Digital reconstruction and storytelling: Exploring funerary artifacts from the Han era in immersive virtual reality

Digital Reconstruction and Storytelling: Exploring Funerary Artifacts from the Han Era in Immersive Virtual Reality*

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***Abstract*—This research focuses on the contextualization and digital reconstruction of twelve funerary artifacts from a Han Era archeological site, currently housed at the Asian Art Museum of Turin (MAO). The reconstructed artifacts have played a central role in a virtual exhibition that has integrated and represented the characteristic elements of Han art, emphasizing architecture, painting, and sculptural features, through the incorporation of storytelling. The process was developed through photogrammetric acquisition and 3D modelling of the funerary artifacts, reconstructive modeling and texturing of a Han tomb, along with a Virtual Reality (VR) experience enhanced by a set of informative descriptions. The study involved a multidisciplinary team of experts in Asian art, digital reconstruction, and information processing systems, with the support of MOD Lab Arch and VR@POLITO at the Politecnico di Torino.**

***Index Terms*—Digital reconstruction, 3D modelling, Virtual Reality, Museum heritage, Virtual tour, Storytelling, Asian Art Museum (MAO)**

I. Introduction

The present work focuses on the digital survey, digital reconstruction and virtual tour of an archeological site and twelve funerary artifacts from the Han Era, currently housed in the Asian Art Museum of Turin (MAO), with the goal of augmenting engagement in museum heritage through digital and immersive technologies.

The study engaged a multidisciplinary team of experts in Asian art, digital reconstruction, and information processing systems, with the support of MOD Lab Arch and VR@POLITO at the Politecnico di Torino.

II. VR for Museum Heritage

In recent years, digital technologies have increasingly influenced various aspects of human daily life, paving the way for new challenges and techniques that were previously inaccessible and unattainable [1]. Among the most significantly impacted fields, cultural heritage has undergone profound and radical changes. Digital technologies have facilitated a paradigm shift in museum experiences, enhancing visitor engagement and participation [2]. This paradigm shift has been made possible by the transformation of two key aspects: digitalization has revolutionized both the concept of preserving archaeological sites and artifacts, and consequently, the methodology for accessing and engaging with digitized material [3].

Regarding the preservation of archaeological artifacts, research has focused on developing techniques to prevent and halt the physical deterioration to which these artifacts are susceptible. In order to combat this phenomenon, digitalization has driven the development of new technologies aimed at safeguarding and restoring the original conditions of various artifacts. This effort has materialized through the use of technologies for three-dimensional reconstruction [4]. The most commonly used technologies for this purpose today are photogrammetry, such as laser scanning, and digital reconstruction through 3D modeling software, such as Blender. These technologies aim to easily create accurate virtual replicas of the original object, which are thus impervious to external agents and the passage of time [5]. In addition to preserving existing artifacts, these techniques are also capable of recreating and visualizing three-dimensional copies of lost or damaged artifacts and archaeological sites [6]. These tools assist archaeologists in their restoration efforts, allowing for a greater emphasis on detail and precision [7].

Regarding the interaction with reconstructed models, the development of immersive technologies such as Virtual Reality (VR) is enabling the creation and population of fully virtual environments. Within these environments, it is possible to view and interact with digitally reconstructed objects as if they were physically present, using Head-Mounted Displays (HMD), in an accessible and repeatable manner [8]. The ability to create interactive virtual replicas has made it possible to reconstruct entire archaeological sites, supporting archaeologists in safeguarding heritage by providing a more convenient and accessible means of engagement, available from anywhere in the world [7]. Simultaneously, VR has led to the creation of fully virtual exhibitions as complementary tools to physical museums, aimed at providing more engaging educational experiences compared to traditional methods. Thus, studies have shown that user comprehension and memory are improved through a more interactive and immersive experience [9].

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An early example of a digital exhibition was theorized and implemented by Bruno et al. [10], where they proposed a methodology for creating virtual replicas of archaeological sites, which can be explored through VR systems. Their approach was based on the use of 3D scanners and high-definition cameras to capture models and textures as accurately as possible, with the aim of creating realistic and lifelike exhibitions for the user.

