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Alessandro Luigini
Editor

Proceedings of the 1st International and Interdisciplinary Conference on Digital Environments for Education, Arts and Heritage

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Interactive Installations and Suggestive Experiences. A Project for the Home of M. Obellius Firmus in Pompeii

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Abstract. The contemporary cultural context has become increasingly fascinated by the multiple cognitive systems dedicated to Cultural Heritage. The development of often captivating methods of communication, the possibilities offered by increasingly innovative and sophisticated technologies, encourages experimentation as well as the development of alternative forms of communication and education. There are various professionals interested and involved in this sector. IT specialists, artists, architects, engineers, archaeologists, art and architecture historians, all take part in the conception of new communication models in tune with contemporary iconographic culture. This paper discusses the project of a temporary multi-sensory installation designed for the Roman Pompeian *domus* of M. Obellius Firmus, developed as part of the DiARC Master of Science in Design for the Built Environment. Images, sounds, videos, physical and virtual installations are used to guide the visitor in a cognitive experience of the *domus*. The main theme of the installation, interpreted in different ways, is the water path in the *domus*. The installation aims to highlight the high technological content as well as the application of the bioclimatic principles present in a Pompeian house dating back to the late Samnite age.

Keywords: Pompeian Domus · Anamorphosis · Installations · Virtual reality

1 Introduction

Today's culture shows a great deal of interest in the multiple projects of fruition and knowledge aimed at the "enjoyment" of Cultural Heritage in general and archaeological ones in particular.

One of the main characteristics of an archaeological site is the lack of integrity it has, thus making it essential to design a communication project capable of filling the communication gap and therefore the *shortcomings*. The aim of the knowledge and valorisation projects, which affect these contexts, is to either make the heritage readable and interpretable or able to convey the cultural significance of which it is a testimony. A cultural meaning that can be understood by heterogeneous users through the integration and reconfiguration of images, places and recognizable contexts. Places characterized by the extreme difficulty of interpretation of the *traces* and often also exposed to serious forms of degradation (Cirafici and Palmieri 2018).

Several studies have been carried out by the authors on these issues, in which different methodologies of analysis, representation and use of archaeological contexts have been experimented, and not only.

With the common aim of identifying effective tools, the methodological paths initiated have been defined following similar procedures. The acquisition and processing of morphometric data, preceded by an in-depth documentary and bibliographic cognitive survey, followed the identification of interpretative and re-constructive hypotheses, along with documenting the current state of the places. The contents were conveyed both through *Virtual Reality* and *Augmented Reality* systems and, by focusing on the user's involvement, by designing installations with which users are invited to interact.

From a conceptual point of view, interactive communication systems can be divided into two categories: those that allow for *remote* study and analysis of the virtual visit of the site, and those systems that are *on-site*, usable during the actual visit. The first category includes immersive images, which allow to structure more or less complex virtual tours, and 3D PDFs, based on the interactive use of easily navigable 3D models, as well as three-dimensional digital models elaborated by photogrammetric techniques; while systems based on the application of *Augmented Reality* belong to the second category. These latest information systems can also include, if referring to the condition of access to *on-site* contents, all those systems and/or installations that create *semantic spaces* by means of different methods, linked to the possibility of enjoying suggestions and emotions experienced at direct contact with the place. As part of projects that can be defined as *analogic augmented reality*, the construction of plexi-glass panels, to be placed in the archaeological site, upon which to reproduce images of the constructive hypotheses that, overlapping the reality, allow to reconfigure the original forms (Capone 2015; Palomba 2015) (Fig. 1).

The project discussed here refers to different communication languages. The object of the experiment is a temporary multi-sensory installation designed for a Roman Pompeian *domus*. Images, sounds, videos, physical and virtual interfaces are used to guide the visitor in a cognitive experience of the *domus*. The common thread is water and, following its path, the visitor discovers secrets, goes beyond the visible, understanding the working of the *domus* and also visualises the image of the house of M. Obellius Firmus in its original configuration.

The possibility and the will to create virtual three-dimensional models, through which to reconstruct the image of places, raises several questions. The need to identify the most appropriate and effective way to represent the lost parts and elements cannot be neglected. However, it is obvious that the degree of fidelity, rather than referring to a more reliable scientifically valid reconfiguration, is linked to different factors ranging from the level of conservation, to the profound knowledge of the good or analogous realities (Fig. 1).

This experiment has two main objectives. On the one hand, work was carried out to restore and reconstruct the image of parts and elements that no longer exist, making it possible to understand the spatiality investigated, while on the other, to identify and construct an installation through which to describe a specific theme, that of collecting rainwater, which becomes the means to tell the story not only of the place in particular but of Pompeian culture.

