CAA Proceedings
DIGITAL HORIZONS: EMBRACING HERITAGE IN AN EVOLVING WORLD
CAA 2025 5-9 MAY
UNIVERSITY OF WEST ATTICA, ATHENS, GREECE

Spatiotemporal reconstruction of pot burial excavations

Melina Katerina Grigoriadi[1]*, Georgios Papaioannou[2]

[1]Department of Informatics, Athens University of Economics and Business – Athens, Greece; ORCID 0009-0005-6676-2002
[2]Department of Informatics, Athens University of Economics and Business – Athens, Greece; ORCID 0000-0003-4774-0746
*Corresponding author: mkgrigoriadi@gmail.com

Abstract

Archaeological documentation has been transformed by the integration of digital technologies, with three-dimensional (3D) recording and visualization offering new means to preserve and interpret excavation processes. This study explores the combined application of Structure-from-Motion (SfM) photogrammetry and interactive 3D visualization to represent both the temporal and spatial dimensions of a pot burial excavation for documentation and public dissemination. Sequential 3D models were generated and incorporated into a custom interactive application that enabled users to explore the excavation process dynamically. The practicality of the proposed methodology together with the labor required for digitalization and the development of the 3D interactive application, is evaluated. A small-scale user evaluation involving participants from professional and general audiences indicated that the experience was intuitive and engaging. The results suggest that this combined workflow may provide an accessible approach for detailed archaeological documentation while fostering public engagement through immersive visualization.

Keywords: 3D digitization, pot burial, 3D visualization, 3D interactive application, Structure from Motion photogrammetry, digital heritage.

To cite this article:
Grigoriadi, M. K. and Papaioannou, G. 2026. "Spatiotemporal reconstruction of pot burial excavations". In G. Pavlidis & D. Moullou (Eds.) Proceedings of the 52nd Conference on Computer Applications and Quantitative Methods in Archaeology. *CAA Proceedings*, 52(1): Article 5:1-15. DOI: https://doi.org/ 10.64888/caaproceedings.v52i1.1179

Submitted: 31/03/2026, Accepted 15/07/2026, First online 10/09/2026
Article preprint: https://doi.org/10.5281/zenodo.17487708

1. Introduction

Archaeology shares a unique relationship with data collection and recording. The emergence and increasing accessibility of digital technologies have brought about a revolution in archaeological recording and visualization, constituting today a major frontier in research and cultural-heritage management (Arnold et al. 2001; Zubrow 2006; Schmidt & Marwick 2020).

Three-dimensional (3D) documentation methods, such as photogrammetry and laser scanning, can capture highly accurate geometric details together with realistic surface textures and spatial relationships, allowing researchers to revisit, analyze, and reinterpret features. Beyond research, 3D visualization has also profoundly influenced archaeological education and public outreach (Hageneuer & Schmidt 2020; Mariotti 2021). Interactive models and immersive environments offer innovative ways for practitioners and non-specialists to understand archaeological materials and processes. By enabling users to engage directly with digital reconstructions of artifacts, features, and sites, such technologies foster active exploration, reflective thinking and wider access to cultural heritage.

3D documentation and modelling have been successfully applied at multiple scales, from small artifacts (e.g., Gallo et al. 2014; Abel et al. 2011; Evin et al. 2016) to historic structures and entire sites (e.g., Themistocleous 2015; Dellepiane et al. 2013) and excavation contexts (e.g., De Reu et al. 2014; Dell'Unto et al. 2017; Campbell et al. 2024).

Excavation, one of the discipline's primary methods, is inherently destructive and leads to the loss of the context and integrity of the remains. It is an "unrepeatable experiment" (Barker 1993), making rigorous documentation and the preservation of the site's overall integrity fundamental to archaeological practice. Traditionally, recording has relied on two-dimensional representations (2D) of the archaeological features, such as plans, drawings, sections, profiles, and photographs.

3D technologies in field archaeology have enabled experts to capture not only the static form of artifacts and features but also the spatial complexity and the dynamic process of the excavation itself. By performing sequential 3D recordings during excavation, multiple temporal instances of a site or feature can be documented. This approach represents the process's temporal evolution and preserves the stratigraphic sequence, enabling precise analysis long after fieldwork.

