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XXI. International Conference on Culture and Computer Science 2024



FROM HUMANISM TO DIGITAL HUMANITIES

October 03-04, 2024
Florence, Italy

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Proceedings of the 21th International Conference on Culture and Computer Science: From Humanism to Digital Humanities

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PREFACE

The XXI edition of the International Conference on Culture and Computer Science – KUI 2024 was held in Florence, Italy, a UNESCO World Heritage Site. After being hosted in Berlin for twenty consecutive years, the conference embraced a new itinerant character in 2023 with its first edition abroad in Lisbon, Portugal. The 2024 meeting in Florence further consolidated this international vocation, reaffirming KUI as a distinguished platform for dialogue at the intersection of Cultural Heritage and digital innovation.
The focus of the year, "From Humanism to Digital Humanities", invited participants to reflect on the role of humans in technological development – both as creators and as users – while reconsidering how cultural values, practices, and tangible and intangible heritage interact with, and are reshaped by, contemporary digital systems.
In today's post-digital age, where physical and virtual realities increasingly converge, the conference highlighted best practices, challenges, and future perspectives in fields ranging from extended reality and 3D technologies to data management, visualization, and hybrid cultural experiences.

The papers collected in these proceedings illustrate the breadth and diversity of current research in this field. They are presented across three thematic topics:

Topic 1 | *Humanising the Informatic*
Contributions in this section explore the encounters between artificial intelligence, big data, and human creativity. From dialogues between AI and painting, to critical perspectives on social media persuasion, from experimental interactions between typewriters and chatbots to new tools for visuohaptic exploration, these papers probe the boundaries between computational processes and human imagination.

Topic 2 | *Steps Forward in Digital Heritage*
The second strand showcases innovative methodologies for the digitalisation, communication, and preservation of Cultural Heritage. Spanning archaeological landscapes, architectural studies, museum practices, and performative artefacts, the contributions address both tangible and intangible heritage. Many reflect the growing importance of participatory approaches, extended reality systems, and generative AI in reshaping the way cultural assets are represented, safeguarded, and experienced.

Topic 3 | Digital Technologies in the Cultural Sector

The final section broadens the scope to consider the impact of digital technologies across cultural practices. Papers range from reflections on Paul Klee's visual language to investigations of cultural resilience, from the political use of AR activism in public spaces to the exploration of VR environments for social catharsis, ultimately underlining the multiplicity of ways in which digital media can influence culture and society.

Taken together, these contributions highlight both the challenges and the opportunities of a digital future grounded in humanistic values. They demonstrate how cultural heritage can be not only preserved but reimagined through digital means, while also raising critical questions about ethics, participation, and sustainability in times of rapid technological change.

The conference took place in person at two distinguished venues: the Opera Medicea Laurenziana, located in the crypt of the Basilica of San Lorenzo in Florence, and the Department of Architecture of the University of Florence, within the Santa Teresa teaching complex. The organisers wish to express their gratitude to both institutions for their generous hospitality.

The editors would also like to thank the authors and reviewers for their valuable contributions, as well as all participants for their stimulating discussions. Special thanks are extended to: Ersilia Menesini – representing the Magnifica Rettrice of the University of Florence), Paolo Padoin – President of the Opera Medicea Laurenziana, Giuseppe De Luca – former Director of the Department of Architecture, Susanna Caccia Gherardini – Director of the Department of Architecture, Jürgen Sieck – KUI Representative, who delivered the opening addresses and institutional greetings.

We also gratefully acknowledge the keynote lecture, "FROM HUMANISM TO DIGITAL HUMANITIES. The Experience of the International Initiative Engineering Historical Memory", delivered by Andrea Nanetti of the Nanyang Technological University.

This volume aspires to provide a valuable resource for researchers, practitioners, and professionals dedicated to advancing knowledge and practice at the dynamic intersection of culture and computer science.

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From Priene to Berlin from Berlin to Digital

Travelling remains and digital applications for objects' biographies phase one

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Abstract

The contribution presents a series of digital acquisitions made at the Altes Museum in Berlin. The subjects are five marble statues from the Aegean city of Priene. Many previous studies have concerned the terracotta sculptures found in the Greek houses of the ancient city, the ruins of which are still accessible to the general public when travelling to Turkey in the Söke district of Aydın Province. Although the site is a reminder of the architectural magnificence of Hellenistic Greece, most of the sculptures and minor artefacts are today out of their original context. Digital acquisition combined with digital tools can now reconstruct the places of the past and reconnect objects to their original locations. This research wants to collect the objects' biographies and history for a future virtual re-presentation in the original context. Archives, digital tools, and 3D models can now reach a non-specialist audience and create storytelling structured on web-based technologies accessible from various mobile devices. With this intention, the digitised objects were contextualised within a virtual tour based on spherical panoramas linking the museum rooms to the 3D statuary models. Also, maps can help to contextualise objects from abroad, linking 3D data and heterogeneous documentation and making them accessible online to assist the visit to Priene. The present paper represents an early report about this documentation and dissemination operation, starting from the findings exhibited at the Altes Museum and coming from Priene.

