The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences, Volume XLVIII-M-2-2023
29th CIPA Symposium "Documenting, Understanding, Preserving Cultural Heritage:
Humanities and Digital Technologies for Shaping the Future", 25–30 June 2023, Florence, Italy

VALORIZING CULTURAL HERITAGE BY EMPLOYING DIGITAL TECHNOLOGIES FOR SURVEY AND COMMUNICATION: THE CHURCH OF SAN VINCENZO FERRERI

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KEY WORDS: Reality-based survey, closed churches, digital enhancement, cultural heritage documentation, augmented reality.

ABSTRACT:

This paper proposes a reflection on the role of digital technologies as a tool to know and enhance architectural and artistic heritage through non-invasive modalities and technologies. The article is part of the broader research work on the closed churches of Naples's historic center, with the Church of S. Vincenzo Ferreri as the case study of this experimentation. The church still has an extremely rich decorative apparatus deriving from various stratifications. However, it is seldom open to the public only when exhibitions and events are hosted. The paper will comply with the foundational concepts of survey and digital architectural representation in the interpretation processes of the architectural heritage to evaluate the validity of alternative fruition techniques aimed at expanding the knowledge of this heritage to the community.

1. INTRODUCTION

The vast architectural heritage of unused religious buildings has been central to a rich debate for some decades. This involves ecclesiastic and political administrations and cultural academies and associations. The architectures making up this heritage are diversified by styles, history, size, and typology and often conceal invaluable assets which contribute to narrating the identity of places. Moreover, these churches no longer have the conditions to be open. The reasons behind the abandonment are diversified and are related to changes in needs, the impossibility of using and managing the buildings, or their conservation state.
These assets can be turned into valuable resources if they are restored through programs and projects aimed to foster and keep up processes of social and economic development of the territory. Such projects must not be limited to individuating different uses for the abandoned places but also new forms of fruition through virtual experiences, which can stand as an opportunity for knowledge, sharing, and inherent enhancement of the architectural landscape of our cities.
Concerning that, the present paper proposes an experience using the digital tool to promote documentation and communication of architectural and artistic assets through non-invasive and sustainable modalities.
The possibility to use survey tools and increasingly sophisticated visualization modalities for the knowledge and communication of the historic built environment has allowed for setting up interactive, fully explorable multimedia documentation.
Indeed, in the last few years, several applicative experimentations have employed interface tools (mobile devices, viewers, glasses, etc.). These have proven the mediation role of the operational practices of survey and architectural representation between the real and the digital worlds.
The new technological supports, based on other perceptive forms of reality and digital content – such as augmented reality, virtual reality, and projection mapping – allow enriching and increasing multi-sensorial experiences involving the architectural and artistic heritage. It is then possible to propose non-invasive and highly customizable solutions regarding the spatial characteristics of places, tailor-made to suit visitors' needs.
These technological supports are increasingly often considered alternative forms to real and static images; they provide art and architecture with more solutions for communication and sharing. Spaces can be examined through representations with dynamic features concerning users' involvement.
An effective communication project is based on a necessary project of comprehension, interpretation, and extraction of meanings and values aimed at individuating the most suitable modalities of information transmission.
In this framework, representation plays a key role when designing graphical interfaces with access to information systems and communicating information with tridimensional models that allow creating various interaction levels. Hence, technology does not represent the solution to the communication problem but instead represents the tool to build structures for knowledge acquisition and diffusion (Di Luggo, Di Dato, 2016).
This experimentation has adopted communication techniques to provide heterogeneous informational data in a direct and shared form, creating a reality-based architectural narration.
The goal has been to experiment with two different approaches to enjoy the physical appearance of architecture both when it is accessible to the public and when there is no possibility for access.

Figure 1. Interior view of the Church of St. Vincent Ferreri.