The application of 3D techniques can extend beyond large-scale excavations to micro-contexts such as artifact clusters and burials, where the preservation of minute spatial relationships can be critical. In burial analysis, the spatial configurations of remains informs the reconstruction of depositional and post-depositional processes, while 3D models allow these relationships to be examined from perspectives beyond those accessible during fieldwork (Sachau-Carcel 2022).

Pot burials (or jar burials/urn burials depending on localized ceramic nomenclature) are a characteristic example of such contexts. They represent one of the most widespread funerary practices across cultures of the ancient world and typically involve the inhumation of infants or young children within ceramic vessels (Power and Tristant 2016). The excavation of a pot burial can either be done in situ or it may be removed en bloc from its primary context for excavation under controlled laboratory conditions. In both cases, excavation follows the same principles of a standard excavation. Given the dimensions and fragility of ceramic vessels and their contents, detailed documentation is essential for post-excavation analysis and interpretation.

The current study positions itself within the expanding field of digital archaeology by exploring how 3D recording and interactive visualization can jointly complement typical excavation documentation practices in the case of a pot-burial. Using Structure-from-Motion (SfM) photogrammetry in conjunction with 3D interactive design, the study documents the micro-excavation of a pot burial by integrating both the temporal and fully spatial dimensions of the excavated object.

The study is guided by the following research question:

- Can a combined workflow of sequential SfM recording and interactive 3D visualization serve as a practical method for documenting and communicating the excavation process?

The key objectives therefore included the development of an interactive time-lapse of the micro-excavation while assessing the methodology's practicality for documentation, labor investment, and its potential for public communication.

2. Materials

The study was focused on an unexcavated pot burial from the Phaleron Delta Cemetery in Attica, Greece (**Figure 1**). The cemetery, which extends across the coastal zone of the **a**ncient Phaleron Bay in Attica, was first explored in the late 19th and early 20th centuries. It has since been the subject of rescue excavations conducted from 2012 to 2013 and 2015 to 2020 under the direction of the Ephorate of Antiquities of Piraeus and Islands in the framework of the construction works for the Stavros Niarchos Foundation Cultural Centre (SNFCC) (Chryssoulaki, 2019b, 243-248; Chryssoulaki and Pappas, 2021; Chryssoulaki, 2018, 89-92; Chryssoulaki et al. forthcoming). A total of 2115

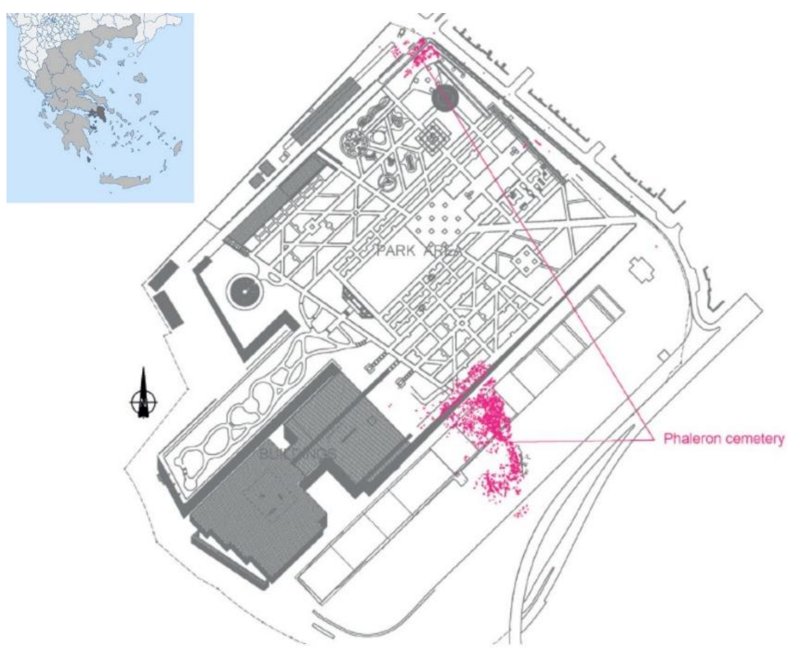

Figure 1: Plan of the SNFCC area showing the distribution of the excavated graves, Ephorate of Antiquities of Piraeus and Islands (Chryssoulaki 2019a, 2).

burials of individuals from various age groups were recovered, dated from the late 8th to the 4th century BCE, with the cemetery's major phase dated to the Archaic period (Chryssoulaki, 2019a).