CCS Concepts

• **General Literature**; • **Data**; • **Computer Applications**;

Keywords

Photogrammetry, Digital Reconstruction, Virtual Reality, Digital Heritage

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1 Introduction

When considering the state of the art of digital reconstructions, the most common arguments run to the digital operations aimed to revive abandoned places, rebuild lost architectures, and restore integrity to remains and fragments. Thus, one interesting application that can be brought on using contemporary tools for digital documentation is the recompositing of disseminated parts coming from significant archaeological sites and bringing them back, at least in digital format, to be recomposed with their original context, exploiting for the best the double interrelation between place and elements, the elements may virtually go back to their contexts, and the results may enrich the fragments in their present locations with better storytelling and an augmented knowledge about their adventure. All along the XIXth and XXth centuries, the archaeological expeditions conducted by the Western countries in the Mediterranean have revealed stunning places and unveiled new chapters of our past, while the process of historical documentation and preservation made appear as logic the idea of moving abroad, safe museums, a variety of masterpieces and fragments coming from the explored areas. In some instances, entire parts of buildings have been unmounted and moved from their original location to European and American museums. This happened in a specific cultural context [6], which defined a scenario where these elements received a proper restoration and found a new setup in exhibition rooms of depots, most of the time catalogued and identified by a simple write similar to "*item coming from... age... material...*" leaving to the knowledge and imagination of the visitors to identify the real context, both in terms of architecture and environment in which the element was initially placed. Using an approach to restoring the identity relationship between "migrated" elements and places may be an efficient approach, starting from documenting both the separated elements. On the one hand, digitalising the elements may create an easy-to-manage virtual clone of the real piece, an item capable of contributing to studies and research about the original setup in its original location. Helping both visitor and scholars in their learning and researching. On the other, the documentation by photogrammetry or lasergrammetry may produce high-quality reproductions of the portions of the landscape, urban space, and buildings where the items are coming from, a system of bases and knowledge that may contribute to a better understanding of the artworks and can provide helpful infographic and integrations to the exhibitions in place, in published works and online products, so to enhance the quality and the options for learning to

the most various users. Such a condition results quite clearly in the context of Priene, now part of Turkey, an ancient settlement of the Hellenistic reign, the large, excavated area revealing a rich and articulated city, abandoned after a series of unfortunate events and characterised by high-quality buildings still well readable in their details as well as in their general urban structure.

2 The complex history of Priene in a nutshell

Nowadays, Priene appears as one of the most interesting archaeological sites on the Turkish Aegean coast. It originates in an ancient Greek city in western Anatolia, near the present-day town of Güllübahçe. It is renowned for its well-preserved Hellenistic architecture and urban planning. Priene was initially founded on the slopes of Mount Mycale near the Maeander River. The exact date of its founding is unknown, but it is believed that it first had its foundation in the XIth century BCE by Ionian Greeks. Due to the silting of the Maeander River and other geological changes, Priene was relocated to its current location around the VIth century BCE during the reign of Alexander the Great. [9].

Urban Planning: Priene has a significant grid plan attributed to the architect Hippodamus of Miletus, who is considered a pioneer of urban planning. The city was designed with a strict grid of streets and uniform city blocks, a hallmark of Ancient Greek urbanism. The city featured significant buildings such as the Temple of Athena, an agora, a theatre, a stadium, and a gymnasium. The Temple of Athena, designed by the architect Pythius, is one of the city's most notable structures. Its architect was also known by Vitruvius, who wrote about Pythius in his *De Architectura*, mentioning that he "*wrote a volume on the Ionic temple of Minerva at Priene*" [7]. Under the rule of the Hellenistic kingdoms and later the Roman Empire, Priene thrived as a centre of culture, commerce, and education. The city continued to grow and prosper, maintaining its importance in the region. In the Byzantine period, Priene began to decline due to changing trade routes, silting of the harbour, and possible seismic activity.



Figure 1: Room with Hellenistic architecture fragments from Magnesia and Priene exhibited using anastylosis in the Pergamon Museum, Berlin (source: Google Streetview).

The city gradually lost its prominence. By the medieval period, Priene was largely abandoned, and its remains were eventually buried under layers of soil and vegetation. Modern excavations began in the XIXth century, revealing a remarkably well-preserved city layout and many structures that provide valuable insights into ancient Greek urbanism and architecture. German missions brought on the most important excavations and research about Priene [39]. The excavation allowed the extraction of various remains from the ancient city and revealed valuable sculptures and high-quality architectural parts. A certain number of these findings were collected, restored, and moved to Berlin, where they entered the Altes and Pergamon Museums collections (Figure 1). As it was quite common in that phase of archaeology, the findings comprehended entire architectural parts, like series of columns, freezes, and even whole portions of buildings. This practice of moving away parts was largely practised then and caused specific dissemination of valuable elements from their original location, mainly to Germany, France, and the United Kingdom.

3 Pieces far from their original context

The pieces collected during the various German archaeological campaigns in the past two centuries are now mostly part of the Altes and Pergamon Museums in Berlin.

Their data and information are stored and documented in the iDAI platform, which collects data from the German Archaeological Institute (DAI) and makes them accessible and retrievable online [10].

The digital collections online include many statues, architectural parts, items, and tools from the Mediterranean coast and its inland. In addition to the large set of findings, the collection at the Altes Museum presents some extremely interesting artworks from Priene, representing a high grade in the quality of sculpture in that land when Priene was a prosperous city.

The methodological approach and conceptual model presented here try to clarify the process of enhancing heritage through digital tools and 3D models.

Digital applications to cultural heritage artefacts require the development of a comprehensive and heterogeneous digital asset that collects the object's biography and documentation.

