

# REPRESENTATION CHALLENGES

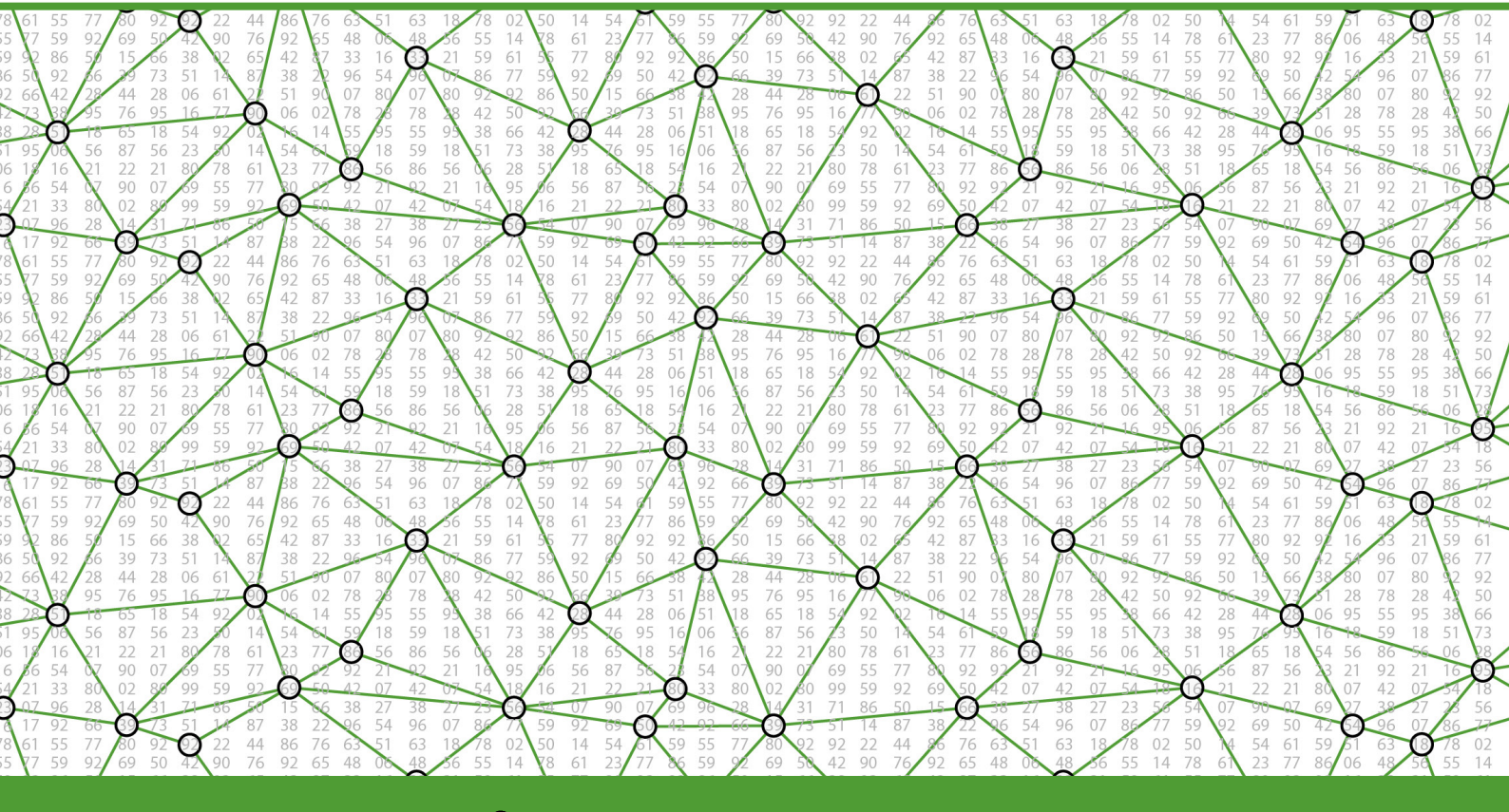
## New Frontiers of AR and AI Research for Cultural Heritage and Innovative Design

edited by

Andrea Giordano

Michele Russo

Roberta Spallone



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Cultural Heritage and Innovative Design

