



# Holographic Representation Tools and Technologies for New Learning Actions: DhoMus Project Applied to Pitigliano and Vetulonia Museums, Tuscany

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**Abstract.** If on the one hand the museum reality, which has its origins in the history of collecting, turns its attention to the collection and custody of objects, on the other hand the exhibited objects necessarily need a way to be told. Museography is part of this dual relationship between the museum and the object. It's a discipline that researches the different technologies of representation, finding tools to tell both the history of objects and the history of what binds them to their context and to the museum in which they are kept. To realize this story, it's necessary a phase of study of the objects, carried out by the experts of the various disciplinary sectors, bringing to light all the information. To communicate these data, a specific narrative is designed to promote not only scientific dissemination, preserving the scientific nature of the content, but also cultural dissemination, through storytelling aimed at learning and understanding the object. The technologies currently present in the field of visual simulation provide visual and dynamic tools based on the concept of storytelling. In this paper, we propose the technology of the hologram: a representation that allows us to interface ourselves with the object by observing the history that the museum offers from the outside. Holography and the technologies that implement it today prove to be effective in creating the efficient narrative to which the museum itinerary tends. For this reason, the hologram appears to be a tool of great potential also in the field of teaching and the dissemination of knowledge. In the dialogue between museology and museography, through technological evolution, the museum must look at this type of applications and the case study that we present within DhoMus Project proves to be an interesting real example of experimentation.

**Keywords:** Museography · New Technologies · Hologram · Narrative and Storytelling Learning · Visual Simulation & Modeling Learning

## 1 The Narration of Scientific Contents in the Museum System

In the scientific communication of data, the contribution made by visual graphic elements plays a role of fundamental importance. The graphic representation is in fact a central element to constitute a communicative process and, therefore, must be designed and

structured after a specific creative process that takes into consideration all the variables and information to be transmitted. This is valid and applicable also in the area in which we operate: the museum system. Here the protagonists of scientific communication are the museum objects, and a correct graphic representation must be able to show them together with all the information surrounding them in order to convey a correct and contextualized message. This contribution aims to focus precisely on the narrative and communicative potential expressed by tools and technologies for the representation of visual content for exhibitions in museums. The discipline of Museography fits into this dimension, researching the various technologies of representation and the tools to tell not only the history of the objects but also the one that binds them to their context and to the museum in which they are kept. Indeed, behind the instrument and the technology of representation of the single object, there must be a story to tell and a narrative project. It is evident that in order to realize this story, a phase of study, research and documentation of the objects is fundamental to bring to light all the information connected to them is necessary. To communicate these data, an *ad hoc* visual narrative is designed to promote not only scientific dissemination, as it guarantees the scientific nature of the content, but also cultural dissemination, through storytelling aimed at learning and understanding the object. The purpose of the narration is therefore to communicate, considering the dialogue that is established between the object and the user. The museum reality evolves and grows according to the society that frequents it and, therefore, the main purpose of musealizing the property has the same weight as that of succeeding in effective communication with visitors. To ensure the success of this communicative dynamic in which information is transmitted to the user who lives the museum experience, it is necessary to be able to carefully choose the right narrative mode and, therefore, the right tool and the right technology. It's clear that this choice depends on the object to be musealized and on the type of user. Indeed, it is not possible to standardize the narrative through a single communication method equally applicable to any object and to any public. It is therefore necessary to build a language that is able to combine these aspects, studying all the characterizing elements, such as the context. This point constitutes another interesting aspect to be explored. We need to consider that the object, when it is put into a museum, undergoes a decontextualization from the place where it belongs or was found. This may be the case for both an archaeological and an architectural monument, as well as an artistic piece, which through this action of museumization is estranged from its original context. We must therefore think that at the base of the museum experience, the user finds himself getting to know this object in a way that hides what is its true reality. This is also true when, in the opposite situation, the object cannot be brought inside a museum, such as for architectural artifacts or large monuments. There are many particular situations that a museum could face, for which museumization is partially or totally impossible. This is the case of an architecture characterized by a series of historical stratifications, some of which are not visible from the outside. Or, there is the need to enter inside the monument, but its access can be partially or totally compromised, such as to prevent the complete view of the architectural object. There is also the case in which the archaeological site is located far from the museum building. These situations have recently been resolved by the most recent methods of museumization that are based on the idea of Open Museums and Widespread Museums