Creating digital assets is preparatory to using and reusing digital data for different purposes and users. Depending on the chosen dissemination purpose, several free or non-free tools, customisable or with predefined specifications, offer multiple digital storytelling techniques [5].

The creation of digital assets, whether 1D, 2D, or 3D, follows a methodology whose steps can be divided as follows:

- Knowledge acquisition comprises historical research and metric data collection through digital technologies (e.g. photogrammetry). This phase includes gathering data from digital repositories and defining acquisition protocols for museum and artefact objects of study [1, 25, 38].

- Data analysis, following the project's aims and desired outcomes, defines the levels of knowledge required for an accessible and reusable digital asset [16]. In this phase, heterogeneous data are analysed and organised.

- Knowledge interpretation occurs in virtual archaeology and virtual reconstructions for digital heritage. This phase is crucial for the transparency of processes and for using paradata within scientific reconstructions [2, 26, 37].

- Knowledge representation refers to storytelling tools and selected target audiences. Digital assets created in the previous phases can be used and reused by several applications for public engagement and user interaction (e.g. extended reality and interactive maps) [15, 17].

4 Knowledge Acquisition: objects biographies

The museum objects are all archaeological findings consisting of marble statues of diverse dimensions. The iDAI platform collects and retrieves their stories and previous studies using Linked Open Data (LOD) technologies. All images stored online document historical ways to document heritage and objects. Data and descriptive metadata also collect references on objects' biographies, including a list of bibliographic references useful for further and future studies. Also, archaeological excavation information was used to determine approximately the area of discovery of each piece according to previous studies and drawings about the city planning of Priene.

Images and pictures available online primarily refer to restoration activities and depict the memory of each object. The data were collected and resumed here for future storytelling use, as described in paragraph 7.

4.1 The Statuette of Dionysus

The statuette of Dionysus (sk. 1532) was found in Priene between 24 and 25 March 1898 during excavations in the Southeast Hall of the *Theaterstrasse 33* in the rubble of a fire that presumably occurred between 140 and 130 BC [31, 39].

The statue was found together with statuettes 1533 and 1534 in a place that was probably a warehouse [4].

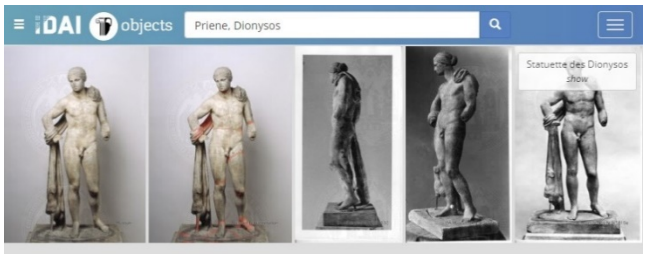


Figure 2: The Statuette of Dionysus in the iDAI platform[1]

The statuette was composed by assembling 34 fragments representing a god figure (Figure 2). It is assumed that the statue represents Dionysus, depicted standing frontally and naked. The panther sitting next to the god's right foot, which is now significantly deteriorated and hardly recognisable, confirms this interpretation. The statuette is a high-quality artwork, albeit damaged and restored, that reflects an important testimony to the eclectic style of late Hellenism. The object is made of light-coloured marble, partially blackened and altered in its structure by fire. It is documented that the object underwent a thorough restoration between 1994 and 1996 by A. Badde [3]. The body is adorned by chlamys, which form a long, narrow shawl. The shorter end is folded in a puff, thrown over the left shoulder, and hangs in a wide drape with zigzag folds at the back. The body's weight rests on the right leg, where the hip bends slightly. The left leg is oriented to the side with one foot placed backwards. The head and upper body tilt to the right, and judging by the arm's position, the hand must have been resting on the hip.

4.2 The Statuette of Aphrodite

The statuette of Aphrodite (Sk 1533) was found in 1898, together with the statuette of Dionysus. Due to fire damage, its material cannot be accurately described, but its marble is the same as that of the statuette of Dionysus.

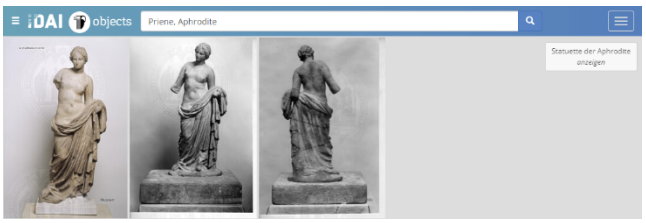


Figure 3: The Statuette of Aphrodite in the iDAI platform[2]

At its discovery, the figure had several fractures and was restored by Massmann between 1998/1999 [18]. The statue was probably placed on a plinth, and only the part near the right foot remains (Figure 3). The base, reconstructed in plaster, was broken several times over time. The statuette shows a frontal view of a young woman, probably Aphrodite, with a naked upper body and a long drape on her hips. The fabric reaches down to her feet and covers her legs and lower body. The cloak covers the left leg with tight folds, leaving only the foot tip uncovered. The free leg is visible on the right under the fabric. The upper part of the body bends towards the side of the supporting leg and rotates slightly forward. The shoulder area falls towards the side of the standing leg. On the other hand, the head is turned to the other side and inclined towards a person standing opposite on the same plinth. The face has an oval contour, and the upper cheeks and hair border the forehead at an acute angle.