Pot burials (enchytrismoi) were the second most prevalent burial type, accounting for approximately 34% of the graves, occurring alongside pit graves, funeral pyres, cist graves, burials in small clay tubs (larnakes), secondary cremations, tile graves, animal burials, and wooden-coffin burials (Chryssoulaki, 2019a, 5; Ingvarsson and Bäckström 2019, 8). The categories of funerary vessels included coarse-ware undecorated chytrae, hydriai, amphorae, and pithoi. Most were furnished with grave offerings, mainly miniature vessels (Alexandropoulou 2024), with occasional figurines, jewellery and amulets. Osteological analyses have shown that the Phaleron enchytrismoi were used primarily for the inhumation of newborns and young children (Chryssoulaki, 2019).

At Phaleron, some pot burials were excavated in situ, whereas others were block-lifted to ensure controlled laboratory excavation. After exposure, each feature was wrapped with transparent plastic film to stabilize the ceramic vessel and its contents, and lifted intact with a portion of the surrounding soil.

The specimen selected for the present study, Pot Burial N. 103 (ΤΦ 103), comprised an individual, probably an infant, inhumed within a large Attic SOS amphora, dated to the 7th century BCE. As shown in **Figure 2**, the amphora was preserved in moderate condition, with visible cracks and losses along the body, and remained supported within the surrounding sediment before the excavation of its contents. The amphora was found on its side with its rim to the southeast, oriented NW–SE, and the mouth was occluded by a second vessel. Field recording was carried out using standardized documentation procedures, including context sheets and scaled photography. Following field documentation, the burial was block-lifted and transferred to the laboratory for micro-excavation under controlled conditions.

Figure 2. Pot Burial N.103 in the laboratory before the micro-excavation of its contents. Photograph by M.K. Grigoriadi.

In situ and laboratory documentation were linked through the assigned context number and field records, maintaining continuity between field and laboratory data.

2.1 Ethical Considerations

All procedures prioritized respectful treatment of human remains and transparency in digital reproduction. The project followed standards of good practice (APABE 2017; BABAO 2019; ICOM). Given the focus was on post-excavation documentation, and public and educational dissemination, the study aimed to preserve skeletal integrity and clearly state aims and methods.

3. Digitization of the excavation process

The laboratory micro-excavation of the pot burial proceeded in nine levels and did not yield preserved human skeletal remains, apart from grain-sized skeletal fragments. However, two grave offerings were present, a miniature skyphos and an inverted trefoil-mouthed oinochoe, consistent with offerings found in other Phaleron pot burials (Chryssoulaki, 2019a; Alexandropoulou 2024).

Given the initially limited access to the pot's interior, Structure-from-Motion (SfM) photogrammetry was selected as the most effective data acquisition method. Although other non-destructive imaging techniques, such as CT scanning, can provide high-resolution internal data, they require specialized equipment, significant logistical demands and time overheads as well as time-intensive post-processing which were not feasible for this project. SfM photogrammetry can handle occlusions in restricted vessels, requires minimal portable and cost-effective equipment, namely a consumer-grade camera, a workstation, and freely available software, and can be deployed swiftly without disrupting the excavation plan (Magnani et al. 2020).

The block-lifted amphora was positioned horizontally, as it was found, on a foam base with free 360° movement around it. Illumination was provided by the laboratory's ceiling-mounted white halogen lamps. High-contrast tape markers and a scale bar were affixed to aid image matching and scaling. The excavation proceeded in levels, with a 5-6 cm sediment layer removed each time, as the fill was homogeneous.

Photography was carried out alongside the excavation in order to document each level as it unfolded. The sequential 3D models followed this stepwise excavation process. For each level, about 100 images were captured in circumferential passes in three vertical angles (approximately 0°, 30°, and 50°) supplemented with 90° overhead shots, with a 70-90% overlap between camera positions. The high degree of overlap was chosen to ensure reliable feature matching and alignment within the interior of the vessel, where surfaces were repetitive. The conditions in the laboratory remained unchanged throughout the process to avoid inconsistencies between datasets. For the photo acquisition process, a 24.2 MP Canon EOS 2000D in full manual mode was used with manual focus, 18 mm focal length, ISO 400, 1/60 s shutter speed, and f/7.1 aperture. After each level, quick low-resolution 3D models were processed to confirm adequate coverage before proceeding with the excavation of the next level.