In order to bring visitors closer to typical museum exhibitions, Debailleux et al. [11] focused on enhancing users' spatial understanding within digital replicas by incorporating the concept of Point Of Interest (POI). Traditionally, POIs are used to guide users more naturally through the orderly viewing of digital reconstructions, thereby increasing visitor comprehension. For this purpose, the experience was structured as a predefined pathway within an architectural heritage showcase, where users were encouraged to linger at POIs near the most significant buildings. Initial results demonstrated that the use of POIs made the experience more engaging.

A further step in creating increasingly engaging VR cultural experiences was achieved by Caliari et al. [12], who focused on enhancing the visitor experience by improving comprehension. The experience took place within a digital representation of a villa from the Roman era, namely Villa Adriana, divided into various POIs, where users could interact with various statues, created starting from point clouds obtained by 360° cameras and refined by 3D modeling. The immersive visualization was further enriched by integrating storytelling, allowing users to access detailed descriptions of the objects through interaction. The combination of POIs and storytelling enhanced visitor engagement and consequently improved the understanding of the archaeological site.

Digital reconstruction technologies applied to cultural heritage are increasingly demonstrating their benefits in preserving artifacts and, more broadly, entire archaeological sites. The integration with immersive technologies, particularly VR, is further amplifying these advantages by enhancing the traditional visitor experience and opening up new possibilities for education and audience participation. This fusion transforms museums into dynamic spaces where history is not only preserved but also actively explored and reimagined through virtual tours.

III. 3D Reconstruction of Archaeological Sites

Methodologies and technologies offered by the digital world demonstrate their full potential in reconstructing archaeological sites in all phases ranging from analysis, interpretation, reconstructive modelling and communication. These operations require the contribution of multidisciplinary teams within the so-called Digital Humanities, which in the present proposal range from art and architectural history, archaeology, digital acquisition, modelling and representation, computer graphics and visualisation.

The potential of reconstructive digital modelling is manifold and relates to the different reconstruction purposes. On the one hand, they allow, through visualisation, the comparison of the various hypotheses formulated by scholars regarding the physical conformation of architectural spaces, their decoration, and the works of art and artifacts that may have been located in them.

The sources for archaeological reconstructions are generally multiple and consist of the remains and rests of architectural structures, archival sources (textual descriptions, design drawings that are increasingly rare as one goes back in time, and survey drawings made in the past), and bibliographical sources (historical treatises, drawings and reports) by scholars and travellers. Reconstructions from these sources can be defined as reality-based and source-based, respectively. They mainly require the integration of these sources and filling lacunae through philologically plausible hypotheses deduced from comparisons with contemporary artworks from the same geographical and cultural area.

Digital surveys allow, above all, to position and geometrically and metrically define the ground plan of the building and to recognise its materials and colours; the paper sources enable the elevations to be enriched and sometimes completed, and finally, philological comparisons can integrate and open up different reconstructive hypotheses.

Integrating sources of different types and completing 3D models with even different hypotheses of formal, structural, and decorative solutions brings out the need to declare and recognise sources and hypotheses deployed during reconstructive modelling activities.

Two essential references are The London Charter for the Computer-Based Visualisation of Cultural Heritage [13] and the Principle of Seville [14].

The first underlined two core concepts for digital reconstruction in general: intellectual transparency, intended as the "provision of information, presented in any medium or format, to allow users to understand the nature and scope of 'knowledge claim' made by a computer-based visualisation outcome", and Paradata as "information about human processes of understanding and interpretation of data objects".

The second one highlighted the importance of the principle of transparency in the archaeological field, where the digital reconstruction of artifacts (in their ancient configuration) is primarily based on indirect information, comparative analysis, interpretative hypothesis". The Principles stated that "all computer-based visualisation must be essentially transparent, i.e. testable by other researchers or professionals, since the validity, and therefore the scope, of the conclusions produced by such visualisation will depend largely on the ability of others to confirm or refute the results obtained".