4.3 The Statuette of a Young Man

The statuette (Sk 1499) was found in October 1895 during excavations in Priene, near house 29. It is thought that the object probably fell from the upper floor. Other Aphrodite marble and terracotta statuettes, as well as a chest of coins, were found in the same area [31]. The statuette was made of light crystalline marble with grey veins and was reassembled from 17 fragments [18]. Fire damage is visible externally in the crumbled surface at the front of the head, on the left shoulder and thigh, and in numerous cracks.

The young man is depicted naked, standing frontally, with his left forearm bent, resting on a column at waist height (Figure 4).

[1] More metadata are available under *'Statuette des Dionysos'*. Retrievable at https://arachne.dainst.org/entity/1121022

[2] More metadata are available under 'Statuette der Aphrodite'. Retrievable at https://arachne.dainst.org/entity/1121024

[3] More metadata are available under *'Statuette eines angelehnten Jünglings'*. Retrievable at https://arachne.dainst.org/entity/1062454

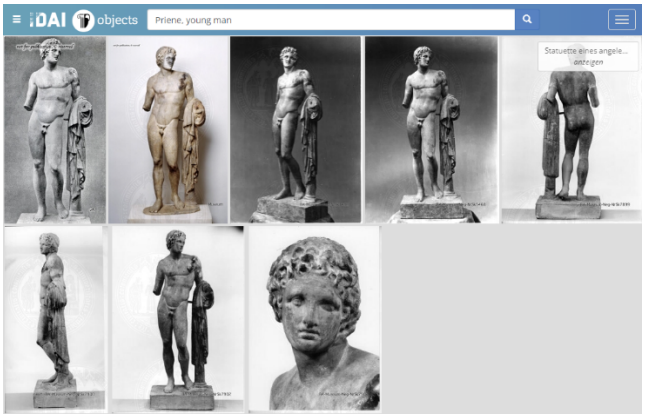


Figure 4: The Statuette of a Young Man in the iDAI platform[3]

The right arm hangs loosely across the body and is only slightly bent at the elbow. The head is tilted slightly backwards and turned towards the left shoulder so much that the face appears in a three-quarter profile. Inside views, the figure remains flat. The bent left leg and resting arm indicate only faint forward and inward movement impulses. The body's shape approximates a rectangle, and the inscriptions refer to Polycletic's models [40]. The standing motif with the elbow resting, the gracefully curved body and the raised shoulder are in the tradition of Praxitelian statues [30, 34]. However, the character of the head is Hellenistic.

4.4 The Statuette of Alexander the Great

The fragment (Sk 1500) belonging to the statuette of Alexander the Great was found in October 1895 in the Prienes' Holy House at *Westtorstraße 22*, between the northern hall (worship hall) and its podium area [31, 32]. It is a fragment consisting of a face and bust, made of medium-grained, grey to grey-blue marble. The upper part of the body was initially inserted into a separately made mantle part, probably made of different material.

The fragment shows the head, neck and naked right breast of a young man, depicted standing, with his head raised to the right and looking down (Figure 5).

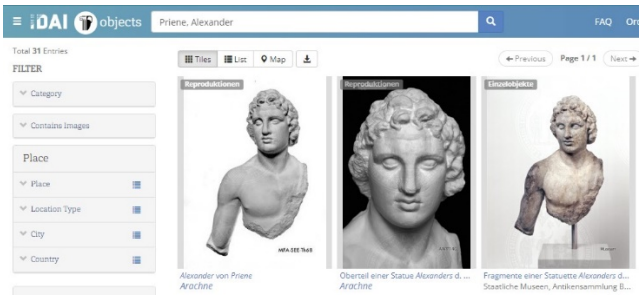


Figure 5: The Statuette of Alexander the Great in the iDAI platform[4]

The right arm is lowered, stretched diagonally away from the body, bent at the elbow, and turned outwards. Another fragment of the left hand found with the ring finger and little finger on the sword's hilt suggests that the left arm was lowered or bent so that the scabbard was held upwards or resting on the forearm.

The statuette probably represents Alexander the Great because other examples of the king depicted in this posture are available at Magnesia and Pergamon [19].

The head is covered with thick, curly hair that initially reaches deeper into the neck and is divided into front hair and on the crown by an indentation for a garland or tiara. The hair is parted on the forehead, forming small curls and swelling on the top of the head.

4.5 The Statue of Priestess Nikeso

The statue (Sk 1989) was found in 1898 in the rubble next to the *in-situ* plinth, right before the entrance to the Sanctuary of Demeter and Kore [20, 33]. The sculpture consists of two main parts: the statue and its plinth (Figure 6). The statue of the priestess is made of fine-grained yellowish-white marble. The figure is upright, with her upper body and shoulders turned left.