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Andrea Giordano

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# Storytelling for Cultural Heritage: the Lucrezio Menandro's Mithraeum

Luca J. Senatore  
Francesca Porfiri

## *Abstract*

The essay is part of the valorization for the knowledge of Cultural Heritage and is articulated according to three different readings: a first semantic reading, concerning the meaning of narration of a specific "story"; an operational reading in which the proposed methodology is applied to a concrete case study; a reading on the possible scenarios of communication for knowledge, using AR. The first results of the ongoing digitization process of the collection inside the buildings of the Ostia Antica Archaeological Park in Rome are presented here, where innovative digitization and data optimization technologies are compared with the immense heritage of the Park, animating the exhibition-interactive itinerary, creating digitally usable content through AR, reflecting on the opportunity of these technologies to create new forms of digital storytelling for use and knowledge.

## *Keywords*

storytelling, integrated survey, photogrammetry, augmented reality, Ostia Antica.





## Digital Storytelling, the Evolution of the Concept of “Storytelling” Over Time

Augmented Reality (AR) represents one of the innovations with the greatest potential in the field of fruition and dissemination of Cultural Heritage. As an interactive tool that guarantees a proactive approach to cultural life on the part of the user, this technology puts into practice one of the concepts of cultural democracy [Evrard 1997; Matarasso, Laundry 1999] and is able to modify the level of interaction of the public with culture and in particular the relationship between the user and the collection of a museum space, by expanding it with personalized and emotionally involving paths and contents. Man has always felt the need to narrate his surroundings. Since ancient times, works of art (such as manuscripts, papyri, cave paintings, architectural decorations) have been the means of communicating a specific message to the multitude, or to an elite public. Over the centuries the mediums have changed, but both the level of involvement offered by the story and the capacity of these tools to become bearers of knowledge have remained unchanged. Nowadays the narration of a particular Cultural Heritage, thanks to the advent of technological devices applied in the museum-exhibition field, can be democratically extended to all, sharing the message to be communicated to the whole community. In fact, the use of a personal device for interaction with the web is a must-have in all the activities of human beings: from asking for information about the route to be followed to integrating one's knowledge in front of a Cultural Heritage. Within this context, it is evident how Cultural Heritage can leave the real enclosure where it is currently located, such as the museum space that contains it, precisely through forms of interaction with digital devices using dedicated tools.

In particular, the use of these technologies is of greater interest to those who approach Cultural Heritage with greater difficulty, also by virtue of the ability to explain, in a visual and easy-to-understand manner, the history of the Cultural Heritage and the events that the space or objects on display have undergone over time. A history that is often complex and articulated and that, to be understood in its evolution, requires a knowledge base that is precluded to all those who are not experts. In this case, “representation” is an effective way of trying to solve this age-old problem precisely because of its ability to express phenomena and events in a simplified manner. All this is done through interactive images that show the narration, or storytelling, hidden in the archaeological remains *in situ*.

Talking about storytelling means turning our attention to an important cognitive tool capable of negotiating common concepts and conveying them in a functional way, responding to the individual's need to reconstruct reality by giving it a specific temporal or cultural meaning. Already exploited for years by marketing and communication to promote the success of a product, the use of narration has demonstrated and continues to demonstrate its usefulness also in the field of Cultural Heritage enhancement. When this is done using digital tools of interaction, it is possible to talk about Digital Storytelling [Bonacini 2020], i.e. implementing a series of practices that make use of digital mediums with the specific aim of attracting and capturing the user through the creation of interactive stories that make the narration of Cultural Heritage engaging, bringing the user closer emotionally [Maulini 2019] and amplifying the experience [Bosco 2016]. AR represents one of the most effective means with which to put this specific strategy into practice, as it is a “transformative” technology, i.e. capable of transferring emotions in such a realistic way as to induce a permanent personal change in the individual: thanks to the “sense of presence”, blurring the perception between physical and digital reality, and thus becoming a vehicle for emotions [Cappannari 2020]. Emotions are generated by the meaning we give to reality: through new technologies it is possible to transfer the feelings we experience into the digital world, creating in the user a sense of wonder that transcends his or her classic mental schemes, resulting in greater emotional involvement, which thus allows an almost “natural” interaction between human beings and digital content. It is precisely this experiential and emotional approach that guarantees an improvement in the enjoyment of the heritage under study, redefining the museographic space, and focusing on the visitor's experience.