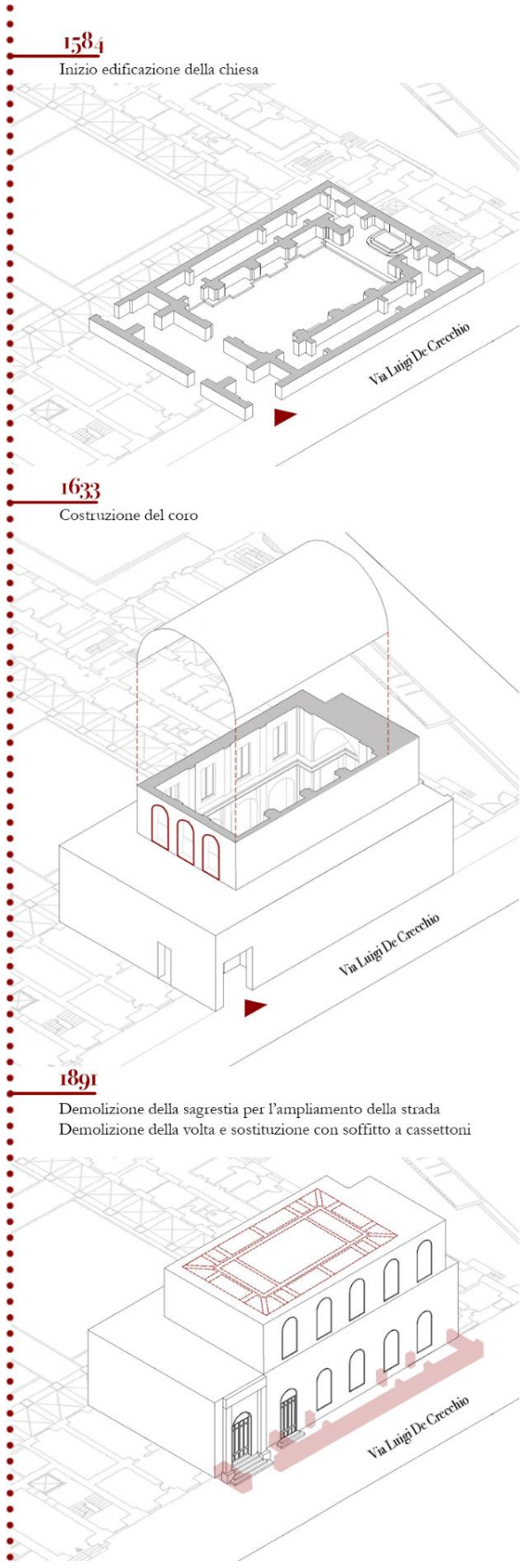

Figure 2. Historical evolution of the Church of St. Vincent Ferreri. Drawing by M. Petrone, C. Romano.

For this purpose, projection mapping was employed. Specifically, in this case, it used the architectural surfaces as a screen to project various information content and a visual communication approach based on a mobile device's camera.
The chosen case study was the Church of San Vincenzo Ferreri, included in the former monastic complex of Sant'Andrea delle Dame in the historic center of Naples.

2. THE CASE STUDY

This experimentation fits in the framework of the studies conducted by the research group in the last few years on the religious heritage of the city of Naples in collaboration with the Associations and institutions operating on the territory. It is one of the numerous closed churches in the historic center of Naples: the Church of San Vincenzo Ferreri, in the former monastic complex of Sant'Andrea delle Dame, which hosts the Faculty of Medicine and Surgery of the University of Campania "Luigi Vanvitelli", is currently assigned to APN (Associazione Presepi Napoletani, Association of Neapolitan Nativity Scenes), seldom opening its doors. The church's floor plan has a single aisle, punctuated by side chapels and separated from the presbyterial area by a large triumphal arch. It takes almost the whole Eastern wing of the monastery and is characterized by a sumptuous decorative apparatus, proving the prestige of the Neapolitan artistic schools from the 16th and 17th centuries. This small Baroque jewel is particularly significant from a historical and architectural point of view. Still, it is – unfortunately – scarcely known and documented since it is open to the public only when it hosts exhibitions or events (Figure 1).
The research shows that the Church of San Vincenzo Ferreri has received numerous interventions over time; these can be recognized in the whole floor plan, consisting of the superimposition of different artistic languages. Due to the scarce and non-exhaustive documentation, an integrated interpretation of direct and indirect sources was performed (Figure 2).
In 1533, during the Spanish Viceroyalty, the city wall was moved west by the will of Don Pedro de Toledo, including a strip of unbuilt land in the urban territory. The 1566 Lafrery view shows the urban situation just before the formation of the land plot of the monastery of S. Andrea delle Dame. In 1583, four sisters of the Palascandolo family bought a land plot measuring 1477 palms belonging to the San Gaudioso monastery in S. Agnello Maggiore a Caponapoli (Colombo,1904). The construction works of the monastic complex started in 1584, on a project by the founders' brother, Innocenzo, in collaboration with architect Valerio Pagano. Construction works continued for several years, but as of 1587, the first core of the monastery already existed; in 1590, the sacristy was built. Following other land purchases, the monastery reaches the size illustrated by the 1629 Baratta view, which clearly shows the borders of the building block and the church inside the convent, including a sacristy overlooking the street. In 1631, after the church's completion, the sacristy was expanded, and the choir was realized in 1633. The most relevant works were executed after the 1732 earthquake. They were participated by engineer Costantino Manni, who directed the construction of the new lookout, which can be seen in the 1775 map by the Duke of Noja. In the 19th century, after the suppression of religious orders, the nuns were moved to the monastery of Santa Maria Egiziaca in Forcella, and the monastery was destined for homeless families. In 1891, the adaptation of the convent into a university hospital started on a project by engineers Pier Paolo Quaglia and Guglielmo Melisurgo. During these operations, the sacristy was demolished, and the church's façade was moved backward to expand the current Via Luigi De Crecchio. Moreover, the superelevation of

