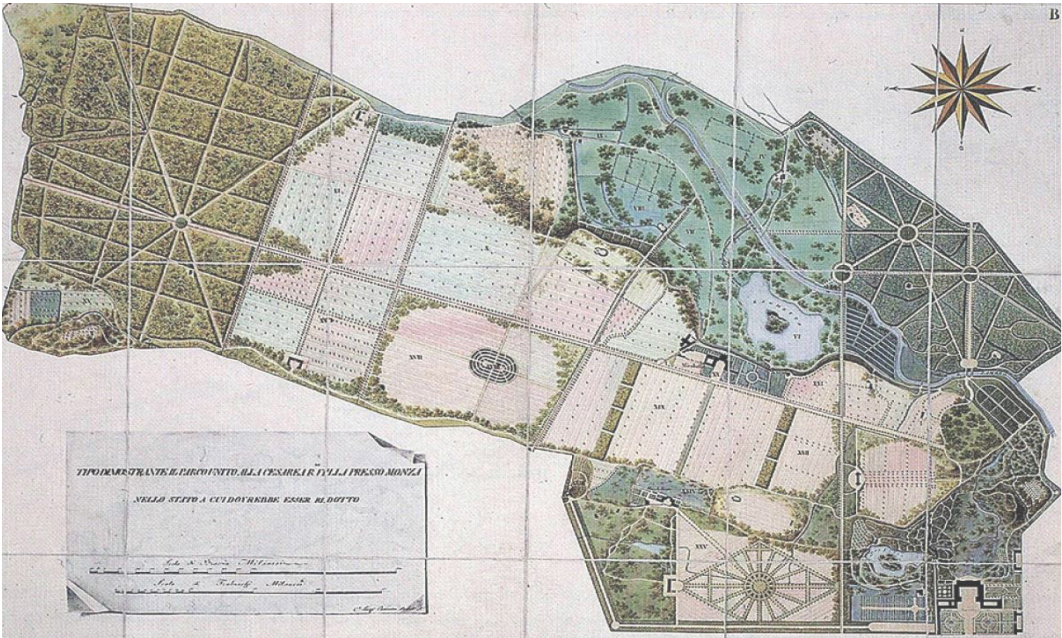
realization being preceded by the acquisition of requisite land. Following the completion of the land acquisition process, the project commences to materialize: the design embodies a comprehensive vision of the park, drawing inspiration from modern landscape garden principles and reaching back to Renaissance influences. Architect Luigi Canonica, a prominent figure in Lombard Neoclassicism, assumes leadership, shaping an expansive landscape to complement the existing Gardens of the Villa.

In the initial phase, Canonica dedicates efforts to crafting an extensive landscaped area spanning over 700 hectares as an extension of the royal residence. This entails creating ample green spaces and a diverse array of architectural and decorative elements. The park emerges from the acquisition and merging of new lands adjacent to those already owned by the court. Consequently, the architect focuses on establishing a complex spatial organization, comprising three main areas: the Reggia area, the central zone, and the agricultural zone. The Reggia area encompasses the Royal Palace, its gardens, footpaths, parks, and fountains. The central zone features vast meadows and centuries-old trees, adorned with a diverse array of flowers and ornamental plants. The agricultural zone, situated to the west of the park, is characterized by farmsteads, orchards, and cultivated fields.

With the perimeters and functions of the individual parts established, Canonica shifts focus to creating new architectural and decorative elements within the park. The aim is to craft a natural and lush environment distinguished by high-quality architectural and decorative features. In this phase, Canonica is commissioned, and he himself commissions the realization of various architectural structures, including the Temple of Diana, the Royal Pavilion, the Mirabello farmstead, Porta Monza, and the Lambro Bridge. All are constructed with meticulous attention to detail, utilizing high-quality materials and innovative construction techniques, thereby setting benchmarks for subsequent Park buildings. Canonica's interventions on

farms and mills exemplify 'cultivated rural architecture', representing minor architectural episodes with a controlled, elegant, and solid aesthetic. These changes are enriched by a chromatic interplay of different materials and references to the rural tradition of Brianza.

Parallelly, alongside the significant work of construction and restoration, there is an equally complex task of landscaping entrusted to gardener Luigi Villoresi. This involves maintaining existing elements and integrating them with the addition of thousands of new plants, regularization of plots designated for agricultural activities, and more.