[1]. We can affirm that it's always necessary to know in depth all the aspects of an object, since the fact that much of the information to be treated is not visible or perceptible, changing the type of language that the communication must adopt [2–4]. In order to reduce the distance between the user and the true nature of the object, the narration within the museum plays a fundamental role. It represents indeed the only possibility of building a cognitive thread that binds all the subjects and information together, and at the same time it can tell them. Narration is now entrusted by technological means that provide tools capable of interacting with different methods of image transmission and are able to integrate together different types of communication such as, for example, visual, auditory and tactile. This expressive capacity is of great potential, as it allows us to create perceptions and arouse sensations much more similar to the daily ones of human experience, moving away from the technical difficulty to understand and interpret highly scientific and specialist languages. This narrative typology expressed by some more recent technological tools is also successful because it is based on a hierarchical structure of information that allows the user to focus clearly and directly on precise data, aiming at the knowledge of the object according to a managed order of information degrees.

As we have seen, the instruments and technological methodologies in the museum field allow us to choose the type of narrative to be applied to the exhibits. Today there are many instruments that can be adopted by museums for the narration of the exhibited goods and in this sector technological progress is constantly advancing. Indeed, in parallel with museum needs, digital language offers many possibilities through visualization systems such as videos, interactive totems, digital platforms, video mapping projects, virtual reality experiences (with VR viewers), augmented reality experiences (via tablet or smartphone), and holograms in holographic pyramids. Here we would like to propose as an example of analysis and discussion the research of the DHoMus Project, promoted by the Department of Architecture of Florence in collaboration with the Diocesan Museum of Palazzo Orsini in Pitigliano, the Civic Archaeological Museum "Isidoro Falchi" and the related archaeological areas in Vetulonia, in Tuscany. This project involves the choice, experimentation and application of one of the various museum communication tools mentioned: the holographic projection.

## 2 The DHoMus Project

The DHoMus Project started in March 2020 and is applied through the involvement of two museums. The first is the Diocesan Museum Palazzo Orsini in Pitigliano, the second is the Civic Archaeological Museum "Isidoro Falchi" of Vetulonia with the Archaeological Area of "Scavi Città-Poggiarello Renzetti", located in Vetulonia, part of the Municipality of Castiglione della Pescaia, in the province of Grosseto (Tuscany). The Diocesan Museum of Palazzo Orsini in Pitigliano was created at the behest of the Pitigliano-Sovana-Orbetello Diocese within the monumental fortified palace. It collects valuable elements such as period furnishings, gold and silver works, coins, wooden sculptures, paintings on canvas, on wood and precious fabrics received by the museum from the main places of worship in the area. Important historical emergencies refer to this museum complex, located in the surrounding areas, such as the Church of Sovana and

the Church of San Francesco, the latter not easily accessible and not sufficiently valued. The “Isidoro Falchi” Civic Archaeological Museum, on the other hand, preserves the memory and collects the finds that come from the archaeological excavations of what was once one of the most powerful and richest cities of the Etruscan civilization, the ancient Vetul (Vetulonia). It reopened its doors to the public in June 2000, with the aim of continuing archaeological research and enhancing the extraordinary archaeological and cultural heritage, establishing a constant dialogue with the territory and with all types of public. Not far from the museum there are: the Archaeological Area of “Poggiarello Renzetti”, the urban remains of “Costa Murata” and “Costa dei Lippi” which, together with the nearby necropolis, constitute the natural completion of the external archaeological itinerary (Fig. 1).