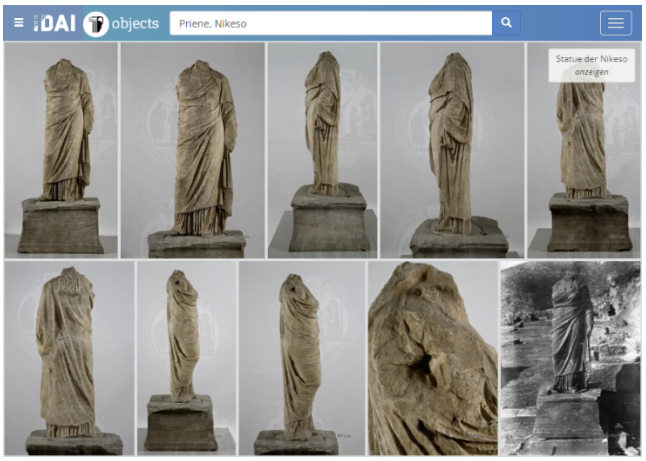


Figure 6: The Statue of Priestess Nikeso in the iDAI platform[5]

As shown by the folded left side of the neck, the displacement of the mass of hair on the nape of the neck, and the curls falling long on either side of the chest, the head was also most probably turned to the left. The body's weight rests on the left leg; the hip is bent slightly outwards. The right knee is bent forward and positioned slightly outwards; the foot is set back with the heel raised and pointing further outwards. The left arm is lowered and only slightly bent at the elbow. The raised right arm probably held an idra and was made separately and set on a smooth surface in pieces running diagonally from the shoulder towards the neck (essentially broken; the remaining part still shows the sloping of the surface. The front side of the robe is carefully worked, while the back side is more synthetic, showing only a few ample, shallow folds. The plinth is made of grey crystalline marble and is probably a reused element.

[4]More metadata are available under *'Fragmente einer Statuette Alexanders des Großen'*. Retrievable at https://arachne.dainst.org/entity/1121023

[5]More metadata are available under *'Statue der Nikeso'*. Retrievable at https://arachne.dainst.org/entity/1093212

Table 1: Camera specifications

Inv. N°	Camera*	Camera Lens	F/num.	Resolution
Sk 1532	Nikon	Nikkor AF 24mm	F 2.8	36.4 Mp
Sk 1533	Sony	28-70mm	F 3.5	60 Mp
Sk 1499	Nikon	Nikkor AF 24mm	F2.8	36.4 Mp
Sk 1500	Nikon	Micro Nikkor 60mm	F2.8	36.4 Mp
Sk 1928	Sony	28-70mm	F3.5	60 Mp

*Sony Alpha 7 R4 — Sony, Nikon D800E — Nikon

Thanks to the inscription ‘’*Nikeso, daughter of Hipposthenes, wife of Eukritos, priestess of Demeter and Kore*‘’ [33], it can be argued that the statue represents a priestess of Demeter named Nikeso and that she or her family consecrated her image in her honour and as a lasting memory of her service in the sanctuary, contributing to the prestige of her family, which would have belonged to the wealthy Priene bourgeoisie that held the Temple priesthood at that time [12].

5 Knowledge Acquisition: Photogrammetry

Photogrammetry offers significant advantages for museum collections, including high detail, cost-effectiveness, and non-invasive documentation, making it a valuable tool for preservation and study. However, its effectiveness can be limited by environmental conditions, the need for substantial processing power, and challenges with certain surfaces.

Balancing these factors is crucial for museums aiming to integrate photogrammetry into their documentation and conservation efforts. The museum's operations are always influenced by various factors. The presence of visitors, the light setup, the presence of windows around the items, and the timetable for the operations may influence the results and cause significant variations in the quality of the results.

In the case of the Altes Museum, the intervention took place in October 2022, during the opening time, but with a modest number of visitors, the kind support of the Director of the Museum helped a lot with all the operations, giving full trustful access to rooms and the findings. The photogrammetric acquisition faces two main challenges: the first related to the dimension of the sculptures (e.g., the Priestess Nikeso shown in Figure 9) and the exhibition layout that included objects placed under glass cases (e.g., the Statuette of Alexander the Great and the Statuette of Aphrodite shown in Figure 8).

The photogrammetry was operated using two different cameras: a Sony Alpha 7 R4 (Sensor FX, 60 Mp) with a 28-70mm F3.5 zoom lens and a Nikon D800e (Sensor FX, 36 Mp) with a Nikkor 24mm F2.8 and a Micro-Nikkor 60mm f2.8. The use of diverse cameras and lenses is summarised in Table 1.

The operations to compensate for the main issues were solved simply by using a tall tripod and remote shutter control for the statue of Nikeso, to reach all the top parts and reduce any possible occlusions and by operating an extra number of shots for the items "under glass", in this way the reflections and flares caused by the glass were well reduced, to avoid other interference caused by the glass a proper focusing strategy was chosen: focusing exactly on the subject and keeping the depth of field strictly on the volume of the statue, in this way all the altered elements on the opposite glass and the elements on the front glass turned completely out of focus with no change in influencing the final result.

Shooting through generic glass reduces the lens's performance but using a high-quality Micro-Nikkor 60mm F2.8 made this reduction not that dramatic. At the same time, using 60mm reduces the field of view but keeps enough perspective to help the SfM/IM process, making it easier to reduce the flares and reflections just casting the photographer's "shadow" on the glass.

This simple trick is worth mentioning that it works best when the photographer is dressed in dark colours, better if in black, to reduce any possible reflections. The use of a special dark rubber hood may be an extra useful measure, but it may reduce the freedom of movement of the lens, and even if it is very practical on a theoretical level, it often results in a lack of usability in real shooting sessions.

Last but not least, for some of these subjects, there were sometimes specific areas with a different level of detail, like the large inscription on the base of the statue of Nikeso. In this case, an extra set of closer shots was taken in perfect continuity with the general series of shots, so to enhance the quality of the resulting mesh and texture, an extra set of closer shots was needed.