In this way we are witnessing a specific change of trend: if in the past the knowledge path took place only inside a museum in a monothematic, unidirectional and univocal way, now

the user can choose what to know inside a multiple exhibition space, can interact with the works present in it and get to experience the information even if not tangible, consciously enriching his cultural background and participating in the construction of the exhibition. The research carried out on the *Mithraeum of Lucrezio Menandro* the subject of this contribution, moves within this framework. To be better understood, the Mithraeum needs to be recounted in terms of its various evolutions over time, which are difficult to perceive at first glance. In this context, it is evident that only a digital medium capable of overcoming the physical limits imposed by the material constitutes the privileged tool for the construction of the story. Through the possibilities offered by AR, it is possible to recount what is no longer visible, that is, what is only comprehensible through a reading of the fragments present within the space, and which AR makes it possible to bring back to life through a participatory and interactive process, telling the story of the evolution of the space.

### Case Study: the Mithraeum of Lucrezio Menandro

The paper presents the first results in prototype form of a large research project aimed at digitizing the heritage of the Archaeological Park of Ostia Antica in Rome, where innovative technologies will be put at the service of conservation and dissemination by proposing AR solutions aimed at improving the exhibition itinerary. In particular, the research focuses not only on the digitization and optimization techniques of the data obtained by massive survey but will also verify the opportunities of using these technologies for the creation of new forms of digital Storytelling through interactive processes, aimed at improving the usability and knowledge of both the Archaeological Park and the Museum area.

Within this theoretical/conceptual framework, the present contribution focuses on the *Mithraeum of Lucrezio Menandro* located within the Archaeological Park. The decision to analyse this specific case study is to be found in its stratigraphic complexity which, to be understood in all its facets, requires a complex and articulated narration of the phases that over time have modified both its architectural components and its function. This has been made possible thanks to a continuous dialogue with expert archaeologists and restorers working in the Park [1], who have contributed to the research work by assessing the accuracy of the results and making available the results of their studies and the historical/critical documentation in their Archives. While an archaeological site does indeed involve us emotionally by virtue of its very nature, it also needs to be described in terms of its evolution (historical and formal) and the reasons why it has been transformed into its current definition. Precisely for this reason, the contribution proposes a solution to the narrative theme that makes use of AR by proposing a digital storytelling operation capable of involving the user through the explanation of the articulated evolution of the *Bene* from the traces that can be read on the surfaces that make up the space.

The *Mithraeum of Lucrezio Menandro* (Region I, III, 5) is in the homonymous block, between Via dei Balconi and Via dei Molini, in the central sector of the state-owned area of the Archaeological Excavations of Ostia Antica and a short distance from the Museum.

The building that houses the Mithraeum was built in mixed construction in the Hadrianic period (as can be seen from the brick stamps dating to around 127 AD) and faces Via dei Balconi with a row of *tabernae*. In this period, the rooms subsequently occupied by the Mithraeum and the adjacent rooms were probably used for commercial functions related to a bakery.

In the second phase, probably dating from the Antonine period, the rooms later occupied by the Mithraeum were renewed in their layout and decoration and used for purely residential functions. The room, previously used as a courtyard, was covered by a barrel vault (of which only the impost remained at the time of the excavation), divided into two rooms, and used as a reception room. The painted and mosaic decoration of the room dates to this phase, perhaps to the age of Marco Aurelio, and the floor was lowered in this phase by about 0.40 m from the floor level.