Ferdani et al. [15] defined the multidisciplinary scientific approach of virtual archaeology as the acquisition, analysis and interpretation process aimed at visualising and simulating the past using 3D digital technologies. Moreover, they stated that virtual heritage is the better way to test complex hypotheses, visualise intrasite change and development, and visually absorb complex datasets about the past. Among the more interesting points of view about uncertainty appear Leyngel and Toulouse (2019), who affirmed that uncertainty in knowledge does not mean the fragility of scientific thinking. In this regard, they set up a new investigation methodology based on the sequence of "visualisation of uncertainty", "visualisation of hypotheses", and finally ", design of abstraction", focused on the idea behind the building.

In the present case study and some precedents (Spallone et al. [16]), both the juxtaposition of chronologically coherent pottery statues from different sites in the same geographical area and the virtual reconstruction of the context, a Han period tomb followed a different direction, aimed at the ideal reconstruction of the cult of the dead with the objects and in the places where such practices were usual. The choice of homogeneous statues, intended as exemplars of Han sculptures for funerary cult and placed in the spaces of an underground tomb, equipped with decorative elements and wall paintings extracted in turn from other philologically comparable tombs, is aimed at constructing a true demonstrative and didactic palimpsest. By the scientific transparency of the operations performed, labels connected with the individual objects and the different elements of the tomb unmistakably indicate the original and current location of the artifacts and the provenance of the single decorative elements.

IV. SOUL-SEARCHING - Miniaturization and spatiality in tombs during the Han period

Since times unmemorable, we have concerned ourselves with death and what may come next. Yet, few people have been so intensely preoccupied with the organization of their tomb as the Chinese. They believed that crossing the great boundary between life and death (da xian) was a matter of thorough preparation. Their concern prompted the construction of thousands of funerary complexes during the Han period (206 BCE-221 CE). From the elaborate mausolea of emperors and officials to the simplest servant pit, tombs not only reveal the extent of expenditure in time, manpower and resources Han Chinese allocated to this endeavour, but also their technical ingenuity and the distinctive logic of space.

Han Gaozu was the First Emperor of the Han Dynasty (206 BCE-220 CE) who consolidated and expanded the authoritarian model promoted by the previous short-lived Qin empire. During the almost 400 years of continuity, power was centred in the emperor and his family. They controlled the state's boundaries by granting land and prestige to relatives and loyal officials. The political and economic stability of the new state boosted cultural, scientific and technological advancements. As Confucianism was adopted as the official government orthodoxy, Indian Buddhism found its way into China, while Daoism grew and peopled the arts, literature and burials with a plethora of intangible spirits and tales of supernatural portents.

Many are the clues burial assemblages provide on shifting beliefs and social customs, bringing to light tomb-making and "soul-searching". Sealed off and theoretically invisible to the living, tombs became symbolic enclosures for the soul. A soul, which was believed to be dualistic since the 6th century BCE: once deceased, a person's celestial soul (hun) departed to heaven while his/her terrestrial soul (po) lingered in the tomb for eternity [17]. To avoid the turning of the po into a hungry ghost wreaking havoc among the living, all precautions were taken to make the eternal home as comfortable and luxurious as possible. Fear of the unknown aside, Confucian filial piety further dictated that the surviving relatives of the departed should bestow the best possible accoutrements for the funeral and the entombment. Specific materials, mediums, shapes and colours were chosen for the architecture, the furniture. Three-dimensional objects and bi-dimensional images were then created and positioned according to their alleged role in the afterlife.

Han burial practices expanded from earlier Qin desire to recreate the world of the living in the afterlife. Evolving from the first Emperor's megalomaniac experiment, tombs in the Han period featured a compressed size and morphed from vertical shaft gasket pits (mu guo) to horizontal stone or brick multi-chambered residences (shi mu), modelled on above-ground palaces [18]. The spatial change was also accompanied by a change in assemblages. Bronze ritual vessels, bells and weapons used in the past were being replaced by a variety of pottery figurines (yong).