3D model reconstruction was performed in 3DF Zephyr Free (v.6.513). Ten photogrammetric models were generated, documenting the burial from the pre-excavation state (Level 0) to the fully cleared interior (Level 9). For each excavation level, the best 50 photographs were selected based on sharpness and even spatial distribution in order to reduce redundancy and allow processing using free software while maintaining coverage. Although fewer photographs were used, high overlap was maintained to ensure stable alignment. The selected photographs were processed through a semi-automated four-step workflow, (i) image alignment and sparse point cloud estimation, (ii) dense point cloud estimation, (iii) mesh generation, and (iv) texture mapping. Following sparse-cloud generation, background geometry was trimmed to reduce computation and improve step-to-step registration accuracy.

As expected, the parts of the models covered with plastic wrap that were semi-transparent surfaces exhibited minor surface reconstruction errors; however, this part of the pot did not bear any interpretive significance for the synthesis of the excavation' s time-lapse. The foam bedding was intentionally retained in the final renders for contextual realism and aesthetic blending with the subsequently modelled virtual laboratory environment.

A central challenge in 3D digitization and modelling was achieving a balance between surface detail and computational efficiency. High-resolution output captures fine geometric details which are not typically relevant to this line of study (excavation progress documentation) but invariably introduces significant processing load and hinders real-time visualization significantly. To ensure smooth performance for the final interactive application across most modern desktop and laptop devices, the models were decimated down to 70,000 to 100,000 triangles, while preserving diagnostic morphology and texture quality.

The reconstructed 3D geometry of each excavation level was brought up to scale within 3DF Zephyr using the photographed scale bar as a reference. Final meshes (.obj) were exported to MeshLab (2022.02) to establish a properly aligned set of textured models with an average alignment error bound of 1 mm. This dataset formed the basis for the interactive application described in the following section. The resulting models also functioned as a structured digital record of the excavation sequence during the development of the study and the interactive prototype, preserving the spatial configuration of the deposit and serving as a reference during the subsequent study of the burial.

4. Multimedia application development

Prior to implementation, a development life cycle of the interactive multimedia application was established, beginning with requirement analysis guided by criteria for 3D cultural-heritage experiences (Malik et al., 2021, p. 19). Requirements were organized around three factors. The first concerned objectives and intended context of use, namely, accurate digital documentation of the micro-excavation, support for preservation, research, and public dissemination and education with transparent methods.

Second, potential users were profiled into two categories. The first included practitioners such as archaeologists, conservators, and researchers, while the second consisted of individuals indirectly involved with cultural heritage, such as educators, museum visitors, and enthusiasts. To better understand and accommodate the needs of both groups, semi-structured interviews were conducted with four representatives from each category. Their feedback informed targeted adjustments during the design stage. All were assumed to have basic computer skills, so interaction design emphasized clarity and accessibility.

Thirdly, the application's core functionalities were determined. Core tasks required the user's ability to freely inspect the models from arbitrary angles, zoom smoothly, move between excavation levels to follow the excavation's progress and trigger concise annotations anchored to points of interest, which display predefined text in a pop-up window when clicked. Usability goals were implemented through plain language, consistent mouse-based controls, minimal action paths, and legible annotation panels (Quesenbery 2001).

The interactive application was built as a desktop application in the Unity game engine, chosen for its versatility and ability to deploy to commonly used platforms. Unity natively imports .obj meshes, provides customizable rendering and lighting, and offers stable interaction features suitable for textured models. The engine is available at no cost for personal and educational use, which made it an appropriate choice for this study. The development process began with defining the core functionality of the application, with navigation identified as a key component, since it shapes the way users perceive and interact with the virtual pot burial. An orbit camera was employed, anchored on the pot with elevation restricted to positive angles above the object's horizon, consistent with tabletop artefact examination. The user was allowed to zoom in and out freely.

This viewing mode mimics natural eye scanning across an element, is familiar to users and allows them to freely inspect the object from any desired angle. Direct control of the viewpoint enables an interactive experience without loss of focus. Although an orbit camera is less flexible as a tool of embodiment than a first-person camera, it ensures that the sole target of inspection is constantly visible and centered in the user's field of view.

For the representation of the temporal dimension of the excavation process, a vertical slider widget was designed with a custom script and implemented in the graphical user interface (GUI). This feature enabled users to examine the excavation spatiotemporally by dragging the slider to switch between models representing successive excavation levels. As illustrated in **Figure 3**, each slider position corresponds to a distinct recorded stage of the micro-excavation.