Napoleon envisioned the park not only as a place of delights but also as a standalone agricultural production enterprise. The first function is fulfilled through an extensive reforestation and repopulation plan for wildlife, facilitating hunting expeditions. The second function is made possible by arranging a series of agricultural lands cultivated for fruits, vegetables, and hay, along with the construction of mills and rural buildings for the processing of raw materials.

Canonica's work: examples and typologies
Canonica introduced significant innovations in the design of the park, including the modification, demolition, and reconstruction of all rural buildings within the area. These works were then continued by his successor Giacomo Tazzini.

The existing architectural heritage at the establishment of the park was quite modest: single-story, single-body buildings following traditional distribution, serving essential functions for managing the countryside. In the modified farms, a floor was added to separate residential functions from animal shelter functions often. This pattern evolved in the second half of the 19th century into the creation of agricultural complexes composed of multiple buildings, each dedicated to distinct and independent functions.

In the distribution system, the scale connecting the floors is always external, protected by a portico, leading to a balcony providing access to the rooms. The roof and floor

structures are consistently made of wood with a covering of clay tiles. The load-bearing masonry is constructed with solid bricks (given the ample availability of clay) and coated with plaster obtained from a mixture of sand, a small amount of lime, and readily available farm materials like straw, blood, or pig fat as binders. For coloring, generally green, pink, or ochre yellow, colored sands are used.

Buildings designed by Canonica maintain simple lines and a single body, with modifications involving the addition of porticoes attached to pre-existing structures. Tazzini's intervention, on the other hand, was certainly more decisive, often resulting in changes to floor plans, the addition of new floors, turrets, side wings, etc.

In their entirety, all the farmsteads in the park still constitute a significant example of high-quality Lombard rural architecture. They were constructed for specific service functions while simultaneously needing to embody an image of prestige and power for the court (Regione Lombardia, 2023). However, what has come down to us today pertains only to a portion of the constructions from that era.

Within Monza Park, at least eight farmsteads disappeared during the 19th century, some of which were modified by

Fig. 3 Reconstruction of Cascina Piotta.

Fig. 4 Reconstruction of Cascina Monzina.
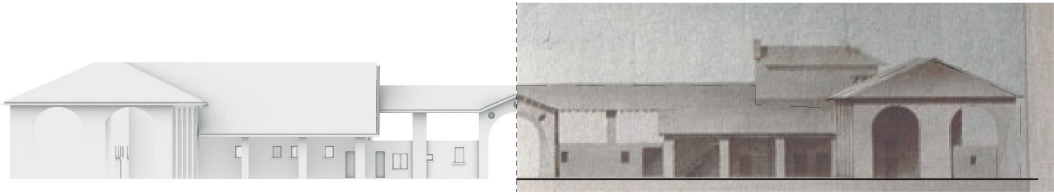
Fig. 5 Reconstruction of Cascina Monzina compared with an archive drawing.

Canonica in the first two decades of the century. For some of these, Canonica himself suggested their demolition due to their deteriorated conditions and the limited architectural value of the buildings, while others were simply torn down when they ceased to serve their original functions.

Documentation for these eight examples, however, remains in the project archive at Canonica's Mendrisio, Switzerland location. Among them is Cascina Caimidi, whose original attribution is uncertain. It was demolished in the second half of the 19th century, having previously served as a residence for hunters and a kennel. Cascina Colombirolo, also of uncertain attribution, was built between 1809 and 1817, later demolished in the 19th century, previously used as a stable. Cascina Michelona, of uncertain attribution, was demolished around 1817, having previously been utilized as a nursery.

The following farmsteads –Geroncello, Latteria, Monzina, Passerina, Piotta– were all modified by Canonica between 1805 and 1818. During this time frame, he reworked the buildings by adding stables, poultry houses, porticos, sometimes additional rooms. However, all were demolished in the second half of the 19th century, leaving their names in the toponymy of the park. Nevertheless, the floor plans and some views are preserved in the Mendrisio archive.