For Confucius (551-479 BCE) to avoid confusion between the living and the dead, numinous, spirit articles (mingqi) in the tomb should depart from their utilitarian prototypes:

"In dealing with the dead, if we treat them as if they were entirely dead, that would show a want of affection, and should not be done; or if we treat them as if they were entirely alive, that would show a want of intelligence, and should not be done. On this account the bamboo artifacts (made for the dead) should not be suited for actual use; those of earthenware should not be able to contain water; those of wood should not be finely carved; the zithers should be strung, but not evenly" [19].

Grave goods acted as visual symbols of death. Whether mimicking a vessel (which was rendered unusable), or shaping a human figure, compressed in size, these man-made objects were essential in the space logic of the tomb. Their quantity and size were calculated according to the status of the deceased. Mostly fashioned in clay from identical moulds and later diversified by hand, figurines were painted, covered in clothes, armed. As silent, unseen extras playing in the dark, they were placed close to a wall painting of a procession, participated in a banquet, served their master, or even took part in musical reenactments. By virtue of their three-dimensionality, they made sense of the emptiness of the tomb while suggesting the movements of the soul. If only they could talk…

All these figurines were also reduced in size as they were meant for the compressed space of the tomb. Rules may have governed the relationship between the architecture, the deceased's status, the soul and the mingqi; given the exiguous space of the tomb, the size of the soul was likely believed to be small too. Regardless, its intangible presence pervaded people's idea of the afterlife; an idea that in turn could dictate the form and scale of the tomb.

Catering for a compressed small-size ethereal soul, all man-made objects and paintings in the Han tombs contributed to liven up an ideal miniaturized residence with ongoing entertainment. Thanks to their visual scheme and assemblages, tombs provided souls not only with a properly oriented cosmic environment, guaranteed by geomantic prognostication, but featured visual clues in paintings and sculpture that evoked an immortal paradise, while the objects once used by the deceased and cherished in the tomb would stand as symbols of his/her past life, which hopefully, had been well spent.

V. Photogrammetry of Artifacts (Henan)

Over the past few years in the field of Cultural Heritage there has been a growing interest in surveying science. Specifically, there has been a growing need to duplicate the museum, even creating its entire digital double, possibly usable online, directly accessible from any computing device. There is, therefore, increasing emphasis on the quality and accuracy of the documentation of the property, paying attention not only to its artistic history but also to its geometric characteristics, its location and contextualization, and its form. Combining these aspects means that knowledge of the asset can be more thorough and complete [20].

The wide variability of artifacts that may fall within the world of Cultural Heritage makes it essential to understand the characteristics of the object (size, shape, and material), the environmental conditions of the survey, and the purpose and ultimate application of the virtual model, to choose the most appropriate technology [21].

This case study is part of a larger project utilizing handheld digital photogrammetry to generate models for web-based visualizations, virtual tours, and the creation of tactile models through FDM 3D printing. The methodology adheres to the standards established by the London Charter, Seville Principles, and the Bordeaux White Paper, which recommend best practices for digitization and visualization in cultural heritage and the humanities [22].

The photogrammetric technique has notable examples of application because of the undoubted advantages of being inexpensive but extremely accurate, easily integrated using different levels of scale, and based on easily transportable but technologically advanced instruments that allow fast acquisitions of both geometry and color components. In addition, image-based procedures (IBM) are flexible and often preferable for digitizing numerous objects that differ in shape, materials, and dimensions [23].

IBM techniques calculate the 3D coordinates of points identifiable in two or more images. To achieve this, both the external (camera position and orientation) and internal camera parameters (focal length, lens distortion, principal point) must be determined. This process is automated through computer vision techniques known as Structure from Motion (SfM), which extract the necessary external and internal camera parameters. As a result, no prior camera calibration is required [24].