In practice, this approach ensured clear, single-state inspection of each excavation level. For users, it is a low-effort interaction that invites exploratory engagement and maintains attention as the excavation sequence unfolds through a draggable slider toggle. Furthermore, it is a widely adopted paradigm among applications that involve processing of time-varying data, such as computer animation and simulations and one with which most users are already familiar.

The application design adopted a familiar and realistic aesthetic by situating the 3D models within a laboratory-like environment that reinforced its professional and educational context of use. Users can explore the different stages of the pot burial excavation virtually, in a digitally modelled workspace corresponding to the controlled conditions under which the micro-excavation and recording were conducted. The environment itself is an enclosed space, a room, with elements commonly found in scientific laboratories and storage facilities. **Figure 4** shows how the reconstructed pot burial was placed within this virtual laboratory setting. The environment provides a visual context while keeping the pot burial as the principal focus of the application.

Figure 3: Screenshots of the interactive application showing successive excavation stages; each slider position corresponds to one excavation level.

Figure 4: Virtual laboratory environment developed in Unity, showing the reconstructed 3D models of the pot burial positioned on a worktable.

In order to enhance the user's immersion, the scene was scaled to realistic dimensions and illuminated to match the capture conditions, thereby minimizing texture–illumination mismatches and preserving material fidelity.

In addition to the core level navigation functionality, annotations were developed as an integral component of the application to enhance user understanding and interaction with the excavation model. Subtle metallic-white low-contrast 3D arrows were placed around points of interest in the pot burial to indicate informative hotspots without visually interfering with the stratigraphic inspection. When selected, these arrows trigger pop-up 2D windows in the GUI that display relevant textual information with smooth animations, thereby enriching the user's interpretive and exploratory experience (**Figure 5**).

A main menu was also developed to facilitate a coherent user journey from entry to exploration, providing direct access to the application, credits, and exiting the application.

Figure 5: An annotation with a metallic white 3D arrow.

All processing was completed using a laptop with an Intel Core i7 processor (1.50 GHz, 4 GT/s, 8 MB cache, 4C), 12 GB DDR4 RAM, 64-bit Windows 11 Home system and an Intel Iris Plus integrated graphics card.

5. Evaluation

The evaluation aimed to determine whether the initial objectives of the application had been achieved and to identify potential usability issues that could be improved. Formative assessment was conducted throughout the design and development stages, while a summative evaluation took place after the completion of the prototype.

The user study involved eight participants (N=8) who were not involved in the implementation itself. Participants represented ranged in age from 15 to 55 years and backgrounds, including both individuals professionally involved in cultural heritage and general enthusiasts.

Each participant was asked to perform a predefined navigation scenario that included launching the application, closing the navigation panel, activating two annotation points, and exploring the fourth excavation level. Their actions and reactions were observed without intervention. After completing the tasks, participants filled out a short questionnaire designed to assess effectiveness, efficiency, ease of use, and engagement, using a five-point Likert scale and one open-ended comment section.

Overall, participant feedback was positive. All participants completed the tasks and described the