Later, the south-eastern sector of the building was transformed into a Mithraeum. The *spe-laeum* was created in the room accessible from the north by a staircase. The central partition, which separated the two rooms while maintaining the original wall decoration, was demolished

in this phase, and two podia were added along the walls (0.45 m high and 1.25 m wide), with niches on the vertical sides in correspondence with the marble threshold, and the altar on the southern side. The altar (0.75 x 0.55 m), made of bricks, was decorated on the front with a marble slab engraved with a deep lunar crescent behind which a lantern must have been inserted, below which was the inscription *DEO INVICTO MITHRAE / DIOCLES OB HONOREM / C. LVCRETI MENANDRI / PATRIS / D(ono) D(edit) D(edicavit)*. The paleographic characters suggest a dating of the inscription to the first years of the 3rd century A.D., a period to which the transformation of the room into a Mithraeum can be attributed.

The *Caseggiato* of Lucrezio Menandro was probably brought to light in the years 1932-1933, as seems to be possible to reconstruct from the archive photos, which also document the first restoration works on the walls and frescoes.

The complex underwent further restoration in the early 1960s, during which most of the frescoes were detached and subsequently reassembled on concrete supports (including those now placed on the front of one of the podia), as can be seen both from the plaques on the walls (1965) and from the documentation kept at the Museum of the Early Middle Ages concerning work carried out on buildings of Region I. A further restoration, for which no documentation is preserved, was probably carried out in 1992-1993 (as can be seen from archive photos). In 2000, a further safety intervention was carried out, which included considerable work on the frescoes, which were detached and subsequently reassembled on concrete supports behind the perimeter wall and one of the *podia*. Finally, in 2021, the Mithraeum underwent major restoration work that returned it to its current state of conservation.

## Methodology of Analysis

The building has undergone three different phases over the centuries, which have profoundly altered its use and architectural morphology, and three successive phases of restoration that have given it back its current configuration. Each of these has left traces which, in order to be understood in their evolution, require a narrative process accompanied by visual support. Given the complexity of the narrative, the use of a tool such as AR, capable of interacting with the space through a digital device, makes it possible to tell a visual story that can explain the spatial transformation over time, the interpretations of the restoration, and the reasons for the current state. After a documentary phase, carried out with the support of the Park's archaeologists and restorers, which made it possible to identify the space's evolutionary characteristics and to understand its stratigraphic complexity, a complex integrated survey operation was carried out, aimed at obtaining the data necessary for the various processes. Topography, laser scanners and cameras were combined in order to control the reliability of the multiscale measurement operations, which allowed a considerable amount of information to be obtained at the architectural scale and at the scale of extreme detail [2] (Fig. 1).

The survey operation was followed by a processing phase aimed at completing the documentation, through the creation of 2D and 3D models of survey and critical interpretation. In order to highlight the various themes addressed, in addition to the traditional architectural drawings on a scale of 1:50, photo plans on a scale of 1:10 of all the frescoed walls, the mosaic floor and the marble slab with engraving were also produced. For the marble slab, the retrieval of an archive photo made it possible to complete, through a process of reverse engineering, the missing part, working on the geometry of the form. All these elements constituted the indispensable data base for the subsequent critical reconstruction of the various phases necessary to complete the story and which were subsequently incorporated into the AR application.

## Digital Storytelling: the Story in the Building

The current state of the building is the last trace of an articulated and complex history which, to be understood, needs to be critically recounted in its substantial phases. The aim of the narrative is to allow users to see the different phases of transformation of



Fig. 1. Mithraeum of Lucrezio Menandro, integrated massive survey, top point cloud generated by 3D laser scanner; bottom SFM of the Mithraeum details.

the building and to recognize the traces still present in situ. Currently, the space of the Mithraeum shows the coexistence, within the same environment, of a series of traces deriving not only from the different construction phases, but also from some choices made during the numerous restorations. This makes the spatial narrative unclear and the overall image that is proposed to the public gives a configuration that is difficult to read and ambiguous to interpret [3]. For this reason, the modelling has concentrated on the critical reconstruction of the various phases that can be digitally brought back to life within the display devices, restoring to the space the capacity to narrate its evolution in a dynamic and interactive manner. For an immediate comprehension of the spatial evolution, three-dimensional models have been created, which allow to clearly narrate the evolution of the analyzed space, highlighting each time the demolitions and reconstructions and telling, starting from the still tangible traces, the different functions it has known in time (Fig. 2):

Phase 1. The first phase shows that the area analyzed had an open space connected to the harbor, close to the neighboring blocks of flats.