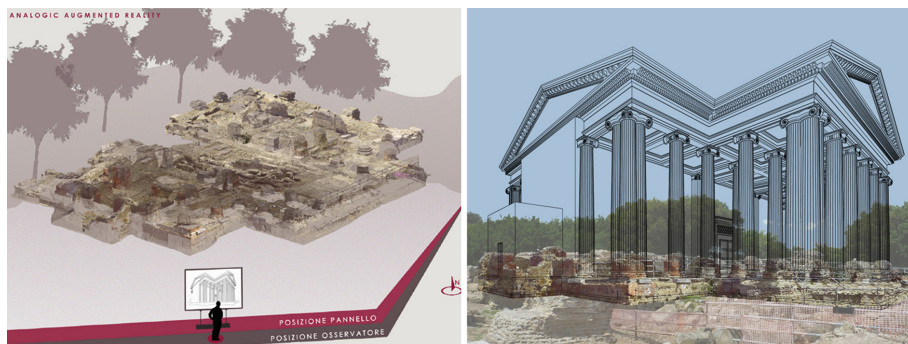


Fig. 1. Temple of Apollo in Cuma. “Analogical AR”: you can see the reconstructive hypothesis, overlapped on reality, from a fixed point of view.

If for the first experience, the increasingly common perceptive experiences that see the use of other devices or viewers to observe the digital reconstructions was *succumbed* to, for the second, temporary installations were *set up* with which to interpret the theme.

2 The Case Study

For more than two centuries, the ancient city of Pompeii has continued to be highly suggestive and fascinating to the visitors who, upon entering the domus and walking along its streets and the forum, rather than walking in the places of the *spaepectacula*, the sacred and thermal buildings, among the shops and public buildings, are transported to places that were once lived in, almost unlikely, more than two thousand years ago. A place, that of ancient Pompeii, which is testimony to the intense life of an entire city, an important colony of the Roman Empire. It is here that it was chosen to experiment with some systems of communication and exploration of cultural heritage in general, applied to the archaeological heritage in particular. The objective of the project is to immerse the visitor in a typical Pompeian residence through a multi-sensory experience, aimed at satisfying, in an alternative and innovative way, the desire for knowledge of the place through instruments connected both to tangible and intangible assets. The site chosen is the home of *M. Obellius Firmus*, one of the largest and most articulated in Pompeii, dating back to the late Samnite period. Situated in Insula 14 of Regio IX, in the area to the north-east of the city, it is located along Via di Nola and has two floors. The house, home of a local aristocratic family, was excavated at the beginning of the last century between 1903 and 1911. The singularity of this *domus* lies in the presence of two halls: a tetrastyle, monumental and representative, in which four fluted Corinthian columns are preserved, and a second Tuscan, both with an independent entrance from the main street. The first is characterized by the imposing, tall tuff columns, with refined marble furnishings. Placed in line with the entrance, there are two pillars in the *impluvium*, which supported a statue of a Satyr, a puteal with grooves to access the underlying cistern and a marble table with lion feet. Going through the

tablinum leads to the peristyle with four different sized paths, opening onto the private garden. The second atrium, probably built after the first, welcomed the *clientes* and gave access to the both the service and private areas, such as the small private spa. A survey of the current state of the places, together with the identification of the historical and documentary sources, made it possible to realise a representative model of what there is today, as well as a re-configurative model of the domus. The latter was realized following the hypotheses elaborated by Vittorio Spinazzola, director of the excavations in 1911, and depicted by A. Sanarica through images of plants, sections, axonometric views and watercolour perspectives (Spinazzola 1953).

Three-dimensional mono-material models were realised, in which it was chosen to represent, without exceeding in detail, the substance of the architectural forms, with the understanding that the philological reconstructions are only possible hypotheses (Fig. 2).