All the shooting sets were later processed using Epic Games Reality Capture, producing optimised meshes and textures. They were then uploaded to Sketchfab.com as a first step in sharing and showing the results from this first documentation campaign using Photogrammetry SfM/IM (Figures 7–9).

6 Data analysis for the reconstruction logic

The attention to these relatively small items was driven by the idea that they are somehow elements capable of defining and influencing the architectural space around them, giving a focus and an important completion to the overall context. In this sense, an accurate representation of the model, is capable of giving all the details of the archaeological remains.

Completing the missing parts (at least on the level of their massive presence) was a desirable base for stepping into a new and more accurate (and more digital) approach to reconstructing the original contest of these artworks.

The resulting model can then be put in a general virtual reconstruction, allowing some reflections about the spatial relationship with the context, simulating the human perception of the original setup, and potentially increasing the quality of knowledge about past architecture.

Table 2: List of objects with primary metadata

ID	Inv. N°	Title	Dimensions (cm)	3D Direct Link
01	Sk 1532	Statuette of Dionysus	h. 61.5 (without base) - Base: h. 4.5 x w. 38 x d. 25	https://skfb.ly/oZVME
02	Sk 1533	Statuette of Aphrodite	h. 61.5 x w. 24	https://skfb.ly/oZXZO
03	Sk 1499	Statuette of a Young Man	h. 76.5 (without base) - Base: h. 4/4.5	https://skfb.ly/oZVMQ
04	Sk 1500	Statuette of Alexander the Great	h. 31.6 - Head: h. 12	https://skfb.ly/oGwMI
05	Sk 1928	Statue of Priestess Nikeso	h. 173 (without base) - Basemin: h. 56.5 x wmax 94 x dmax 85 Basemax: h. 56.5 x wmin 99.2 (front) x dmin 92, 6 (left)	https://skfb.ly/oZGDU

Table 3: 3D models data

ID	N. pictures	Geometry (Triangles)	Vertices	N. textures	N. materials	Resolution	OBJ file	JPG file
01	579 shots	5M	2.5M	1	1	16384x16384	723MB	24MB
02	187 shots	1.2M	596.8k	3	3	4096x4096	139MB	2.3MB
03	833 shots	5M	2.5M	1	1	16384x16384	726MB	32MB
04	481 shots	4M	2M	1	1	16384x16384	573MB	16MB
05	690 shots	5M	2.5M	1	1	16384x16384	721MB	32MB



Figure 7: 3D models (04, 02) of the statuette of Alexander the Great (left) and of Aphrodite (right).



Figure 8: 3D models (01, 03) of the statuette of Dionysus (right) and of a Young Man (left).

This last step is considered as the phase two of the present research; it constitutes a future development and will not be presented in this paper but some consideration about the statuettes and statues are here presented as part of the comprehensive description of them and their value.

As shown in figure 10 the statue of Nikeso was exposed in the upper part of the city (statues 05), near the first settlement. The Sanctuary, of which reconstructive hypotheses have already been made [31, 39]. Now it appears with partial portions of the perimeter wall elements and it is left in a state of neglection, partly because of its remoteness from the Temple of Athena Polias and the Theater, which are the major attractions of the archaeological site of Priene. Instead, the remaining statues were located within the housing fabric and in houses that have been codified and studied since the 1900s: house 33 (statuettes 01-02), Holy House (statuettes 04), and house 29 (statuettes 03). Regarding the topic of houses, the Altes Museum itself has a model *insula* of the city of Priene (2002), that was curated by Hoepfner and Jasieńko.

On the possible location of the statues within the living environment, studies suggest that the figures of Dionysus and Aphrodite



Figure 9: 3D model (05) of the statue of priestess Nikeso, with notes and watermark from www.sketchfab.com.



Figure 10: Maps with the localisation of findings in diverse areas of Priene. On the left is the Plan of Priene by Gerkan [13]. On the right is a map with archaeological evidence of buildings (2019).

would be suitable for placement as a motif and quality in the Andron (house 33). Even there is no evidence of domestic cults of Aphrodite at Priene, although statuettes of the goddess in marble and clay were also present in large numbers. The small figures of deities were found mainly to be sacred objects used in domestic worship [24, 31].

The installation of Aphrodite statuette would be also possible in a context that would appeal to lovers of cultured art (or admirers of feminine charms). The image of the goddess as the ideal of female beauty and as the protector of conjugal love and nascent life is also conceivable in the women's chamber [27, 28]

The circumstances of the find of the Young Man confirm it was placed in a residential building (house 29) but say no more about its original context. The naked young man with the bandage on his hair, the column, and the cloak placed on top can initially also suggest a connection with the Gymnasium, an athlete. Against the rich, curly hair, does not represent the hairstyle of an athlete, and the fact that the figures of athletes are not otherwise part of the decoration of houses [22].

Regarding the fragment of the statuette of Alexander the Great and its presence at the cult area of the house (holy house) specified by the inscription '*hieron hagnon*' does not allow us to understand what its location within the environment might have been. Its proximity near a podium, however, presupposes that it was a part e of cult statuette [23] or a votive gift [29].

The statuette of Dionysus, Aphrodite and the statuette of the Young Man, appear as the most capable of influencing the architectural space, while their size, quality and level of detail have a clear capacity to focus attention and may bring an important 'weight' in the balance of shapes and the overall composition of the virtual environment.