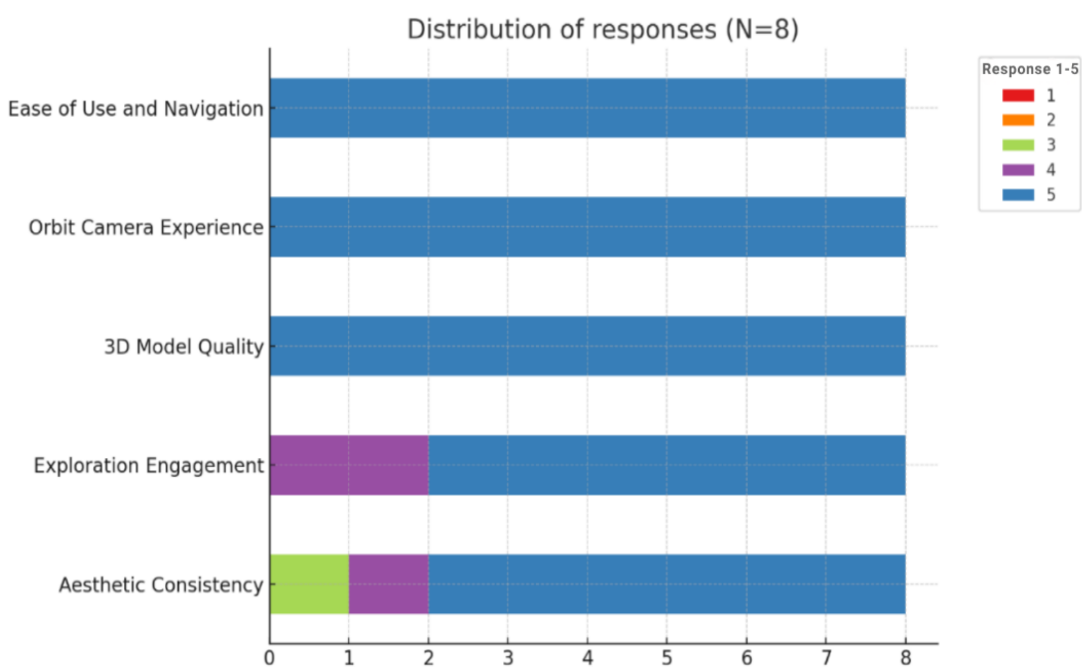

Figure 6: Distribution of participant responses (N=8). A score of 1 indicates strong disagreement or very low performance, and a score of 5 indicated strong agreement or very high performance.

interface as intuitive and user-friendly. The orbit camera was particularly well received for its smooth control, while slight variations were observed in participants' ratings concerning visual uniformity and engagement, as summarized in **Figure 6**. Observations during the sessions also indicated consistent focus and genuine curiosity during navigation.

Participants' comments offered constructive suggestions for refinement. The most common recommendation included increasing the ambient brightness to improve engagement and adding subtle auditory cues to enhance accessibility and immersion. These insights provided valuable input for future refinements of the system and its user-centered optimization.

Given the limited sample size, the findings should be interpreted as preliminary, and broader validation with larger and more diverse samples would be desirable in future work.

6. Discussion

This study demonstrates the potential of combining Structure-from-Motion (SfM) photogrammetry with interactive 3D multimedia application development to document and visualize across time and space an archaeological pot burial excavation.

SfM photogrammetry proved to be an efficient method for producing accurate digital surrogates and allowed the excavation work to proceed without interruption. Each image acquisition round required approximately 5-7 minutes, followed by a 10-minute period for preliminary low-fidelity 3D model generation. Post-processing, however, was comparatively time- and labor-intensive, requiring approximately 17-25 minutes per reconstructed model with the computational resources available, and the overall processing time increased since several models were generated per level using different parameters to optimize accuracy and visual fidelity.

Regarding multimedia application development, the time and effort required were largely dependent on the developer's technical background and available computational resources. Although the interactive application was developed around a particular use case, the modelled (laboratory) setting and all scripting functionalities can be used to accommodate different specimens, thus compensating for the length of the development process and the initial investment of time and labor. The set principles for the reconstruction could potentially be extended to a large-scale excavation site for the fieldwork progression.

Virtually experiencing an excavation and acquiring the spatial context of each object could allow experts to virtually re-experience the unrepeatable process, thereby enriching reflective practices. In this sense, such digital documentation can serve as both an alternative and a supplementary form of recording, reducing the subjective nature of traditional archaeological reports and accelerating data sharing within the scientific community (Sachau- Carcel 2022; Badillo et al. 2024).

Beyond its methodological value for professionals, the findings suggest that the application has potential for representing and communicating of the archaeological methodology. The immersive presentation conveys both the tangible and intangible dimensions of archaeological practice, capturing not only the physical artifacts but also the experiential aspects of the excavation process, making archaeological research more transparent, accessible, and engaging for non-specialist audiences. By allowing users to explore excavation stages and the pot's contents in a 3D environment, it transforms them from passive spectators into active participants. Reflecting a laboratory micro-excavation, the application presents the methodological reality of laboratory-based investigation, situating it within the broader archaeological workflow.

Although currently developed as a research prototype, it offers a transferable framework that may be adapted to educational or exhibition contexts, within structured settings where contextual guidance can support informed engagement with the interactive application. Such adaptation nevertheless requires careful mediation, as the transition to public-facing interactive environments entails different expectations and interpretive needs. Broader testing across more diverse audiences would be necessary to assess usability and engagement in a systematic manner and to inform future implementation strategies.

Looking ahead, further work will focus on incorporating additional media, such as embedded videos, audio, and hyperlinks, in order to enrich the sensory and informational experience. Enhancing accessibility through inclusive design features could make the experience available to a wider audience. Another particularly promising direction involves converting the current application into a modular Unity plug-in that could be integrated into other archaeological projects. Such a system would enable researchers to import their photogrammetric datasets and produce interactive reconstructions within that platform without requiring advanced technical skills.