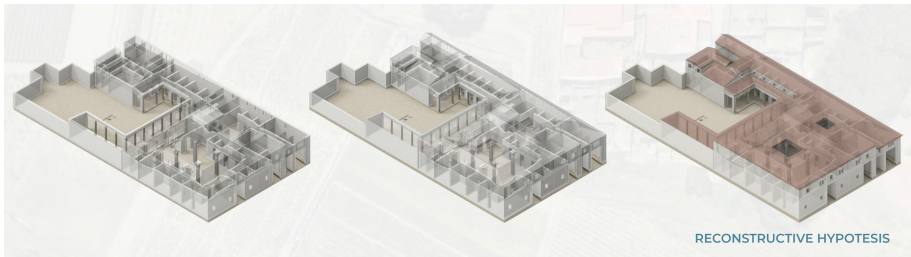


Fig. 2. M. Obellius Fimus reconstructive hypothesis: 3D model

If, on the one hand the objective is to reconstruct the image of the house of *M. Obellius Firmus* on the basis of philological studies and reconstructive hypotheses, on the other, the main aim of the project is to show the engineering capabilities of Romans who established themselves not only through their great works, but also in the designing of their homes. The architecture of the domus responded not only to representational aspects but also, and mainly, to functional factors. The exploitation of the bioclimatic principles, linked to the use and collecting of rainwater, is based on the apparent simple system of the *impluvium* and *compluvium*, which in reality is a highly ingenious system. The collection method not only guaranteed water in the house, it was also used to cool the rooms in the hot seasons.

The system was designed for rainwater to be collected in the *impluvium* as well as the cistern below. The conformation of the *compluvium* and the closed court atrium limited the sunshine in the hottest period, ensured the entry of light and favoured the generation of air currents that, thanks also to the presence of water, cooled the rooms.

3 The Installation

The imagined temporary installation is designed to be realised in the tetrastyle atrium, with the idea of giving shape to elements of the past through physical and perceptive elements that use a contemporary language.

What considerations were made at the beginning of the project? The first aspect was to hypothesise an experience that could be experienced exclusively on site, which therefore involved the user once having reached the chosen place, through *immersive* and engaging experiences. Secondly, what to communicate and how to do it was considered. It was chosen to focus on both the temporary installations through which to *reconstruct* the path of the water conceptually, but also to use Computer Vision to make it possible to see the domus virtually reconstructed and appreciate those places in possible original forms as hypothesized.

3.1 References

Before describing the project and the components of the installation, there are some cultural and artistic references that provided suggestions for the concept.

The research related to the identification of projects and artistic experiences that directly involve the users as well as use contemporary languages, while paying attention and respect to the places with which they interact.

The work of Edoardo Tresoldi, the Italian sculptor, is effective, with him giving shape to his art through the use and modelling of metal meshes. Sculptures that are realised in the forms of architectural elements, which blend with the architectures and contexts in which they are inserted. The project for the Basilica of Siponto expresses all the poetics and communicative power of his language. Ephemeral and evanescent signs, albeit made with metal structures, outline and describe the three-dimensionality of the places that were. Works that reconstruct time, as they have been defined, a time made of other places capable of generating a strong fascination. A work designed to be crossed, enjoyed, observed by multiple points, internal and external to it.

Even the artistic installations that make the perspective artifice the instrument through which to realise and stage singular and surprising perceptive inventions, have been sources of inspiration.

Architectures, rather than parts of cities or landscapes, become the canvases, the supports upon which to build the installation. The reference starts from here to all those works that are translated through anamorphic projections (De Rosa and D'Acunto 2002). From the famous spatial optical illusions of Felice Varini to those of Georges Rousse, to the exceptional works of artists who create 3D street-paintings. Perceptive suggestions in which the observer recognises and reconstructs the theme of figuration, conquering the only possible point of view.

If with these works, sight and touch are the senses involved, artistic expressions in which other senses are stimulated have also been considered: multi-sensory installations in which hearing, along with the sense of smell, are involved. The sounds amplify

the suggestions and the involvement of those who assist and participate in the performances, often containing sounds, videos, static and dynamic projections. Forms and ways to rethink artistic expressions designed by Studio Azzurro. It is with the realisation of what are known as *Sensory Environments*, where it is possible to witness the participation of the spectator in the work, which can mutate and change in a certain place and in a certain time thanks to his choices, actions and interactions.

3.2 The Project

In the planned temporary installation, there are different components, two of which are dedicated to the theme of channelling rain water. The first is an installation that conceptually alludes to the falling of water from above, visually enhancing the function of the *impluvium*. A sculpture composed of two surfaces to be realised with nets tied in four points. With the dual purpose of re-configuring the original integrity of the columns, but also of creating a structure that could help to support surfaces, the columns are caged by cylindrical surfaces made from electro-welded metal nets, just over six meters high.

Symmetrically placed close to the longitudinal axis of crossing the *domus*, the sculpture is placed between the pairs of columns of the tetrastyle atrium.