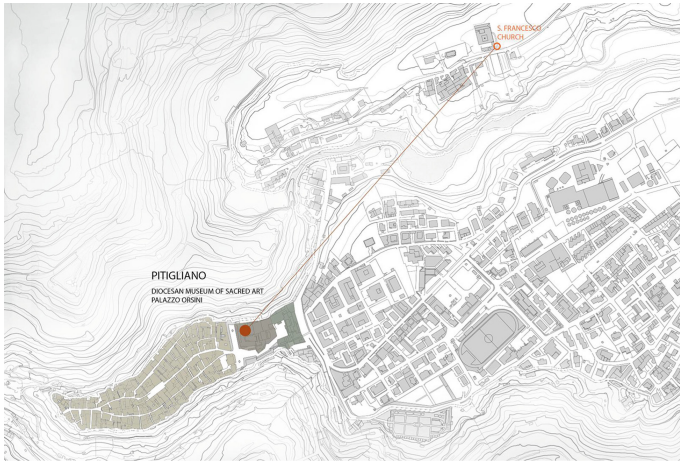


**Fig. 1.** Map of the geographical area of Pitigliano and Vetulonia’ sites, Tuscany.

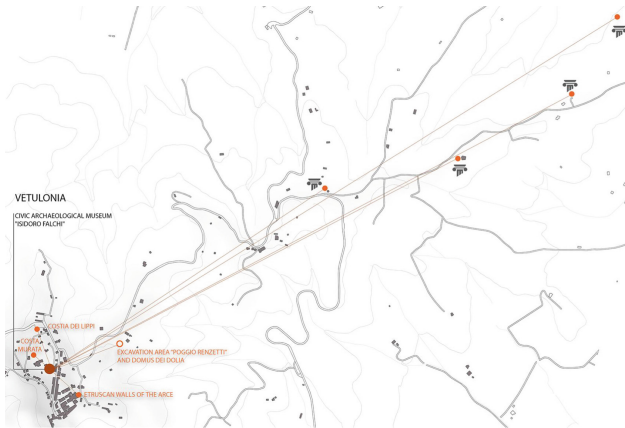
Both museum poles, that of Pitigliano and that of Vetulonia, present those critical factors that make the narration of the exhibits less immediate. This makes the two museums a valid challenge for putting research into practice and testing the new potential of digital language. In this regard, the research aims to design a museum itinerary (Figs. 2 and 3) with the use of new technologies that allows both to integrate the monuments of external sites within the museum and to make the museum a link to these nearby sites, decreasing the dispersion of information between one place and another.

### 3 The Case Study of San Francesco Church

The research analyses we carried out before choosing the most suitable narrative path are a series of preliminary inspections in museums and archaeological areas as well as in an architectural survey of the monuments connected in the nearby areas. Subsequently, the research focused on the possible subjects that could be shown in digital format and become part of the history that comes to life in the museum itinerary. Specifically, we selected for the site of Pitigliano the church of S. Francesco (Fig. 4), far from the historic center, currently in a state of ruin and not usable for any type of activity, and the church of Santa Maria in Sovana (Fig. 5). For the site of Vetulonia we selected some artifacts found during the excavation campaigns in the Etruscan site, such as a cycle of votive bronzes,



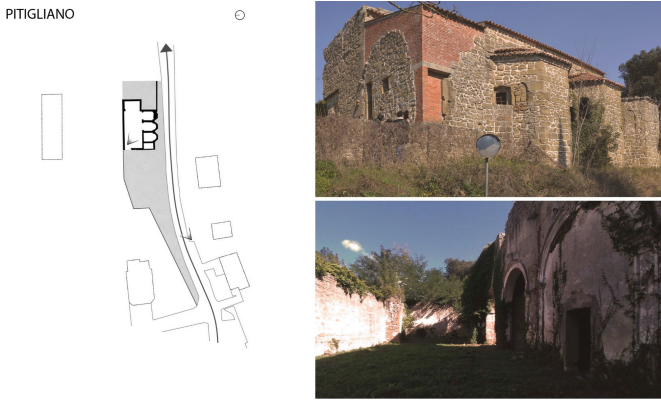
**Fig. 2.** The itinerary plan studied for the museum of Pitigliano.