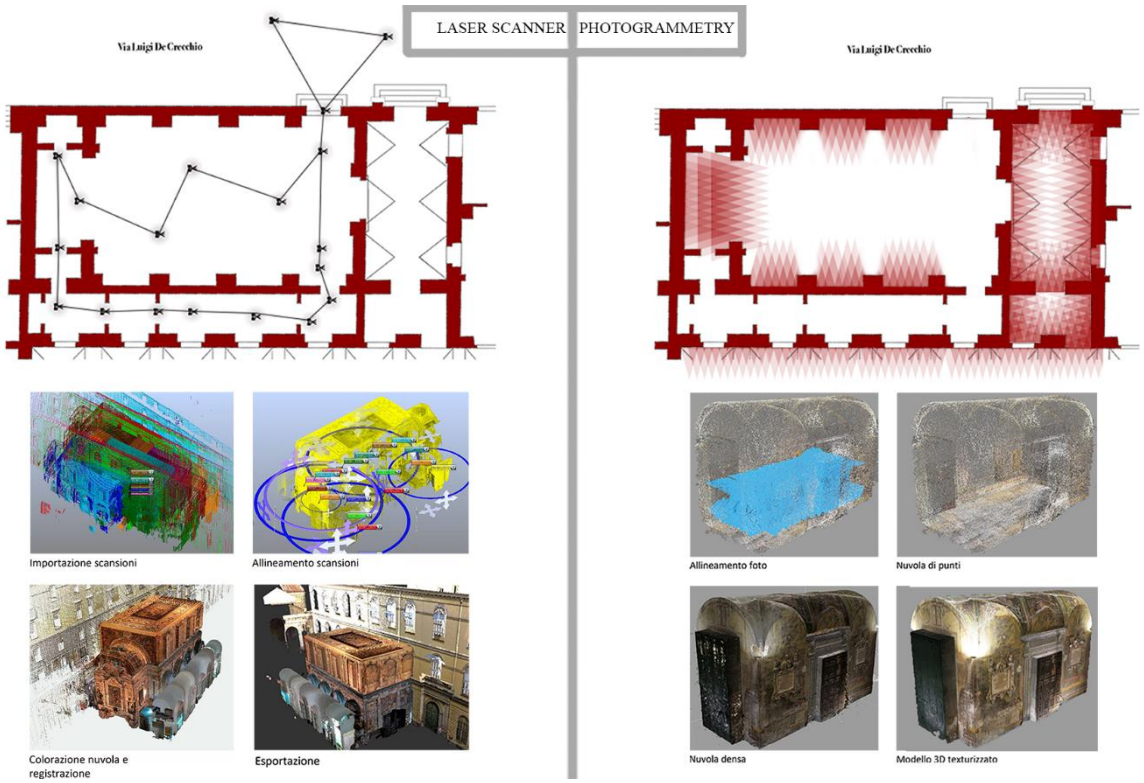

Figure 3. Scan position (left) and photo acquisition (right) to build the 3D reality-based model.

the building by one floor led to the demolition of the buttressed vault of the church, substituted with a coffered ceiling. During the 20th century, the church suffered significant structural damage from World War II and the 1980 earthquake. In the current urban layout, resulting from the various urban redevelopments involving the whole building block, the church is wholly incorporated and camouflaged in the university building. The church is richly decorated and has a double quadripartite layout. The lower one is characterized by the presence of 3 chapels on each side, framed in a system of Corinthian pilasters. The fourth aisle hosts access to the main body of the church on one side and the sacristy's entrance on the opposite. On the upper level, there is the same layout of pilasters, but it frames 4 trompe-l'œil windows on each side. Along the surfaces, very evident scars have been left by the mending intervention on the cracks, realized within the consolidation project supervised by Roberto Di Stefano.