7 Knowledge representation for the use and reuse of 3D digital assets

Using 3D models and virtual tours to access museum cultural heritage offers numerous advantages.

The many experiences in the last years have tested and confirmed how the availability of digital content may help and contribute to research and enhance user experiences in accessing knowledge. Digital contents enhance the educational experience and accessibility for a wider audience, making it easier to create personalised learning paths. Virtual tours and 3D models allow people worldwide to access museum exhibits, regardless of geographical location or physical mobility. Individuals with disabilities, who may find it

challenging to visit museums in person, can explore exhibits comfortably from their homes. This approach may appear reductive in front of real visits, but in real it may operate in two positive conditions: as a preliminary visit to the place, before the real visit takes place, and as a later visit to the place, when the real visit is done, to understand better, fix and recall a moment of the real experience. Besides, the use of virtual tours and digital models in school and as a support for teaching may be considered a powerful tool yet to be fully explored and exploited, bringing interesting benefits to the learning process [14, 36].

Interactive maps can also be a useful tool for conveying knowledge. The use of GIS systems for the use of historical maps (HGIS), for example, is a widely used system in the field of historical studies [11] and digital humanities where maps are used for data visualization [21].

In this contribution, we would like to focus on a type of map, which can be called Heritage GIS or Heritage Map that allows cultural content to be georeferenced in space and made accessible to the general public through the use of smartphones and mobile devices online.

This type of storytelling allows the user to enjoy the content independently and benefit from the in-depth information that may be offered within the descriptive field linked to a specific point in the space. Within the field it is possible to insert not only textual content but also embedded contents already available online [35] including images, videos, audio tracks and 3D models, specific and multimedia contents, and/or web pages can be inserted simply adding a link or a QR code in one of the various fields.

Heritage map can also retrieve structured data (e.g., files .csv) stored on web that can be implemented and managed multiple times and allow a better support to new research.

7.1 Sustainable virtual and immersive reality

Regarding the documentation of the statues from Priene at the Altes Museum, a simple and basic solution was adopted to refer the artworks to their locations in the exhibition, keeping all in Sketchfab.com.

Three virtual reality panoramas were taken from the rooms in the museum and used to reference the five statues applying simple hypertext notes. In this way, the collection on this platform was enriched by a more complete context of the present location of these findings. Such a solution can be easily used for orienting the visitors and may work fine in orienting them before the visit and may work fine in helping them in finding back details about their visit when they came back to their houses. A possible alternative may be the use of an independent virtual tour presenting the panorama views of the rooms produced in HTML5 and directly linked to the Sketchfab.com contents, with the possible extra option of connecting museum rooms, items, artworks, and digitally reconstructed scenarios. And presenting the whole set of results in an independent platform, maybe even integrating other visualization methods to enhance the overall result. This solution may turn good in a more advanced state of the research, at the moment of writing, with a minor number of collected pieces, the "all Sketchfab" approach seems more direct and practical.

Table 4: ID of the 3D panoramas and their direct links

ID scene	N. annotations	VR Direct Link
Pano_01	3 (01, 03, 05)	https://skfb.ly/oZWDs
Pano_02	1 (02)	https://skfb.ly/p7VPn
Pano_03	1 (04)	https://skfb.ly/oZWD7

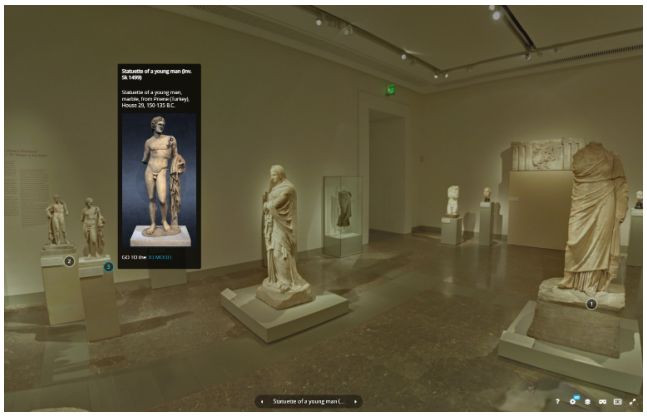


Figure 11: VR Panorama (Pano_01) view of the rooms at the Altes Museum integrated into Sketchfab.com.

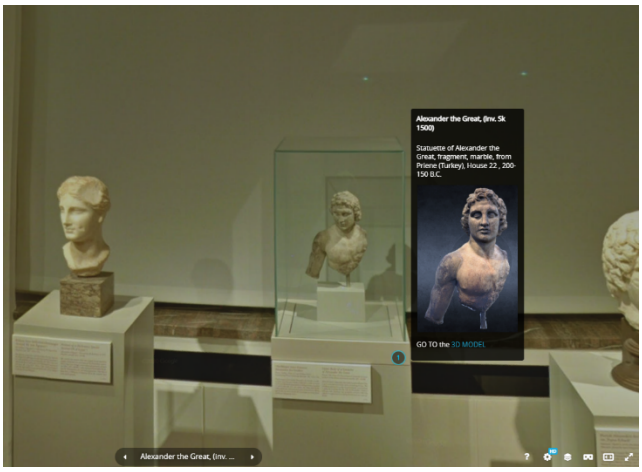


Figure 12: VR Panorama (Pano_03) view of the rooms at the Altes Museum integrated into Sketchfab.com.