The digital reconstruction process for the museum's sculptural heritage has now become well-established. Twelve artifacts – eight sculptures and four jars – have been selected with the assistance of conservator Laura Vigo. Thanks to their manageable size, they have been moved to a room for photogrammetric surveying. Each piece was placed on a square table to optimize shooting distances and ensure uniform lights distribution around the objects. The table surface was covered with newsprint to guarantee good photo-matching. The lighting setup included two softboxes alternating with two lamps and reflective umbrellas (Figure 1).

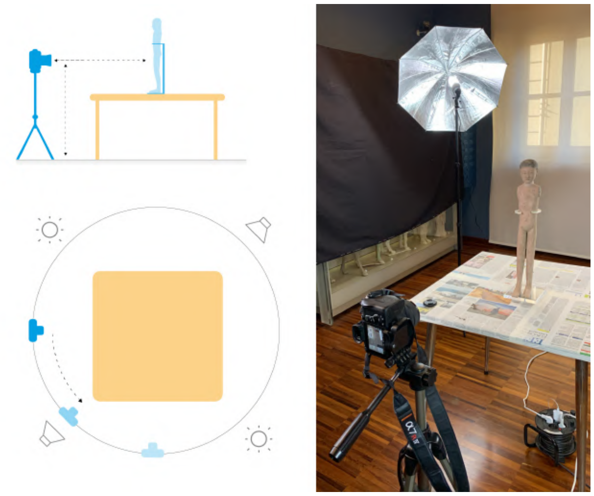

Fig. 1. Photo shooting set scheme on the left (Graphics by M. Raso) and picture of the surveying activity on the right (Photo by F. Ronco).

A color checker and a marker with a metric scale were used to guarantee reliable textures and metric information.

Depending on the dimension of the artifact, the number of turns around it was established, varying from a minimum of three turns to a maximum of five. The number of pictures for each turn was determined to guarantee a minimum of 80% overlap between adjacent ones.

The first set of pictures includes the object in its entirety, the subsequent ones are nearer and frame only portions of the artifacts.

The pictures were taken with a 61.0 MP Sony full-frame Alpha 7R IV equipped with two lenses: Sony FE 2/28 mm and Sony FE 2.8/50 mm macro lens for the details. The pictures were then processed with Agisoft® Metashape. In some cases, the algorithm had some problems aligning them, including some background elements. It was, therefore, decided to mask some images with the software itself to avoid this inconvenience (Figure 2).

After aligning the photos, the software proposes the creation of the Sparse Cloud, which undergoes a cleaning process before launching the calculation to obtain the Dense Cloud. Thus, the points define the mesh faces once we reach the Build Mesh step. The meshes have been simplified, reducing the number of faces to minimize models' size while preserving the shape, volume, and boundaries.

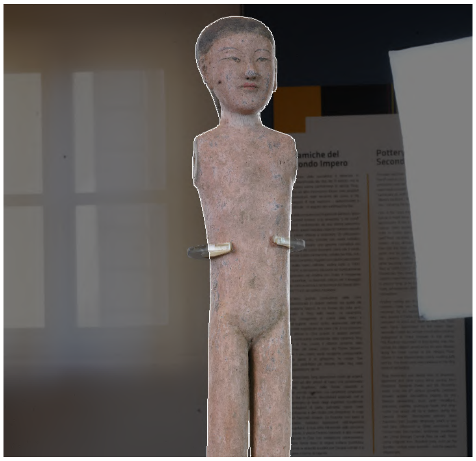

Fig. 2. Picture masking on Agisoft® Metashape.

Finally, the texture is created by finding commonalities among the photos (Figure 3). The resulting reconstruction was of high quality with a consistent point cloud density, capturing details. The mesh model was finally exported to .obj for implementation within the Blender® environment.

Fig. 3. Textured model on Agisoft® Metashape.