Overall, the approach balances technical precision with creative presentation, offering an approach that serve both scientific and educational purposes. Its adaptability, efficiency, and potential for modular expansion highlight its relevance for future archaeological practice and digital cultural heritage initiatives.

Data Availability

All raw data and 3D models are available at Zenodo:
https://doi.org/10.5281/zenodo.17496627

Conflicts of Interest

The authors declare no conflicts of interest.

Funding

This research received no external funding.

Acknowledgements

A preprint version of this article has been peer-reviewed and recommended by PCI Archaeo (https://doi.org/10.24072/pci.archaeo.100701).

References

Abel, R. L., S. Parfitt, N. Ashton, et al. 2011. “Digital Preservation and Dissemination of Ancient Lithic Technology with Modern Micro-CT.” *Computers & Graphics* 35 (4): 878–884. https://doi.org/10.1016/j.cag.2011.03.001

Alexandropoulou, A. 2024. *The Pottery from Phaleron Cemetery, Part I (Η κεραμική από το νεκροταφείο του Φαλήρου μέρος I.)*. Ministry of Culture.

Arnold, D., A. Chalmers, and D. Fellner, eds. 2001. *Proceedings of the 2001 Conference on Virtual Reality, Archaeology, and Cultural Heritage (VAST '01)*. ACM. https://doi.org/10.1145/584993

Badillo, A. E., M. R. Brennan, A. M. Estes, S. P. Aldrich, and A. L. C. Emmerson. 2024. "A Paperless and 3D Workflow for Documenting Excavations at Insula I.14, Pompeii, Italy." *Advances in Archaeological Practice* 12 (2): 107–121. https://doi.org/10.1017/aap.2024.1

Barker, Ph. 1993. *Techniques of Archaeological Excavation*. 3rd ed. Routledge. https://doi.org/10.4324/9780203442173

Campbell, R., M. J. Boyd, J. Herbst, H. R. Indgjerd, N. Meyer, and C. Renfrew. 2024. "A Holistic Solution for the Analysis of Excavation and Specialist Data in a 3D GIS Framework." *Journal of Greek Archaeology* 9: 47–64.
https://archaeopresspublishing.com/ojs/index.php/JGA/article/view/2735.

Chryssoulaki, St. 2018. "Phaleron Delta: The Phaleron Necropolis (Δέλτα Φαλήρου: Νεκρόπολη Φαλήρου)." *Αρχαιολογικόν Δελτίον* 68 (B1): 89–92.

Chryssoulaki, St. 2019a. "The Excavation of Phaleron Cemetery 2012–2017: An Introduction." In *Rethinking Athens before the Persian Wars: Proceedings of the International Workshop at the Ludwig-Maximilians-Universität München, Munich, 23–24 February 2017*, edited by C. Graml, A. Doronzio, and V. Capozzoli, 103–114. Utzverlag.

Chryssoulaki, St. 2019b. "Cemetery at the Phaleron Delta: Aspects of Athenian Society in the Early Archaic Period (Νεκροταφείο στο Δέλτα Φαλήρου: Όψεις της αθηναϊκής κοινωνίας των πρώιμων αρχαϊκών χρόνων)." In *Memory Becoming Present: The Archaeological Work of the Ephorates of Antiquities during the Period 2011–2019*. Athens: Ministry of Culture and Sports.

Chryssoulaki, St., and I. Pappas. 2021. "The Shackled Men of Phaleron: A 3D Model of a Mass Grave Found in the Phaleron Delta Cemetery." Swedish Institute at Athens. https://www.sia.gr/en/articles.php?tid=520&page=1

Chryssoulaki, St., I. Pappas, and A. Alexandridou, eds. Forthcoming. *Phaleron: The Coastal Cemetery of Athens (Φάληρο. Το παράλιο νεκροταφείο των Αθηνών).* Aigeas AMKE.