3. DATA COLLECTION

The organization of a suitable information system to share the extraordinariness of this place with the collectivity followed a specific study to understand and interpret the site, its history, and its related material and immaterial values.

The choice to adopt specific acquisition technology and work methodology was influenced by considerations tied to the characteristics of the building and the established objectives.

Data collection was subdivided into various phases characterized by an integrated use of diverse acquisition technologies to obtain a complete model of the interior and the spaces next to the church. The possibility to integrate the data acquired through range-based and image-based technologies allowed for maximizing their potential and optimizing the acquisition and data processing phases. For the Church of San Vincenzo Ferreri, a 3D survey has been performed using a Faro Focus S150 Plus laser scanner to acquire geometric-architectural data and terrestrial digital photogrammetry to achieve more photo-realistic results for the main altar and the frescos. This allowed obtaining digital, photo-realistic morpho-metric data to set up models for the virtual investigation of the whole church, also with multi-scalar detail levels (Figure 3).

The first survey phase was conducted on the external façade of the university building, in particular, the entrance of the church on Via Luigi De Crecchio, the interior of the main body of the church, and the spaces of the sacristy.

The preliminary reflections on the site conditions allowed more accurate planning of the data acquisition phase, preventively individuating the survey stations. The employed laser scanner enables recording scans on the site, permitting workers to verify superimpositions and possible noise in real-time. Moreover, the closed-loop acquisition covers all areas, obtaining complete and homogeneous data that facilitate final data processing. Due to the characteristics of the surveyed area, the camera has been set to

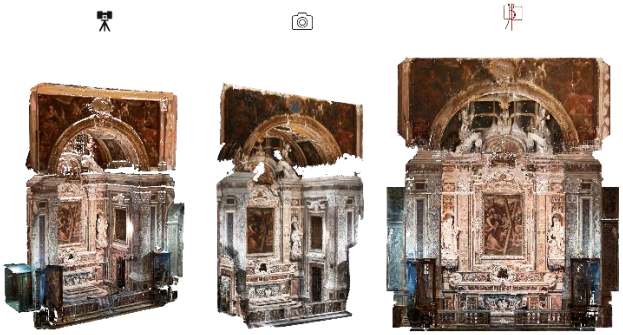

Figure 4. Integration of the point cloud obtained from the laser scanner survey with the point cloud from terrestrial photogrammetry.

Figure 5. Orthophoto from the final point cloud and graphic restitution of St. Vincent Ferreri Church. Drawing by M. Petrone, C. Romano.

internal view, with 1/4 resolution and 3x quality. In addition, the tool has an integrated HDR camera, which permits an ideal contrast with any lighting condition; for this purpose, a 3x HDR value has been set.

In total, 19 station points have been chosen: 3 external ones for the connection between Via De Crecchio and the internal space, nine inside the main body of the church and the presbytery, and 7 in the side rooms of the sacristy. Overall, the survey lasted 4 hours.

The acquired data were imported into the proprietary software FARO SCENE and processed. The following operations were sequentially performed: semi-automatic scan alignment, coloring, point cloud registration, and exporting. The check report proved a correct scan overlapping, reporting a mean error of 1.6 mm.

To obtain a suitable 3D model representing the extraordinary richness of decorative apparatuses, the second survey campaign involved integrating the data acquired with the laser scanner with a terrestrial photogrammetric survey. In particular, the photogrammetric shots were focused on the main altar and the side chapels. Moreover, since the atrium before the main body does not allow accessing the church due to the permanent closure of the door, this area was acquired with a photogrammetric process up to the door between the sacristy and the cloister to complete the data.