VI. 3D Modelling and Texturing

Three-dimensional models produced using Metashape®, while characterized by high quality and remarkable detail, have excessive polygons. This makes them unsuitable for applications requiring optimized performance, such as video games, interactive simulations, or virtual reality projects. To overcome this limitation, retopology is used, which allows the number of polygons to be significantly reduced without compromising the overall visual quality. The basic principle is to start from a high-polygon-density model, called High Poly, to generate a low-density version, Low Poly, that retains the essential geometry (Figure 4). Details are then recovered through normal textures and maps, providing an ideal compromise between visual quality and file size.

Blender®, one of the most comprehensive and widely used open-source and free 3D modeling software, was used in this project. The retopology process began with the creation of a base mesh, to which the following modifiers were applied:

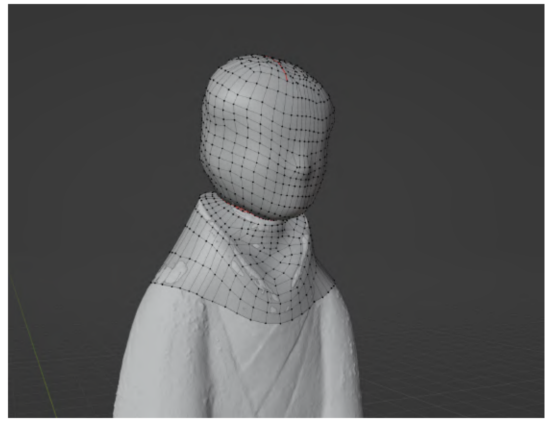

Fig. 4. High Poly to Low Poly in Blender.

- *Shrink Wrap*, which moves the vertices of the Low Poly model to the surface of the High Poly, ensuring a perfect fit;
- *Subdivision Surface*, which moderately increases the resolution of the mesh, making the surface seemingly smoother and more beveled.

Next, manual intervention was made by extruding the sides of the Low Poly mesh to match the underlying geometry. This approach reduced the number of polygons by up to 95%, resulting in a compact yet detailed model.

The Low Poly model obtained by retopology, which is devoid of details, requires the use of textures to faithfully reproduce the visual elements originally defined by the number of polygons in the High Poly counterpart. To reproduce these details, the baking technique is used to transfer light and shadow information from the High Poly model to the Low Poly model. In this way, the lighting simulated using normal maps reproduces the effect of the geometric details in the original model (Figure 5).

Fig. 5. Normal map, comparison between activated (left) and deactivated (right).

The baking process requires accurate division of the model into sections, through the use of seams, and generation of an optimal UV map. After creating a blank image file for each required texture (color, roughness, AO and Normal), the Low Poly model is overlaid on the High Poly and through the baking option in the Cycles rendering engine the data transfer takes place.

In the specific case of Tomb No. 61 in Luoyang (Henan), an optimal virtual environment was reconstructed to display the modeled three-dimensional works (Figure 6), integrating data from the archives of the Museum of Oriental Art (MAO) and other archaeological sites.

Fig. 6. Renders of the twelve artworks, Blender (Rendering by M. Raso).

Through the use of Nomad Sculpt®, an app available on iPadOS, and starting with simple shapes with a limited number of polygons, defining spaces and primitive shapes, we moved on to more complex models with a large number of faces to recreate as much detail as possible. Crucial to this step was the use of .png images used as alpha, modifying the shape and brush action to replicate cracks, surface textures, and reliefs (Figure 7).

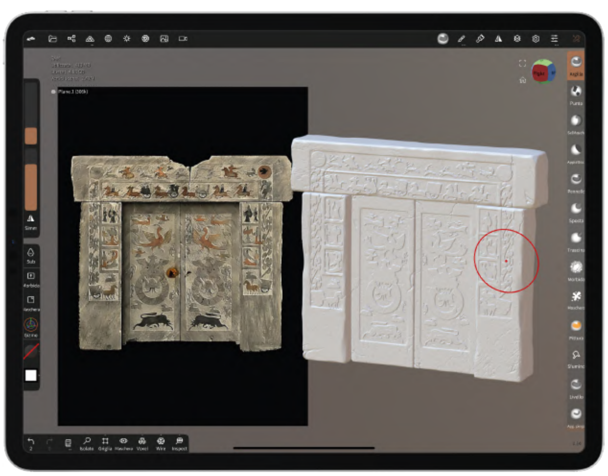

Fig. 7. Nomad Sculpt, interface: Paradise Portal model (Modelling and sculpting by M. Raso).