De Reu, J., P. De Smedt, D. Herremans, M. Van Meirvenne, P. Laloo, and W. De Clercq. 2014. "On Introducing an Image-Based 3D Reconstruction Method in Archaeological Excavation Practice." *Journal of Archaeological Science* 41: 251–262. https://doi.org/10.1016/j.jas.2013.08.020

Dell'Unto, N., G. Landeschi, J. Apel, and G. Poggi. 2017. "4D Recording at the Trowel's Edge: Using Three-Dimensional Simulation Platforms to Support Field Interpretation." *Journal of Archaeological Science: Reports* 12: 632–645. https://doi.org/10.1016/j.jasrep.2017.03.011

Dellepiane, M., N. Dell'Unto, M. Callieri, S. Lindgren, and R. Scopigno. 2013. "Archaeological Excavation Monitoring Using Dense Stereo Matching Techniques." *Journal of Cultural Heritage* 14 (3): 201–210. https://doi.org/10.1016/j.culher.2012.01.011

Evin, A., T. Souter, A. Hulme-Beaman, et al. 2016. "The Use of Close-Range Photogrammetry in Zooarchaeology: Creating Accurate 3D Models of Wolf Crania to Study Dog Domestication." *Journal of Archaeological Science: Reports* (9): 89–93. https://doi.org/10.1016/j.jasrep.2016.06.028

Gallo, A., M. Muzzupappa, and F. Bruno. 2014. "3D Reconstruction of Small-Sized Objects from a Sequence of Multi-Focused Images." *Journal of Cultural Heritage* 15 (2): 173–182. https://doi.org/10.1016/j.culher.2013.03.006

Hageneuer, S., and S. C. Schmidt. 2020. "Introduction." In *Communicating the Past in the Digital Age: Proceedings of the International Conference on Digital Methods in Teaching and Learning in Archaeology (12–13 October 2018)*, edited by S. Hageneuer, 1–10. Ubiquity Press. https://doi.org/10.5334/bch.b

Ingvarsson, A., and Y. Bäckström. 2019. "Bioarchaeological Field Analysis of Human Remains from the Mass Graves at Phaleron, Greece." *Opuscula. Annual of the Swedish Institutes at Athens and Rome* 12: 7–158.

Magnani, M., M. Douglass, W. Schroder, J. Reeves, and D. R. Braun. 2020. "The Digital Revolution to Come: Photogrammetry in Archaeological Practice." *American Antiquity* 85 (4): 737–760. https://doi.org/10.1017/AAQ.2020.59

Malik, U. S., L. Tissen, and A. Vermeeren. 2021. "3D Reproductions of Cultural Heritage Artifacts: Evaluation of Significance and Experience." *Studies in Digital Heritage* 5 (1): 1–29. https://doi.org/10.14434/sdh.v5i1.32323

Mariotti, S. 2021. "The Use of Serious Games as an Educational and Dissemination Tool for Archaeological Heritage: Potential and Challenges for the Future." *Magazén* 2 (1): 119–138. https://doi.org/10.30687/mag/2724-3923/2021/03/005

Power, R., and Y. Tristant. 2016. "From Refuse to Rebirth: Repositioning the Pot Burial in the Egyptian Archaeological Record." *Antiquity* 90 (354): 1474–1488. https://doi.org/10.15184/aqy.2016.176.

Quesenbery, W. 2001. "What Does Usability Mean: Looking beyond Ease of Use." In *Proceedings of the 48th Annual Conference—Society for Technical Communication*, Chicago, May 13–16, 2001.

Sachau-Carcel, G. 2022. "3D Models as Useful Tools in Archaeothanatology." In *The Routledge Handbook of Archaeothanatology: Bioarchaeology of Mortuary Behaviour*, edited by Christopher J. Knüsel and Eline M. Schotsmans. Taylor & Francis.

Schmidt, S. C., and B. Marwick. 2020. "Tool-Driven Revolutions in Archaeological Science." *Journal of Computer Applications in Archaeology* 3 (1): 18–32. https://doi.org/10.5334/jcaa.29.

Themistocleous, K., M. Ioannides, A. Agapiou, and D. G. Hadjimitsis. 2015. "The Methodology of Documenting Cultural Heritage Sites Using Photogrammetry, UAV, and 3D Printing Techniques: The Case Study of Asinou Church in Cyprus." In *Third International Conference on Remote Sensing and Geoinformation of the Environment (RSCy2015)*, vol. 9535, 312–318. SPIE.

Zubrow, E. B. W. 2006. "Digital Archaeology: A Historical Context." In *Digital Archaeology: Bringing Method and Theory*, edited by T. Evans and P. Daly, 10–31. Routledge. https://doi.org/10.4324/9780203005262.