**Fig. 3.** The itinerary plan studied for the museum of Vetulonia

a stone stele with inscriptions, gold and painted pottery. At the same time, the available documentation was integrated with architectural surveys (direct and photogrammetric). Based on the data obtained through 2D drawings (plans, elevations and sections) and 3D models, we carried out studies, researches and readings to deepen the knowledge and to hypothesize their original appearance, applying these discoveries to the contemporary experimentation of new technological applications [5].

The digital display method chosen in our experimentation is that of the hologram. This type of representation is actualized through the support of the holographic showcase, an instrument formed by a display that contains the images and/or videos to be projected and by a transparent glass prism on which they are reflected. Thanks to the projective geometry, the image or video contained in the display of the support is therefore projected onto the transparent surfaces inclined at  $45^\circ$  of the pyramid device. This allows you to



**Fig. 4.** San Francesco Church in Pitigliano. Plan and photos.



**Fig. 5.** Santa Maria Church in Sovana. Plan and photos

faithfully recreate an image or video animation of existing or digitally created objects that appear through an optical effect, in a three-dimensional view in the center of the pyramid. It therefore leads to the illusion of seeing an object move in the air almost as if it were in 3D (Fig. 6) [6, 7].

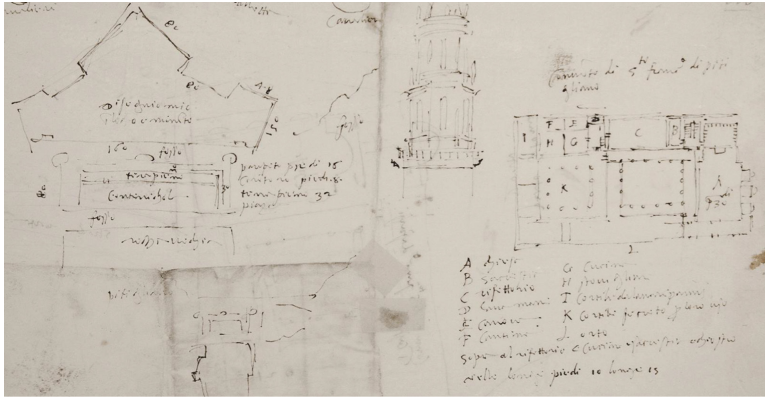
The researcher chose to experiment with the hologram solution, still in the process of change and evolution, with the aim of implementing the use of the monumental complex by exploiting the potential provided by this multimedia device. Among the various possibilities, the research looked at the application of holographic projections because it proved to have a series of advantages that would enhance our objects to be told. First of all, the holographic representation allows you to have an active and interactive experience of the object, without being completely immersed in it, otherwise risking losing the conception and dimension of real space. After that, it returns a three-dimensional representation of the objects that facilitates understanding, offering an approach certainly more direct than that possible through classical two-dimensional representations,



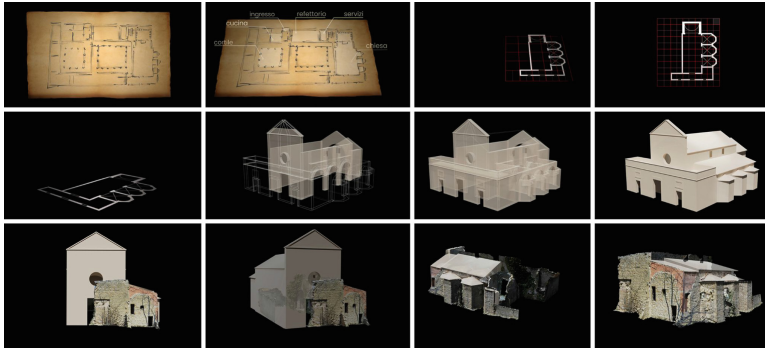
**Fig. 6.** The holographic showcase [5].