Terrestrial photogrammetry was performed with a non-professional camera Canon EOS 1100D, guaranteeing photogram overlapping above 70%, with horizontal and vertical photo slides to avoid result invalidation during data processing.

Figure 6. Graphical rendering of the flooring of the Church of St. Vincent Ferreri. Drawing by M. Petrone, C. Romano.

This acquisition phase returned a total of 1.089 photograms, which were used to obtain a photorealistic result of the decorative apparatus and integrate the data acquired with the laser scanner.
Photographic images were processed through the Agisoft Metashape software, resulting in a tridimensional texturized model of the rooms. Finally, the various models were aligned and connected using shared photograms in each chunk.
Integrating the collected data allows for filling the gaps in the various acquisition modalities. Indeed, laser scanning was not sufficiently thorough in each case to output the complexity of the decorated surfaces (Figure 4).
Instead, integrating data from laser scanning and photogrammetry allowed a unitary and complete interpretation of the structures and decorative apparatuses.
The point cloud acquired by laser scanning was used as a reference. First, the point clouds from laser scanning and photogrammetry were superimposed in a CAD environment. This allowed for increasing the density of the acquired data; after obtaining the complete point cloud, the orthophotos were generated to output the geometric-dimensional and decorative data of the artifact (Figure 5).

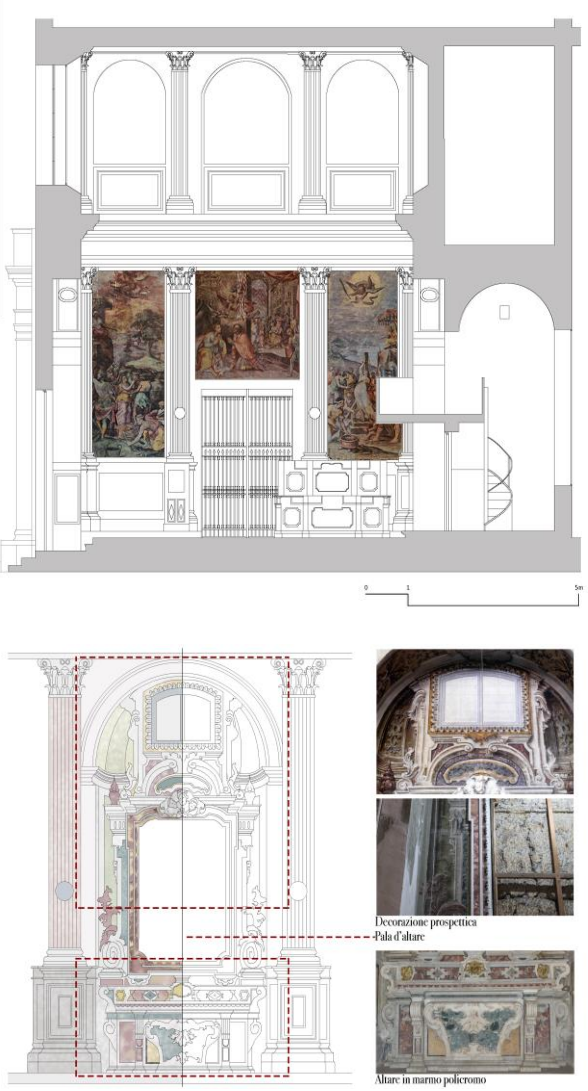

Figure 7. Detail of the counterfacade and altar side chapel. Drawing by M. Petrone, C. Romano.

The extraordinary richness of the decorative apparatus and the artworks in San Vincenzo Ferreri required a process of interpretation by decomposition, starting from the complexity of the overall area, detailed on the specific parts to read its intrinsic values. Hence, the articulation of the internal spaces was studied first; then, the pavements – which differ in each room – were analyzed.
The pavement of the atrium consists of lavish stone; in the sacristy, there is a marble pavement with squared slabs, while opus sectile pavement around the altar and the 18th-century earthenware pavement of the main body by Ignazio Giustiniani have significant artistic value. The central figures of the work are richly framed by decorative motifs with floral festoons, cherubs, various animals, and bright colors, such as green, yellow, and light blue, which firmly stand out on the white lacquered background (Figure 6).
Then, greater detail was achieved for the frescoes decorating the counterfaçade, in addition to the Baroque style of the marble altars of the chapels and the main altar (Figure 7).