The symmetrical surfaces are portions of a hyperbolic paraboloid generated as a function of the slanted quadrilateral, whose configuration has been defined in relation to the anchoring points. The intelligent use of geometry makes it possible to construct an object capable of enhancing a principle, that of collecting, and evoking an operation, collecting water in the cistern. The flat projection of the double curved groove is in this case a square, the rectilinear generators allow to easily construct the object that presents a single plane of symmetry that contains the main parabola, represented, in the first image, by the diagonal of the square. The main parabola conceptually represents the path and channelling of water (Fig. 3).

During evening visits of the archaeological site, scheduled for the presentation of the event, the parabolic curve will be made visible thanks to a strip of warm LED lights. The design surfaces, made with an elastic nylon membrane, are anchored with adjustable tensors in correspondence to the four vertices of the aquifers. Two connect the surfaces to the metal structures that surround the columns of the atrium, while the other two supports are positioned, one in the *impluvium* basin and the other, which also acts as ballast, to a support anchored to the ground.

The composition is designed to be crossed and observed from multiple points. The user is forced to move below it to access the other rooms of the *domus*. The movement the mesh of the nets gives unprecedented visual impressions due to the overlapping of the lattices of the membranes. The idea is to create an emotional event that stimulates the observer to interactively explore all the components of the installation upon reaching the atrium, the first representative area of the *domus* that is entered upon passing through the vestibule.