Phase 2. This phase is characterized by the partial transformation of the open space into two covered rooms pertaining to a new residential building, which involved the construction of new walls, the lowering of the ground level and the construction of a vaulted roof, which were subsequently decorated with mosaics on the floor and frescoes on the walls.

Phase 3. Phase 3 is characterized by the transformation of the rooms into a single space used to contain the Mithraeum, which is accessed via a system of stairs located at the entrance. The Mithraeum, consisting of a single vaulted room, is denoted by the two podia placed at the sides of the walls and by a marble slab that identified the altar.

In addition to the architectural theme, the study focused on the chromatic reconstruction of the rooms by simulating, through a critical process, what the decorations in the various rooms must have looked like, completing the numerous gaps and reconstructing the various missing portions following a geometric study of the proportions that were still legible (Fig. 3).



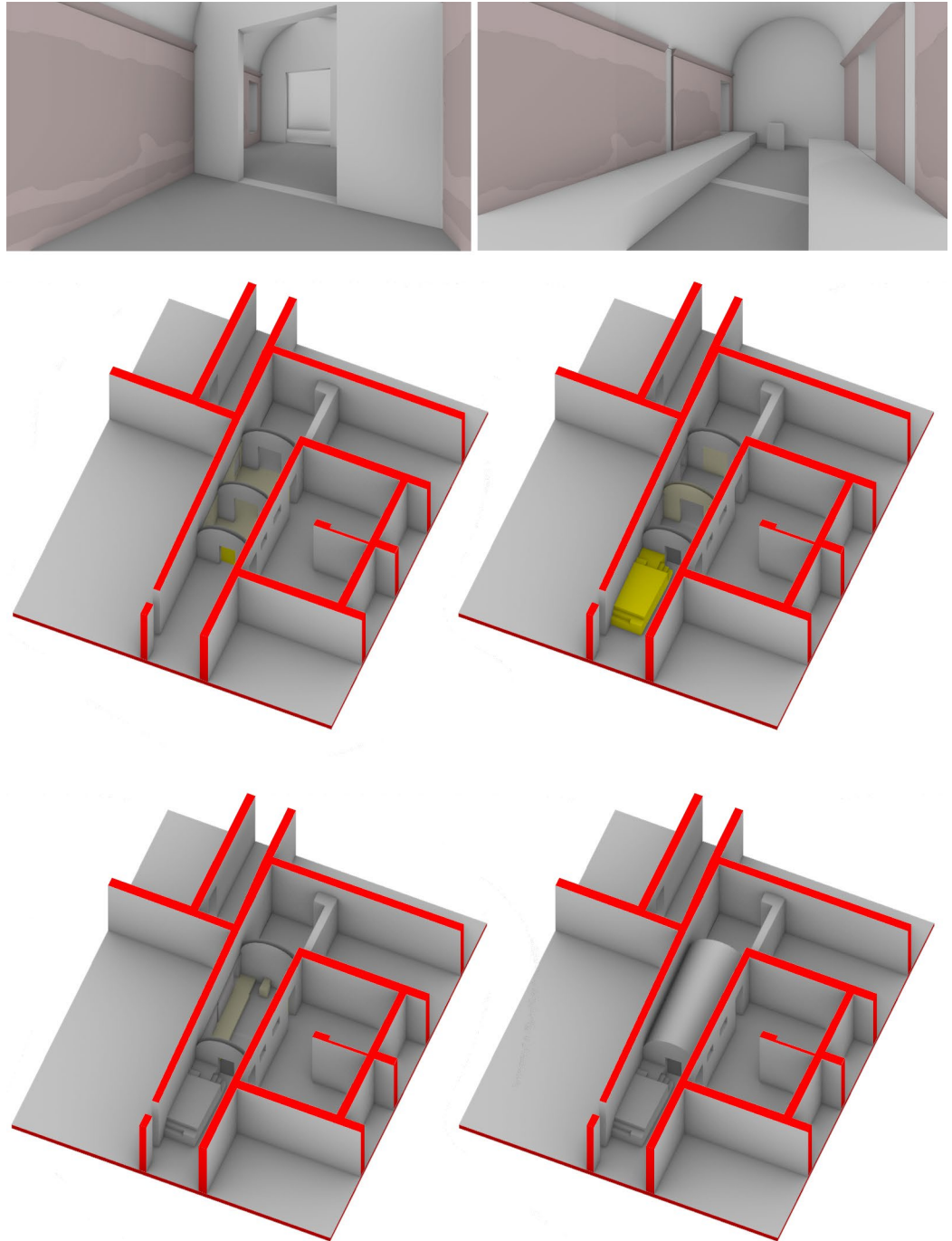


Fig. 2. Simplified 3D models of the case study showing the different phases of transformation of the Mithraeum space.

### AR Application

Once the user enters the application, by framing a QR code located near the entrance, he or she can view the different phases that have characterized the Mithraeum on his or her own device, in total autonomy, comparing each time with the real space. Through an interaction with their device, the user can modify the quality of the model, passing from a simplified visualization characterized only by veiling, to the critical and reconstructive version with greater detail, able to guarantee a better understanding of the perceptive aspects [4]. At the same time, by clicking on the different tags present in the overall model, each user can access the scientific documentation that is the basis of the reconstruction, comparing reality in the

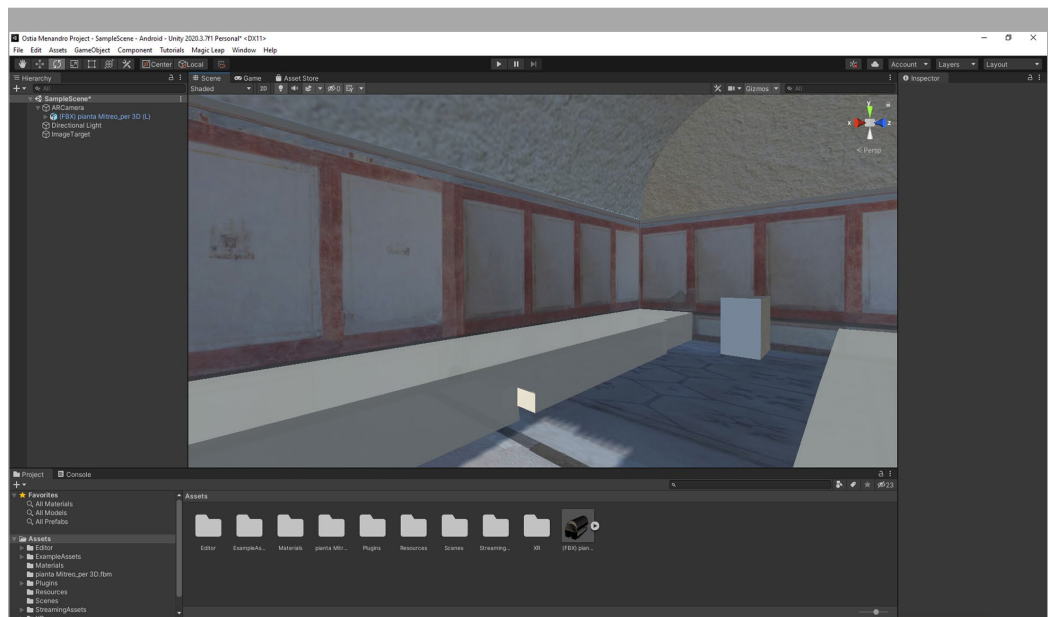
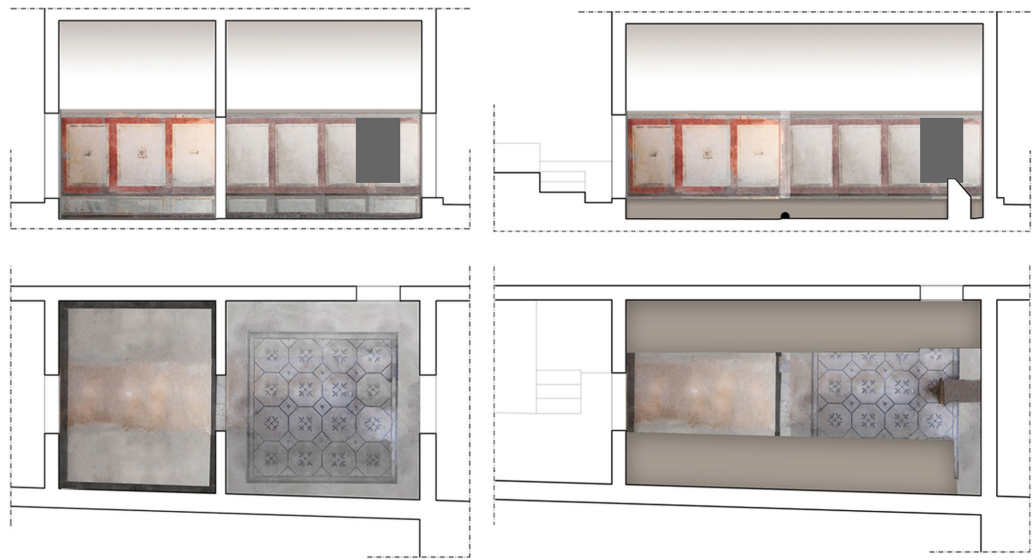