A FAITHFUL RECONSTRUCTION

The case presented here concerns the reconstructive hypotheses of some farmsteads modified by Canonica that no longer exist but were located within Monza Park or the

adjacent park of Villa Reale. These structures belonged to a specific historical phase of the Park, coinciding with the implementation of Canonica's initial project. They aligned perfectly with openings and orientations towards meadows or woods created with specific scenographIC designs, featuring a morphology of specific tree species. The following procedures were employed for the digital reconstruction of these examples:

1. 3D acquisition of existing parts of similar adjacent buildings;
2. Previous 2D surveys of existing parts;
3. Original project documents;
4. Non-metric iconographic sources of the studied artifact (prints or similar);
5. Metric and non-metric iconographic sources related to artifacts similar to the studied one.

All these sources were used for the reconstruction of the historical threshold of Canonica's Park monumental project. The current state of affairs and the still-existing green areas are no longer exhaustive as the park has been repeatedly modified over time. A comparison between the present situation and certain iconographic sources became necessary.

Fig. 6 Historical thresholds related to changes in the gardens, in the fusion between the English and French gardens. In red, the location of the Dairy Farm.

1815   1830   1838   1850   1900
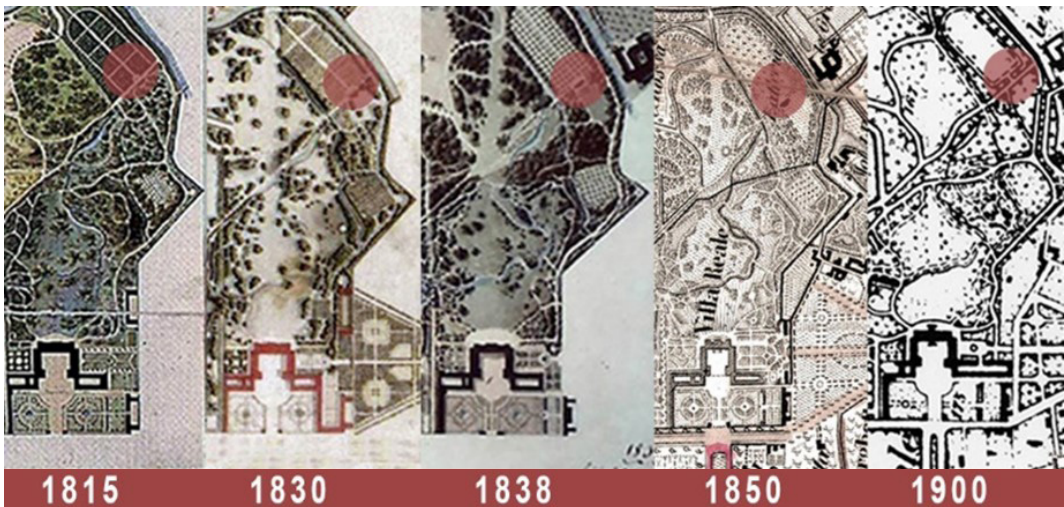
As documentary sources for the reconstruction of the no-longer-existing farmsteads, drawings from the Luigi Canonica Collection in the Modern Archive of Mendrisio were utilized. The documentary sources from Monza Park (Pellissetti, 2009) include survey and project drawings by Piermarini, Luigi Canonica, and Giacomo Tazzini. Through a rigorous and constant comparison of site plans for the expansion of the park with views and images, it became possible to reconstruct the context in which Luigi Canonica's project was realized. Historic site plans and drawings of the farmsteads that dotted this context are preserved.

THE SPACIAL LITERARY RECONSTRUCTION

In the process of reconstruction based on the iconography preserved in the archives of Mendrisio from the Canonica collection and project drawings, the reconstruction of the Monzina, Geroncello, Piotta, and Latteria farmsteads was carried out. The 3D models of the demolished farmsteads required special attention focused on studying their original locations, as the areas where they were once built and later demolished have undergone significant changes. An illustrative example is the Latteria Farmstead, constructed on a pre-existing building between 1805 and 1818 and demolished in the second half of the 19th century. Creating a natural and lush environment around the farmstead is crucial for recreating the design and rural atmosphere of the past, enhancing the authenticity of the virtual environment for potential visitors.