To ensure adequate optimization of graphical resources, the retopology technique was again employed, resulting in lightweight yet detailed three-dimensional models that could be visualized without excessive computational load. A particularly significant example of this optimization process was the development of the tomb floor. The original model, containing about 1.2 million polygons, was reduced to 390 polygons, a number significantly more compatible with use on platforms such as Unity®. By using normal maps obtained through the baking process, it was possible to maintain the detailed appearance of the original model despite the drastic reduction in the number of faces.

The same technique was applied to all sections of the tomb, including the soil in the entrance gallery and the brick walls of the side spaces. This approach resulted in a significant reduction in rendering time, thus improving the overall performance of the project and ensuring smooth visualization on even lower-performance platforms.

In virtual reality (VR) projects, the element of immersiveness plays a crucial role in the success of the user experience, and for this reason, it was decided to use Adobe Substance Painter®, one of the most advanced and widely used software for creating high-definition three-dimensional textures. This program makes it possible to apply procedural materials and simulate details such as wear, dirt, plaster, or frescoes in a realistic way, thanks to the use of smart materials and generators (Figure 8). Every element has been taken care of down to the smallest detail, starting with a flat color base and modifying surfaces using masks and generators, capable of acting on specific areas such as curvatures or reliefs.

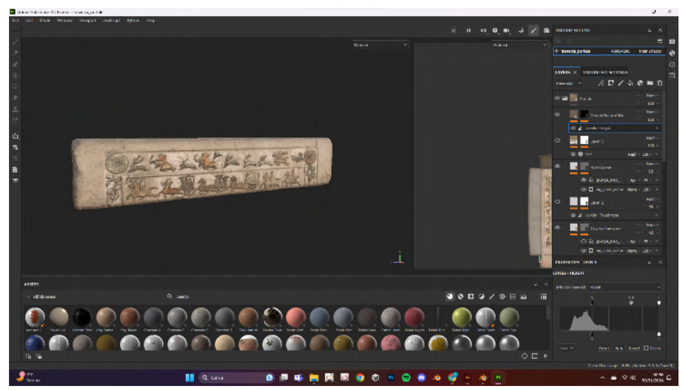

Fig. 8. Adobe Substance Painter®: creating texture for the Portal of Paradise (editing by M. Raso).

The use of Adobe Substance Painter® allowed for extremely detailed and realistic textures, capable of amplifying the user's sense of involvement within the virtual environment. This created a highly immersive experience that reinforces storytelling through interaction with a detailed and true-to-life three-dimensional environment (Figure 9).

Fig. 9. Tomb main room textured (Modelling and texturing by M. Raso).

VII. VR Experience

Regarding the VR experience, it was decided to rely on Unity version 2022.3.24 for the creation of the virtual tour and to orient the project towards compatibility with standalone Meta VR HMDs (e.g., Meta Quest 2 or Meta Quest Pro). The OpenXR application API was adopted, in order to design the application to be compatible and accessible with the various VR devices. Furthermore, it was used as a foundation for the design of the User Interface (UI) and the entire User eXperience (UX) in general.

Regarding the navigation within the virtual environment, it was decided to use continuous locomotion through the controllers to increase the immersion of the user, as it is closer to the simulation of walking in the real world. Based on the previously mentioned advantages in section II, the VR experience was subdivided into POIs, in order to simultaneously advise and guide the visitor in the enjoyment of the archaeological site and the reconstructed models. In order to indicate the various POIs within the VR experience, it was decided to use contextual balloons, corresponding to locations or surfaces of significant importance. After selecting the balloon, a textual description of the POI will be displayed (Figure 10).