4. AUGMENTED FRUITION

The overall analysis and acknowledgment of the values of the various parts analyzed singularly have allowed reconstructing elaborations at multiple levels of knowledge and experimenting with suitable communication forms, both on the site and at a distance.
The realized surveys allowed designing an articulated communication system on multiple levels of building interaction to valorize the church of San Vincenzo Ferreri and make it visitable. The first level allows immediate communication and is conceived for short visits or when the church is closed to the public. Instead, the second level proposes a more in-depth visit route, where communication occurs experientially, employing sounds, animations, and graphical reconstructions.

4.1 Tipe- 1 Fruition

The first fruition modality allows virtual visits to the church through mobile devices. Thanks to an App, it is possible to access the preset digital content, navigate the 3D model of the building, and view the related informational content. This type of experience can be started at a distance, online, but also on-site just outside the church through a direct link activated by the geopositioning of the smartphone, and the camera recognition of

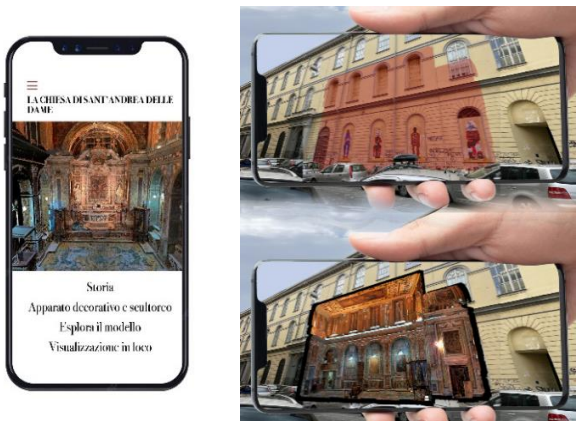

Figure 8. App and visual communication proposal with navigation in the 3D model.

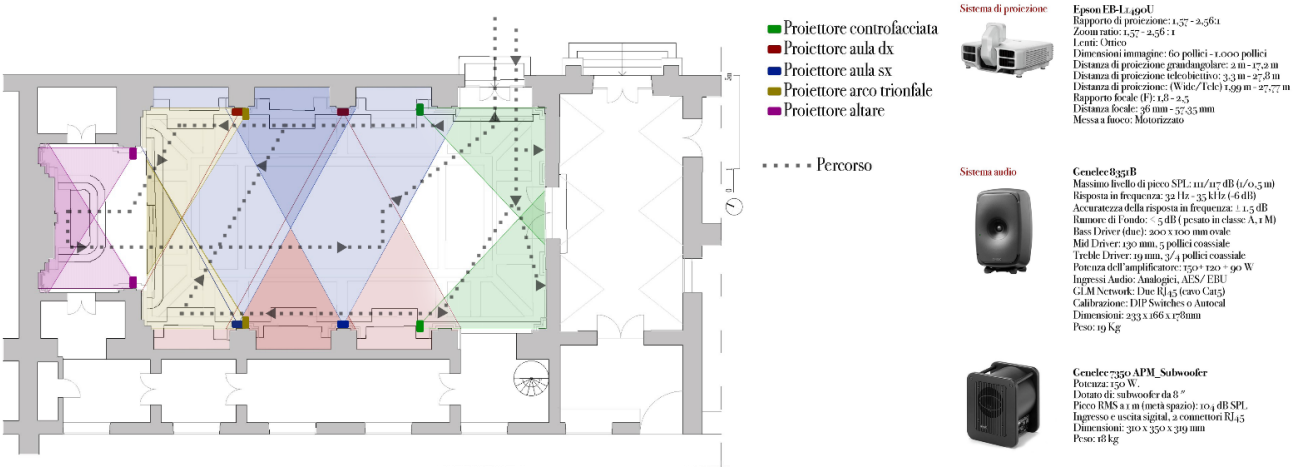

Figure 9. Light and sound mapping design. Drawing by M. Petrone, C. Romano.

the prospect of the university building concealing the Church of San Vincenzo Ferreri.

In particular, through an AR-based visual communication approach (Russo, 2021; Maniello, 2018), which can be activated through the smartphone or tablet's camera, the city becomes permeable thanks to the superimposition between the digital content and the real building.

In this way, the church can be seen beyond the walls enclosing, hence allowing users to walk the internal space in the virtual representation made of the point cloud and the photographic model of the laser scanning survey, in addition to accessing the preset informational content with opportune hotspots (Scandurra, 2016).