For the Latteria Farmstead, it was possible to verify its original location in the corresponding green area in the current state. In Luigi Canonica's project for the Latteria Farmstead, the building consists of a three-story structure with a rectangular footprint and a hipped roof. The central feature includes an elliptical hall arranged over two floors. Canonica's design demonstrates his skill in combining the

functional requirements of the building within a structure with classical and prestigious features. The facade is adorned with neoclassical elements, providing an elegant touch. With the demolition of the farmstead in the 19th century, the associated green space, designed with a specific optical telescope, lost its original distinctiveness.

The phase of creating the 3D model relied on the original historical documentation produced by Canonica, utilizing the project drawings found in the archive, composed of a detailed project description sheet at a scale of 1:100 (Russo, 2021). Proportions and geometric shapes were directly derived from the document, while for material processing, reference was made to buildings still existing within the park that were constructed by Canonica. From the same period is the restoration of Casalta Vecchia, not far away, later modified by Giacomo Tazzini (Diego, 2001).
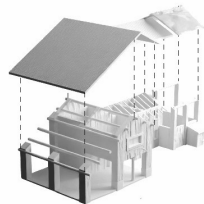
The use of NURBS surface modeling software, employing extrusions and the application of textures specifically

Fig. 7 Longitudinal section of Casalta, both old and new, with stylistic elements and materials used for the reconstruction of Latteria Farmstead.
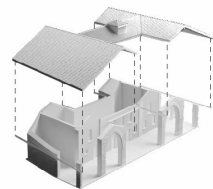
Fig. 8 Decomposition of the general structure of the reconstructed farmsteads.
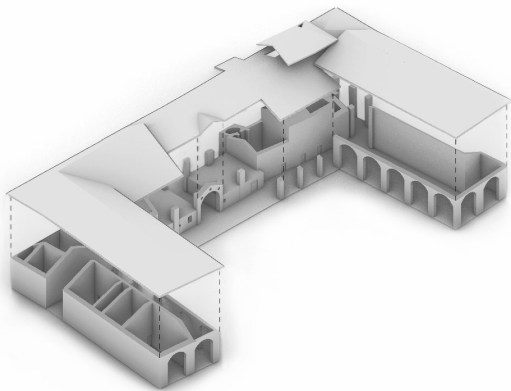
Cascina Monzina   Cascina Geroncello   Cascina Piotta

created and extracted from other existing buildings within the park, allows for a virtual representation faithful to archival documents. Using the same approach, the vanished architectures on which Canonica had worked were then recreated.

THE DOCUMENTED ENJOYMENT OF NEW SPACES

To allow visitors to the Monza Royal Villa Park to explore the history of both existing and lost farmsteads over time, it was decided to develop a prototype smartphone application utilizing augmented reality (Palma, 2019). In this way, walks can not only benefit from the existing heritage but also provide a view of what is no longer there, placed in its original location. For managing augmented reality, the 'Vuforia' plugin was chosen, a mobile software development kit enabling the creation of augmented reality applications, integrated into the 'Unity' asset, a cross-platform graphic engine allowing the creation of interactive content such as architectural visualizations and real-time 3D animations. To use the augmented reality function through the Vuforia software, some modifications to Unity settings are necessary. The first step involves inserting the AR Camera into the settings, representing the device's camera on which the application will be used. Subsequently, the image target is loaded, acting as a visual marker for augmented reality creation. For each of the farmsteads, the corresponding site plan was selected as the image target. By pointing the camera of any smartphone device at it, users can visualize the respective three-dimensional model through augmented reality technology.