Fig. 10. Contextual balloon and corresponding textual description of a selected POI.

For the purpose of streamlining the experience and to allow visitors the maximum comprehensibility and engagement on the site and the reconstructed models, it was decided to enable the diegetic UI only in the event of one of the two triggers being pressed on the user's controllers.

The architectural layout of the virtual tomb experience is subdivided into four distinct segments underpinned by structural considerations. In order to make the UX as intuitive as possible to increase visitor understanding and engagement, it was decided to present a small initial tutorial, through a textual and visual explanation of how to interact with the various elements that make up the virtual tour (Figure 11).

The initial segment is represented by a corridor followed by a descending ramp at the end of which is a stone portal,

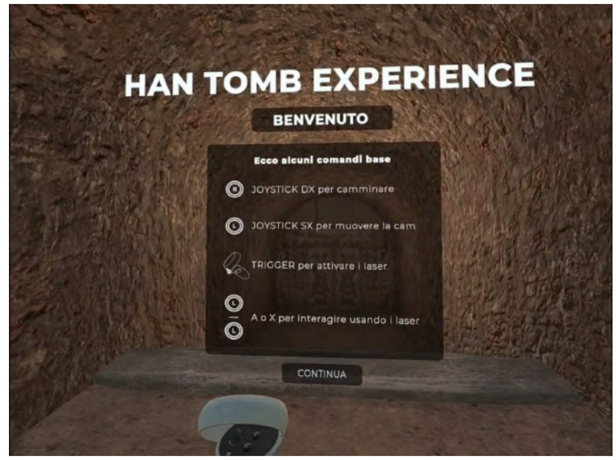

Fig. 11. Textual explanation of the interactions for enjoying the virtual tour.

decorated through a combination of painting and sculpture, which has strong symbolism as the "gateway to paradise". In front of the portal, it was decided to include a practical explanation of how to interact with the two gates, which are graspable and whose opening allows passage to the next segment, respectively the central funerary chamber (Figure 12).

Fig. 12. Visual explanation of the interaction with the grab for opening the portal.

The funerary chamber consists of the funerary coffin, wall paintings, decorated beams and ceiling, and some artifacts in the form of standing and kneeling men, made of terracotta. Informational balloons are present on these tomb frescoes, dedicated to Zhang Boya and his wife. These paintings depicted highlights of Zhang's life, including a scene of a banquet with jesters. In addition, a balloon is present on the main beam, decorated with two figures riding two dragons, symbolising ascension to heaven.

Two minor symmetrical chambers branch off from the central funerary chamber, inside of which multiple replicas of artifacts were found. In the chamber branching off to the right, multiple funerary artifacts were found depicting armored horsemen on horseback, horses with ornaments, and kneeling archers, while in the chamber branching off to the left, several vases with different shapes and decorations were found. Both the artifacts in the central chamber and the artifacts in the minor chambers have been made interactive via the controllers; to make the interaction more intuitive, an outline is activated upon selection and the name of the object is displayed. Once the artifact has been collected, the user can decide to enlarge or reduce the size of the artifact by moving the two controllers away or closer together, to view the paintings present in more detail, or can decide to rotate the object freely (Figure 13).

Fig. 13. Funerary artifact while being enlarged through interaction with controllers.

VIII. Conclusion

This research has demonstrated the significance of digital reconstruction in the preservation and fruition of Han Era funerary artifacts. The twelve digitally reconstructed objects served as the foundation for a virtual exhibition that effectively highlighted key elements of Han art, including architecture, painting, and sculpture, through immersive VR storytelling. Photogrammetry and 3D modeling facilitated the accurate recreation of the artifacts and a Han tomb, providing a comprehensive and detailed representation. The interdisciplinary collaboration between experts in Asian art, digital reconstruction, and immersive technologies, supported by MOD Lab Arch and VR@POLITO, has proven essential in advancing the field of digital archaeology and interactive museology.

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