Hence, users can use their mobile device as a magnifying lens to experience an otherwise conc ealed asset. In this sense, the real object is enriched with data and information but is never wholly substituted. Instead, the virtual and the real object coexist at the same time and place (Figure 8).

4.2 Tipe-2 Fruition

The second fruition modality regards the design of an exclusively on-site tour. This required setting a period when the space is open to the public. In this case, the project involves a continuous-cycle representation in the only aisle of the church, based on the alternation between dark and light, highlighting each of the relevant elements individuated in the multi-sensorial narration.

The goal is not to alter the perception of the real space but instead orient visitors' looks in an ordinate way so that each of the parts of the architecture is suitably valorized.

This led to designing the projection of light, video, and audio content directly on the architectural surfaces, so that architecture directly participates in narrating itself.

The project aims to interpret the constitutive parts of architecture, making them a communication means by interacting with them through light, digital animation, and sound effects. On the one hand, these are aimed to illustrate what is no longer present and valorize the remaining decorative apparatus, highlighting through new visual approaches (Figure 9).

Designing the mapping (the choice of tools and methods) for this case study involved elaborating a specific workflow and establishing the times and modalities of storytelling.

The mapping project was realized based on the survey data: it consists of the set of correspondences between the real objects and what is projected on them. Naturally, projection mapping and punctual lights work best in optimal dark conditions. Therefore, the projectors have been chosen and set so that they work in perfect synchrony, setting the projection distance with the support of the digital model of the building, to achieve a projection size that is adequate to the typology of narration. To achieve the desired storytelling, the following elements have been elaborated for the mapping: digital images to be projected on the surfaces, the lights needed to highlight the single elements at the right time, the coincidence with music and sounds, the times of the narrative voices to be activated throughout the visit route. Hence, lights and sounds guide visitors along a fixed

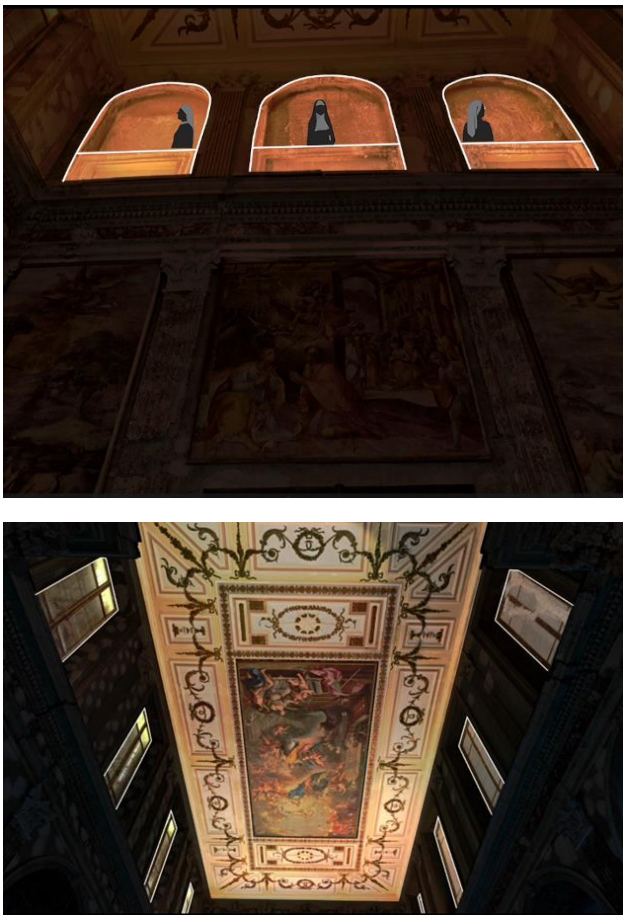

Figure 10. Light and sound installation for the oriented tour in the Church of St. Vincent Ferreri.

course. Each phase of the projection, including choosing the content, switching between sources, and regulating audio and video was digitally managed and tested through simulations supported by the mesh model from the survey.
Hence, the time of observation is turned into a time for knowledge. In this sense, the interaction between the real and the digital components helps provide an exhaustive iconographic and perceptive comprehension of the whole building (Figure 10). This avoids dispersing the gaze, as the richness of this decorative apparatus might easily create this risk.