To add the image target, a new database was created on the 'Vuforia' website. Subsequently, the package of the new database is downloaded and imported into 'Unity', where the scene is organized by selecting the elements that will be displayed by the AR application on the device.
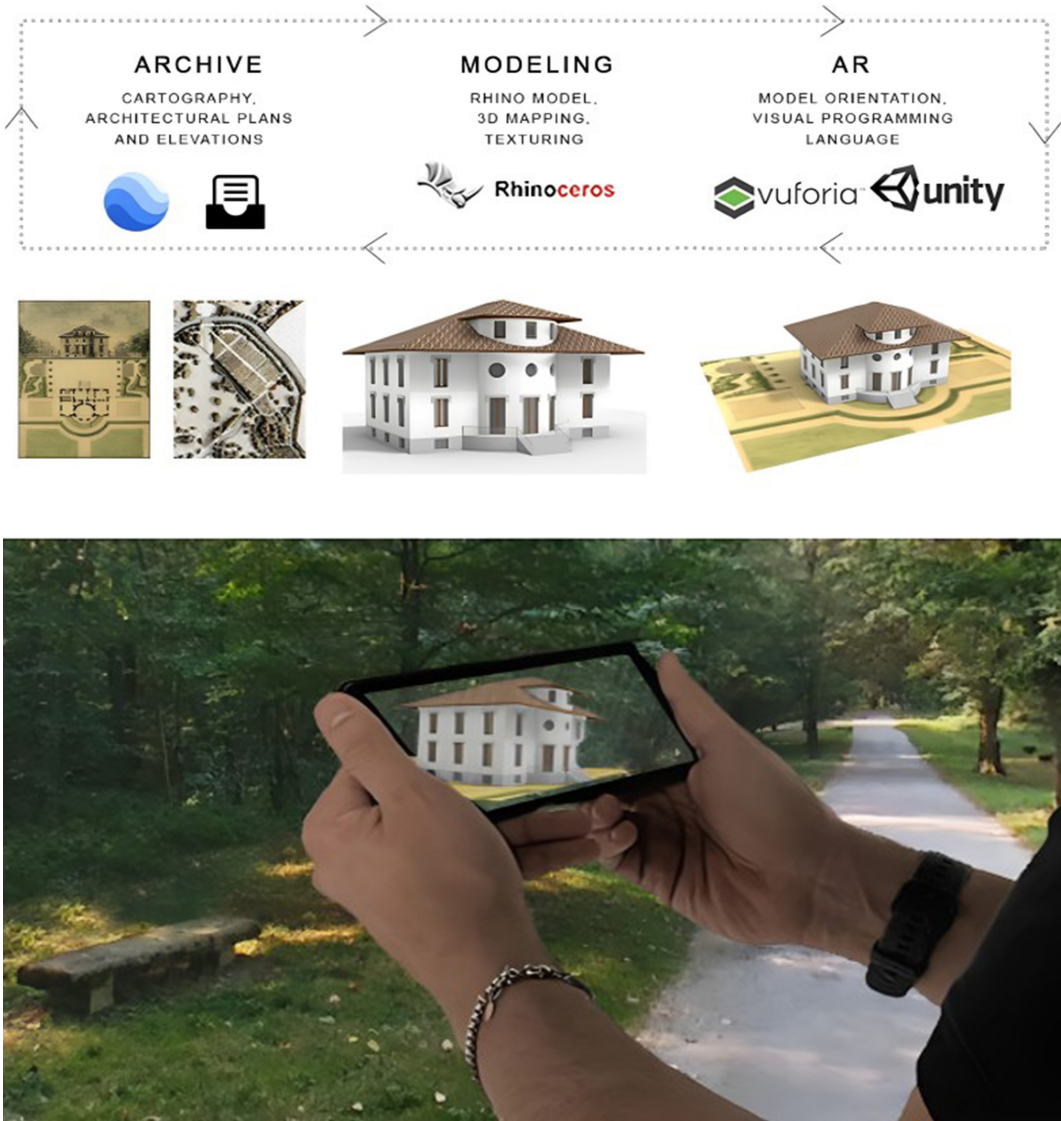
Fig. 9 General process from modeling based on archival documents to placement on-site through augmented reality (AR).

The final phase of the project involves incorporating the image targets into dedicated boards that provide specific information about the examined phase, enhancing and enriching the AR visualization.

CONCLUSION AND NEXT STEPS

This paper traces the development of a modelling for an immersive use of a series of buildings that no longer exist. The accuracy of the modelling and the coherence with previous realizations was made possible by previous survey work and in-depth analyses carried out on the still existing farmsteads in the Park; it is only scientific expertise, with the geometric study of the proportions and in-depth study of the building techniques of the period that made it possible to reproduce and place the models exactly on the Canonica project drawings.

There is a close relationship between the materials of historical documentation and the modelling of an artefact that no longer exists, where knowledge of the typologies and architecture canonica built in the period of his time play an important role. Stylistic features such as stone arches, large trusses of existing buildings, cornices in masonry and others were reproduced in the existing modelling. In the future space of this research, the benchmarks to be used for the faithful reproduction of the models will be increasingly codified in the search for an effective validation of the models, created with a view to offer immersive experiences that are playful yet effective for the preservation of our architectural heritage.

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