Remaining on the subject of further developments, the same data produced in this part of the research may be connected in future, to the archaeological site of Priene, in place, in the excavated areas accessible to visiting, and/or in dedicated spaces and/or museums. The hypothetical reconstructions can serve as an interactive portal between the collection in the museums, and the original place of provenience, creating a close relationship where the great distances are solved, or at least reduced, by the virtual approach.

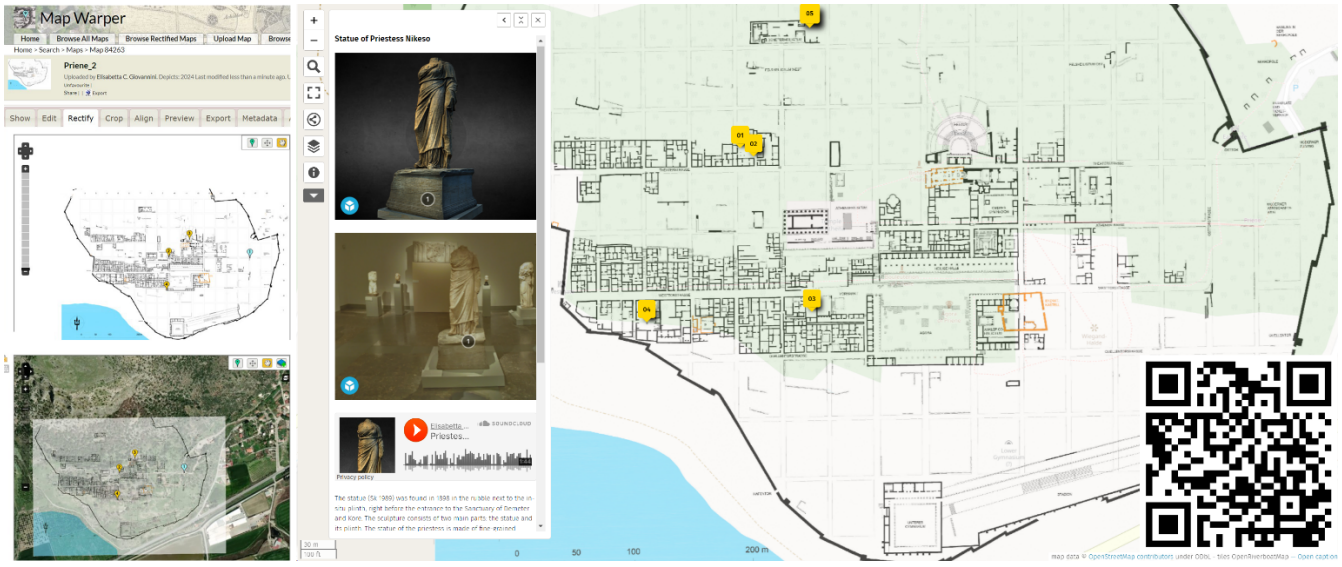


Figure 13: On the right, the rectify process in MapWarper. On the left, Heritage Map (Umap) for objects biographies of relocated statues from Priene. The descriptive tab is enriched with 3D models, an audio track and a textual description.

7.2 A Heritage map as digital ecosystem to access 3D collections

The Heritage map developed in this first phase represents a first step of georeferenced interactive use of the digital collection developed and stored in SketchFab. For the creation of the map, a web-based and open-source tool, based on OpenStreetMap (OSM) [8] was chosen that allows the retrieval of data and information through the embedding of resources within the descriptive field: *Umap* [16].

The two-dimensional map containing the archaeological evidence was transformed into the *Tiles* format based on the OSM scheme. This conversion was made possible by using *MapWarper* to rectify our map against a real map (OSM). Finally, five points were inserted in the vicinity of the areas where the statues were located. The information fields were thus filled in, inserting the 3D model, the short description of the work, bibliographical references, and audio tracks (developed with synthesized voices) that allow the contents to be enjoyed according to different visiting needs (Figure 13).

8 Conclusions

The migration of findings from their original location to the important collections of foreign museums has signed a very specific moment in archaeology and museum pedagogy. The price of restoration, preservation, protection and public sharing in safe and comfortable places was removing entire monuments from their original context, considering them as independent artworks with the option of preserving their value even out of contest. But this choice even if efficient and capable of bringing in good conditions all these elements was not so truly safe as it appeared in the mind of the archaeologists and museums' planners of that time, the tragedy of World War Two and the bombing of Berlin has caused damage to collections and the following occupation had brought to some further dismembering of the collections. In the present, the rich treasure of findings and parts of buildings represents a new challenge in digital preservation and dissemination, with the possibility of digitally cloning elements and bringing them into a future of possible uses and knowledge. The re-composition of disseminated parts with their former location is a challenge of knowledge and communication, finding approaches free from any spectacularisation but contributing to a gradual increase of knowledge aimed at conceptualising the past relationships between artworks and places. Contemporary technologies like the SfM/IM photogrammetry allow fast creation of sharable three-dimensional digital models, which may be the base for a better understanding of the past, their integration with professional documentation may produce a gradual enhancement in the context of the migrated items, producing a virtual recreation of the past situations that may greatly influence the comprehension of places and artworks. The early results presented here are just an initial step in this direction, making the effort to set procedures and define collaborations in the virtual re-integration of items to places and places to items.

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work by E.C. Giovannini, all the other paragraphs are a common work by the two authors.

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