Fig. 3. At the top the reconstruction in plan and section of the two main phases of the transformation of the Mithraeum, complete with frescoes and mosaic decoration. At the bottom the insertion of the 3D model in the Unity software.

representation at different scales and for different purposes, integrating the visit in real time with supplementary information, archive images, with the “stories” hidden by the space and the decorative apparatus.

### Conclusions

In the field of cultural and museum communication, storytelling has the specific aim of attracting the user with stories that make the cultural heritage, museum, archaeological monument or work of art attractive: telling a space through small stories, anecdotes, curiosities related to the works, are all strategic topics in cultural communication, allowing an emotional approach able to arouse interest in the public. For this very reason, it is equally important to understand which stories can be extrapolated to create emotional and empathic connections, drawing “unexpected meanings” from the details.

With this logic in mind, Digital Storytelling has been built to tell the story behind the archaeological remains, overcoming the physical limits of reality to offer the public a new way of



engaging with the case study. Although not yet tested in the field, the documentation work and the prototype phase of the application appear to have been completed and the AR application will soon be implemented within the visit route for Park users. This will enable a series of surveys to be carried out with the public, an essential action aimed at assessing the real effectiveness in terms of both involvement and understanding. It will therefore be the same user for whom the models were created that will provide a new key to interpreting the entire study, activating a process of circularity of knowledge: by defining the areas of improvement, the contribution of the users will make it possible to make the necessary adjustments to improve the quality and type of representation as well as the narrative aspects in a democratic and participatory process, so that we can really think about building an experience capable of giving new life to this important vestige of our past.

#### Notes

[1] The study was carried out with the support and valuable contribution of the Park's archaeologists and restorers. In particular, we would like to thank the Director of the Park, Dr. Alessandro D'Alessio, Dr. Claudia Tempesta, Dr. Alberto Tulli and the Restorer Antonella Docci, for the precious indications that have allowed the construction of the story told through the different elaborations.

[2] The documentation phase was carried out by means of an integrated multiscale survey using different technologies: Leica Tp 805 Total Station; Faro Focus 3D Laser Scanner; Full Frame Canon 6D MII digital camera. Once the topography of the study area had been defined, 27 laser scans were made for the architectural definition of the space, guaranteeing an accuracy of less than 1 cm. 1300 photographs were taken and used for SfM applications dedicated to the study of details. In particular, the images allowed the construction of 3D models and high-resolution photoplans of frescoes and mosaic floors with an uncertainty of less than 1 cm, while for the engraving, a greater concentration of photographic shots allowed the construction of 3D models with an uncertainty of less than 0.5 mm. We would like to thank Prof. Leonardo Paris and the CRITEVAT Laboratory for providing the Laser Scanner used in the research.

[3] We refer in particular to the presence of frescos placed close to the podia and which were originally in continuity with those decorating the perimeter walls of the space, as well as to the lack of a roof capable of restoring the typical quality of space that characterised the places of worship dedicated to the God Mithras.

[4] Unity software was used for the augmented reality and subsequent reconstruction of the Mithraeum.

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