which instead encounter the problem of the user's interpretive skills. Furthermore, this solution seemed to adapt to all types of exhibits to be enhanced. Once the objects were chosen, a study was carried out on the museographic path of the possible location of the holographic display cases in the two different museums, according to the different thematic rooms and the subjects previously chosen. At the same time, for each object it was possible to study video contents, structuring a storytelling, to be included in the holographic showcases. Thanks to the 2D and 3D materials obtained in the previous stages, it was possible to structure a storyboard of the narrative plot for the creation of the video animation. In this case, for both museums, the subjects chosen to be transformed into holograms deal with the themes of both the large architectural scale, such as the ruins of churches and archaeological areas, and the medium and small scale of the objects of vases, bronze statuettes and golds. The statuettes less than ten centimeters high could have been placed inside the holographic pyramid to be able to play through visual effects on them, making them larger in order to focus on their details and give them a clearer vision of its symbols. On the contrary, the architectural structure, since it cannot be put inside the pyramid structure (unless creating a real 3D scale), prefers an external reading that describes its compositional, volumetric and chromatic forms. In both cases the story is structured starting from a historical basis, such as from an architect's sketch of the plan of a church, as in the case of the Church of S. Francesco in Pitigliano, (Fig. 7) or the discovery of a name found on an ancient sheet of an archive. This is the starting point to be able to structure an evolution of the story that continues in the description of the subject in its details and ends with the current vision of the same, following the storyboard we created (Fig. 8).

Through the holographic technique and thanks to the video that is shown inside, we try to overcome the only two-dimensional representation of description on descriptive panels and complex technical documents. We therefore try to involve the visitor in a three-dimensional visual cognitive experience of the history of the subject that is shown regardless of whether it is an archaeological area or a small object of different character and size. Everything is done to be able to tell the story of the artifact in a clearer and more understandable way thanks to different visualization styles (wireframe, transparent, solid and with texture) and 3D views that facilitate the understanding of the same. The multimedia contents that are obtained, thanks to the use of adequate technical elements



**Fig. 7.** Photograph of the Figure n° 811A by Antonio Sangallo and representing the drawing of the city defensive walls and the convent of S. Francesco in Pitigliano. The figure is kept inside the Gabinetto dei disegni e delle stampe in the Gallerie degli Uffizi in Florence.



**Fig. 8.** Sequence of frame of the video elaboration created for the monument of S. Francesco Church.

and thanks to the multidisciplinary professional interaction at the basis of their creation, become dynamic documents that never betray their scientific nature. We therefore try to open a conversation with the widest possible audience, strengthening the transmission of the content through intuitive and interactive exploration. The aim is also to develop many forms of representation capable of involving the observer and transferring them adequate knowledge on the subject through a didactic and informative approach. To date, the project continues successfully thanks to the creation of the first video animations and the continuous experimentation of the potential of holographic representation.

### 4 Conclusion

The possibility of realizing this project proposal allows us to implement the innovation continuing developing adequate strategies and equipping it with suitable tools so



that the Museum can increasingly emerge as a cultural laboratory and social identity reference for its own community. The results to be achieved are to contribute to the development and growth of the Museum, continuing with the work carried out since its origins, aimed at updating the exhibition proposal. Therefore, through the use of high technology and new methods of digital representation (as in this case of the holographic displays) we expect to develop more explanatory and engaging narratives of the material. Holograms become a form of interactive and didactic visualization, closer to the reality that surrounds us and that moves away from all those special viewer supports (VR) that isolate us from the outside world. The project will be able to give visibility both to the museum and its external archaeological sites, making them visitable, virtually, even if it is impossible for visitors to access them. The aim is therefore to present new forms of dissemination of knowledge of the historical-archaeological heritage. This allows to involve always more different targets of users, offering a complete and satisfying visit experience. Finally, research is always open to innovations that are not linked only to holographic representation, that shows the limit of specific size within the museum site, but it progresses towards overcoming also the dimensional scale.

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