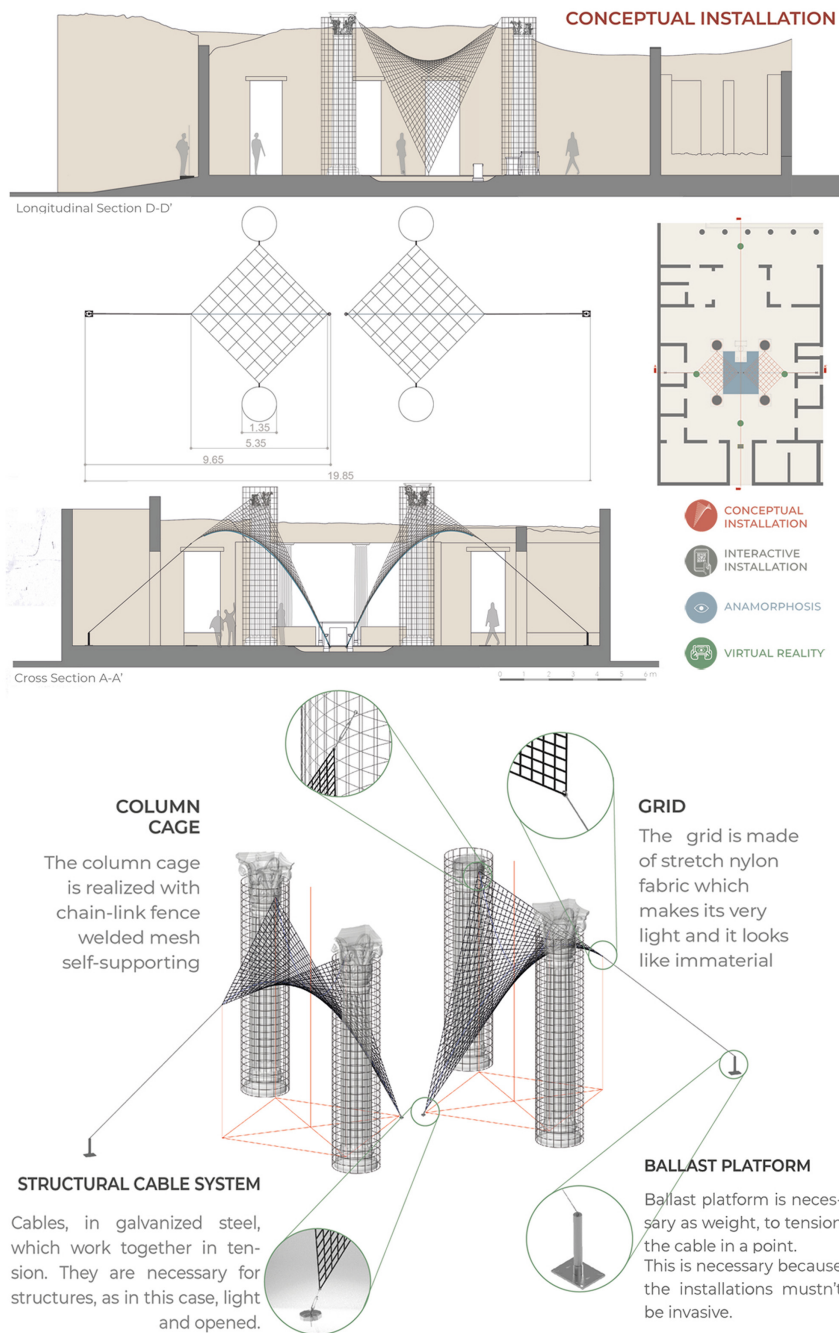


Fig. 3. Temporary installation concept: the water cycle in domus

It is at the end of the vestibule that the visitor meets, upon entering the domus, the first element of the temporary installation. A totem composed of a corten vertical sheet, 1.90 metres tall, inserted into an iron base that acts as a trapezoid. On the panel, there is a map of the area with the path of the exhibition upon which the *points of interest* (POIs) are indicated, which have been suitably designed to be immediately identified during the visit. The laser cut sheet is characterized by the installation logo, *Living Pompeii*, at the bottom. The upper edge recalls, with its irregular profile, the irregularity of the walls of the archaeological site.

A QR code, placed at the beginning of the visit path, invites to download the App that manages the virtual visit, the components and the multimedia contents.

The icon is a laser-engraved stylized eye that suggests to the user to look beyond the panel, where the other installation dedicated to the theme of collecting water is revealed: an anamorphosis created on a plexiglass panel arranged horizontally and installed in the *impluvium*, with the underlying tank and water collected in it are depicted. The perceptual experience is accompanied by a sound experience. When the user enters the totem platform, loudspeakers are automatically activated by weight sensing sensors that emit sounds of water. The installation makes the spectator a *spect-actor* since the events are generated as a consequence of his possible actions. Originated from a projective transformation, the deformed anamorphic image reveals its essence only if observed from the only privileged point that allows to recognise and reconstruct the figuration.

The last component of the installation refers to the POIs and the virtual contents accessible from an appropriately prepared App. The points are indicated with circular iron plates, with a diameter of 80 cm, upon which some corten plates are placed, engraved with the image of an electronic device and the eye alluding to the virtually accessible perceptual experience. Once again, the communicative power of images is used, in general, and pictograms in particular, in which the semantic content can also be understood by individuals of different languages and cultures. These elements, positioned on the ground along a hypothetical tour route, give access to virtual reconstructions. Through the App, it is possible to see videos and reconstructions of the reconstructive hypotheses of the *domus* that can be appreciated from those particular *points of interest*. The *spect-actor* walks over metal sheets and activates sounds, such as water falling into the cistern, as well as that of a receptacle being dropped from the puteal to draw water, which are activated thanks to the presence of sensor speakers for vertical sound diffusion (Fig. 4).



Fig. 4. Temporary installation elements

4 Conclusions

The project is part of a field of research and experimentation connected to the identification of methodologies capable of transmitting cultural content to a wider and heterogeneous public, without however yielding to the often sterile spectacle connected to the use of digital technologies. In other words, the concept tends to favour interactivity, without however exhausting itself in the exclusively recreational use of the installation. The use of ancient techniques and methods, such as anamorphosis, are integrated with the most innovative technologies, viewers, sensors, etc. with the aim of spreading the cultural content of the artefact. Therefore, not a trivial *storytelling* capable of representing the image of the reconstructive hypothesis, but rather a communicative system capable of transmitting the immaterial values of the Pompeian house through a multi-sensory experiential fruition able to stimulate suggestions.

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References

- Spinazzola V (1953) Pompei alla luce degli scavi nuovi di Via dell'Abbondanza (anni 1910–1923). La Libreria dello Stato, Roma
- Capone M (2015) Teorie e metodi per la rappresentazione del patrimonio archeologico su piattaforma digitale. In: Giovanni M, Arena M, Raffa P (eds) Spazi e culture del Mediterraneo 4. La Scuola di Pitagora, Napoli, pp 556–567
- Cirafici A, Palmieri A (2018) Lacune apparenti. La 'reintegrazione dell'immagine' nell'esperienza del patrimonio archeologico. In: Salerno R (ed) Rappresentazione materiale/immateriale, Atti del 40° Convegno internazionale dei Docenti delle discipline della Rappresentazione quindicesimo congresso UID. Gangemi Editore, Roma, pp 1043–1050
- De Rosa A, D'Acunto G (2002) La vertigine dello sguardo. Tre saggi sulla rappresentazione anamorfica, Cafoscarina
- Palomba D (2015) Il Tempio di Diana. In: Giovanni M, Arena M, Raffa P (eds) Spazi e culture del Mediterraneo 4, Costruzione di un Atlante del Patrimonio Culturale del Mediterraneo, Conoscenza, Comunicazione, Governance. La Scuola di Pitagora editrice, Napoli, pp 89–94