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Cultural Heritage in the Digital Age: Innovative Approaches to Preservation and Promotion (Editorial)

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Cultural heritage is the vital link between the past and the present, ensuring the identity and social cohesion of individuals, communities, and peoples, and plays a crucial role in shaping the future, namely, a more sustainable one. Both tangible and intangible cultural heritage represent one of humanity's most valuable assets, and their preservation, dissemination, and promotion are paramount for safeguarding this shared heritage and simultaneously crucial in confronting the interconnected challenges that define our era, from environmental degradation and global inequality to technological exclusion and escalating humanitarian crises (UNESCO, 2025).

Digital technologies have been used for decades to make cultural heritage accessible to a broader audience, providing tools and platforms for accessing, acquiring, storing, preserving, understanding, and disseminating cultural heritage. In recent years, however, the digital heritage field has undergone a conceptual and methodological transformation, moving from technocentric and archival approaches towards emphasizing the critical role of cultural, social, and institutional contexts in shaping how heritage is represented, experienced, and preserved. The concept of mediation has emerged, we believe, as a key framework, highlighting how interfaces, algorithmics, platforms, and participatory technologies are never neutral, but can actively shape what is included, how narratives unfold, and which audiences are empowered or excluded. Rather than positioning innovation as an end in itself, this evolving paradigm calls for a more reflective and situated integration of technologies that foregrounds epistemic diversity, ethical responsibility, and long-term sustainability in the design and deployment of digital heritage initiatives.

Authors have begun to acknowledge this entanglement between infrastructure and interpretation. Haldrup, Achiam & Drotner (2021), for example, have pointed to the need for "experimental museology", an emerging approach that emphasizes museum-led experimentation, co-design, and co-creation to transform established practices and discourses and that encourages research and implementation of enactive practices to facilitate meaningful visitor experiences by promoting agency through technological appropriation and critical thinking (Rojas, 2020).

Building on the same line of thought, Champion (2022) stresses that Extended Reality (XR) technologies, when anchored in curatorial intentionality and shaped through participatory design, can open space for more nuanced, multi-layered readings of the past within museums. Similarly, Silva & Oliveira (2024, 2025) demonstrate how artificial intelligence (AI) holds the potential to democratize

access and interpretation, namely when applied to crowdsourced photographic data in cultural heritage contexts; nevertheless, they also highlight that such systems can either challenge or reinforce heritage hierarchies depending on how they are designed and deployed.

These conceptual developments also find concrete expression in community-led, virtual-world initiatives intended to address the lack of cultural significance in virtual places, by inviting communities not just to consume heritage narratives but to shape them actively (Champion, 2021) - a move that is both epistemologically and ethically significant. The LOCUS project (Gonçalves, Oliveira & Amaro, 2022), for example, illustrates how collaborative digital placemaking can empower rural communities, support intergenerational knowledge transfer, and foster inclusive heritage imaginaries by co-creating playful and immersive representations of local cultural identity in Second Life, thus offering a compelling alternative to technocentric heritage simulations (Amaro & Oliveira, 2024).

This special issue of the Journal of Digital Media and Interaction (JDMI) is situated within this transformative moment, where digital tools and frameworks are reconfiguring the epistemologies, affective logics, and materialities of heritage, raising new opportunities and deep ethical, conceptual and even practical challenges, demanding balancing innovation with reflection, inclusion with curation, and technological sophistication with long-term sustainability.

As such, this special issue's call for papers outlined a broad yet interconnected set of critical themes, which can be grouped into five thematic axes:

1. Reconstruction and Preservation, addressing both tangible and intangible heritage, digital twins, simulations, AI, and the evolving role of computational tools in archaeological and cultural documentation.
2. Immersive and Sensorial Experiences, including Virtual/Augmented/Mixed Reality, haptics, and biofeedback, to generate new modes of engagement with heritage environments and narratives.
3. Participation and Community Mediation, focusing on collaborative curation, community-driven platforms, and digital tools that promote inclusion, co-authorship, and heritage democratization.
4. Education, Play, and Engagement, encompassing gamified learning, virtual field trips, and interactive experiences that reimagine how heritage is taught, accessed, and shared.
5. Infrastructure, Accessibility, and Ethics, covering IoT-enabled cultural spaces, long-term digital preservation, and cultural heritage digitization's legal, environmental, and ethical dimensions.

These thematic axes were not meant as strict categories but as interconnected zones of innovation and tension that framed the conceptual scope of this special issue and defined the critical ground from which the selected contributions emerged. And, although diverse in focus and methodology, each selected paper responds to one or more of these challenges, offering situated contributions that advance theoretical understanding and practical application.

These contributions are organized around a conceptual arc that begins with material reconstruction and concludes with technical innovation for accessibility, and rather than treating these works as

isolated case studies, we propose to read them as part of a broader, multi-voiced inquiry into how digital technology and cultural heritage converge to reshape how the past is remembered, narrated, and made accessible in the present.

The opening paper by Brittany Glassey explores the reconstruction of missing historical garments using 3D CAD modelling, reflecting on how virtual reconstruction not only supports museum exhibitions but also enables ethical and design-oriented decisions in making substitute garments for tangible display. The paper highlights the potential and constraints of virtual prototyping in sensitive heritage contexts by anchoring the study in the case of a Meiji-period ceremonial skirt.

In the following contribution, Isidre Ot Padilla, Esther Travé Allepuz, Pablo Del Fresno Bernal & Josep Socorregut Domènech present a digital twin developed to overcome physical and interpretive barriers in disseminating an archaeological site, providing researchers and the broader public with new avenues for exploration, while raising critical questions about representational choices and the evolving relationship between excavation and digital simulation.

The next paper, by Diogo Menezes Costa, engages directly with the epistemological implications of modelling archaeological processes. Through the Abade Artificial Archaeological Site project, the author demonstrates how agent-based modelling and artificial inference engines can serve as analytical tools and speculative environments where archaeological hypotheses are tested, refined, and made legible to multiple audiences.

The fourth contribution by Gil Fernandes & Gorete Dinis, examines a small heritage organization's digital presence (and absence), underscoring the unevenness of digital transition and the structural limitations many institutions face. It calls for more grounded, context-sensitive strategies in implementing digital heritage communication.

The last paper by Ian Bacellar & Tarcízio Macedo ventures into the geopolitical dimension of digital media by comparing esports policies in Brazil and South Korea. The paper frames digital gaming not just as entertainment or a cultural industry, but as a potential tool of cultural diplomacy. While not conventionally situated within cultural heritage, this piece expands the boundaries of digital heritage studies by addressing how national narratives and youth cultures are negotiated through digital platforms.

This issue closes with a technical note by Dirk HR Spennemann & Sharnie Hurford, which proposes a method for 3D scanning heritage objects using low-cost mobile technologies, which offers a low-barrier solution for academic and institutional cooperation.

Together, these contributions reaffirm the need to integrate technological innovation with inclusive, critical, and ethically grounded practices in cultural heritage. While they do not exhaust the scope of the field, they collectively signal pathways for future interdisciplinary research and application.

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