5. CONCLUSIONS

Digitalizing cultural heritage and creating platforms of data, animations, and tridimensional reconstruction have redefined spaces, times, and relationships with knowledge.
The evolution of the accessibility to cultural heritage and its dissemination produce numerous advantages concerning the application of information technologies to communication. In this specific case, animations and graphical reconstruction results were undoubtedly more immediate than the classic and traditional textual support: the digital acquisition of the building allowed for overcoming the constraints imposed by the structures.
This paper aims to provide insights into the positive effects of these “augmented architecture” forms for inaccessible or hardly accessible places. The proposed experience underlines that these techniques allow sharing virtual simulations and documental sets. On the one hand, these favor inclusive and sustainable promotion processes of architectural heritage; on the other hand, they represent an interpretation tool to restore these places in the circuit of possible experiences provided by the highly significant context of the historic center of Naples.

ACKNOWLEDGEMENTS

The research was developed within an agreement of scientific collaboration between Commissione Arciconfraternite di Napoli and the Interdepartmental Research Center Urban/eco, under the scientific coordination of Prof. A. di Luggo.
Surveys and graphic elaborations have been realized by M. Petrone and C. Romano for the thesis entitled “La Chiesa di Sant’Andrea delle Dame: Dal Rilievo alla Conoscenza”, with proff. A. di Luggo and D. Palomba as the supervisor and proff. L. Repola and S. Scandurra as assistant supervisors.

REFERENCES

Alabiso, A. C., Campi, M. e di Luggo. A., 2016. Il Patrimonio Architettonico Ecclesiastico di Napoli, Art Studio Paparo, Napoli.

Colombo, A., 1904. Sant'Andrea delle Dame. Napoli Nobilissima, vol. XIII, fasc.

De Rosa, F., 2014. Valori e valutazioni del paesaggio storico urbano: metodologie e approcci per la conservazione integra-ta e gestione dei siti UNESCO. BDC Università degli Studi di Napoli Federico II, 14, 1-2014.

Di Luggo, A. e Di Dato, G., 2016. Sistemi innovativi per la rappresentazione delle trasformazioni del costruito storico: la facciata del Duomo di Napoli. Delli Aspetti de Paesi. Vecchi e nuovi Media per l'Immagine del Paesaggio, vol.II, CIRICE - Centro Interdip. di Ricerca sull'Iconografia del-la Città Europea, Napoli, pp. 209-217. ISBN 978-88-99930-01-1

Maniello, D., 2015. The Video mapping projection for promotion of cultural heritage: The GLOWFestival case. http://www.academia.edu/25552175/.

Maniello, D., 2018. Miglioramenti e implementazioni della realtà aumentata spaziale applicata su modelli in scala di beni culturali a scopo visivo e comunicativo. De Paolis, L., Bour-dot, P. (eds) Augmented Reality, Virtual Reality, and Com-puter Graphics. AVR 2018. Lecture Notes in Computer Science, vol 10851. Springer, Cham. https://doi.org/10.1007/978-3-319-95282-6_23.

Maniello, D., 2015. The Video mapping projection for promotion of cultural heritage: The GLOWFestival case. http://www.academia.edu/25552175/.

Milovanovic, J.; Guillaume, M.; Siret, D.; Miguet, F., 2017. Virtual and Augmented Reality in Architectural Design and Education: An Immersive Multimodal Platform to Support Architectural Pedagogy. In Proceedings of the 17th International Conference, CAAD Futures 2017, Istanbul, Turkey, 12 July 2017; Çağdaş, G., Özkar, M., Gül, L.F., Gürer, E., Eds.; HAL Archives-Ouvertes. pp. 1–20.

Montanari, T., 2021. Chiese chiuse, Giulio Einaudi Editore, Torino.

Russo, M., 2021. AR nel dominio dell'architettura: stato dell'arte. Appl. Sci. 2021, 11, 6800.
https://doi.org/10.3390/app11156800.

Scandurra, S., 2016. Realtà aumentata per la conoscenza e la disseminazione del patrimonio storico dell'architettura. di Luggo, A., Campi, M., Capone, M. (a cura di) Scenari del patrimonio culturale e metodologie di conoscenza per la divulgazione culturale. Pulisci Edizioni. ISBN: 9788884976116.