

The Possibilities of Applying Artificial Intelligence in Cultural Heritage Preservation

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Digital technologies, including the increasingly prevalent artificial intelligence (AI) technologies, offer opportunities in creative and art mediation practices while also raising questions regarding their application. The application of artificial intelligence presents challenges for cultural professionals, particularly in light of the ethical and social issues surrounding AI-generated art. When shaping institutional practices, decision-makers must consider societal processes that influence audience preferences. Alongside the evolution of art mediation methods, digital technologies also play a crucial role in cultural heritage preservation and conservation. In terms of application goals, AI tools enable the reconstruction or reinterpretation of cultural assets more accurately and rapidly than ever before. The aim of my research is to highlight current practices in art projects at both international and national levels, as well as to explore problems that shape artistic and cultural discourses in the context of AI implementation.

cultural heritage, artificial intelligence, digital culture, museum studies, collective memory

"It cannot be the subject of art, in which there is no humanity!"

– Ferenc Chiovini¹

1. Introduction

1.1. Challenges and opportunities

A report convened by UNESCO with an Independent Expert Group on Artificial Intelligence and Culture (CULTAI) was released in 2025 with the aim of discussing diverse perspectives and gathering ideas *on culture and artificial intelligence*. As summarised below, the independent experts found three main challenges and imperatives as key components of current issues concerning culture and AI. Although many core challenges have been identified, they also highlight opportunities, notably how to protect cultural heritage through, for example, restoration and preservation.

Challenges:

- Rapid technological acceleration in creative sectors
- Unequal access across regions
- Rising ethical concerns around rights and ownership

Imperatives:

- Rights-based AI governance transparency, safeguards, fair compensation
- Fair & diverse creative economics: algorithmic diversity, public infrastructure, skill development;
- Sustainable & resilient futures: low-impact AI, heritage protection, inclusion of local knowledge" (UNESCO Independent Expert Group, 2025, p. 10).

The research aims to raise awareness and was guided by a principle, namely, "technology must serve humanity, not the reverse" (2025, p. 12). Whether it is a *tangible* or *intangible* cultural heritage, AI can contribute through "digital preservation, virtual reconstruction, data analysis, as well as the transcription and documentation of endangered oral traditions and performance practices" (2025, p. 13). On the contrary, the experts mention cultural, linguistic and gender *biases* that are presented in training data, which can be transferred to cultural heritage preservation. Moreover, experts draw attention to the intellectual property (copyright) issues, as the AI tools (currently available on the market) have used copyrighted content without authorisation to train their models. Furthermore, they emphasize the risk of cultural appropriation by technology firms, leading to *decontextualization* and *misrepresentation*. (2025, p. 14)

The experts also discuss the term and meaning of *datafication* (Mayer-Schönberger, Cukier, 2013, cited in UNESCO Independent Expert Group, 2025, p. 21), as they refer to the transformation of social action into online quantified data. It is noted that, as culture becomes datafied, the digital traces of everyday life contribute to the production of the so-called cultural data that relate to "*digitized heritage*, online cultural practices and digitally created, distributed and consumed cultural goods" (2025, p. 21).

2. Literature Review

2.1. Digital preservation enhanced by AI

AI technologies have been integrated into cultural heritage preservation, among other digital tools, in recent years. "The digital preservation of cultural heritage is rapidly becoming a powerful field, employing cutting-edge technologies to safeguard historical and cultural artifacts for future generations. The augmented reality (AR), virtual reality (VR), and artificial intelligence (AI) are discipline leverages to fundamentally create a culture in which heritage is documented, restored, and experienced." (Al-Khazraji, Qassim, 2025, p. 308)

AI-driven methods have been applied across tangible and intangible cultural heritage, and they play a crucial role in *digitalization, conservation* and *protection*. Tangible heritage refers to physical objects and structures of historical, artistic or cultural significance, such as monuments, paintings, archaeological artifacts, etc., while intangible cultural heritage is defined as practices, expressions, knowledge, etc. AI technologies could offer strategies to protect and restore heritage assets for the future, as well as support *digital storytelling*. "Beyond protection and conservation, AI also facilitates the adaptive reuse of heritage by enabling virtual access and immersive interpretation [...]" (UNESCO Independent Expert Group, 2025, p. 56).

An analysis from 2024 on *Research Trends for Using Artificial Intelligence in Cultural Heritage* shows that AI and its subfield, machine learning (ML) techniques, have been applied in various application fields of cultural heritage. For example, "neural networks (NNs) and deep learning (DL) techniques have demonstrated potential in archaeology, specifically in reconstruction, remote sensing, and collection management". The study also found that "emerging techniques like Neural Radiance Fields (NeRFs) have been identified as effective in creating detailed 3D models of cultural heritage assets, especially those with challenging characteristics for traditional photogrammetry. Additionally, "AI and subfield ML/DL techniques have also been used to significantly improve the performance of image-restoration methods, extract choreographic sequences from traditional dance, improve accessibility of museum and online cultural heritage content, and improve the management of archives." The research also explored "how AI can enhance visitor interactions with cultural assets, focusing on techniques and tool integration" (Gîrbacia, 2024, p. 1–2). Furthermore, research on *Artificial Intelligence in Heritage Tourism* from 2025 found that "traditionally, cultural tourism has focused on the in-person experience and direct appreciation of tangible and intangible heritage. However, the integration of AI and immersive digital platforms is revolutionizing the way visitors interact with cultural instruments and practices, enabling personalized, adaptive, and immersive experiences that were previously unattainable." (Sánchez-Martín, Guillén-Peñafiel, Hernández-Carretero, 2025, p. 2). A study on *AI for Restoring and Reconstructing Damaged Heritage* from 2025 highlights that "AI also enhances access to heritage through virtual experiences, ensuring preservation despite physical threats" (Agarwal, Agarwal, 2025, p. 118).

2.2. Restoration and digital reconstruction with AI

AI has emerged as a tool in cultural restoration to revive and reconstruct damaged or incomplete works of art and heritage (UNESCO Independent Expert Group, 2025, p. 56). In restoration, for example, computer vision and machine learning are

essential to detect damage, simulate original features, and predict future deterioration. AI detects damage such as cracks, erosion, and missing elements by using advanced image analysis techniques, and it enhances restoration by predicting original colours, textures, and patterns in artworks and buildings. Moreover, AI-powered drones and robots assist in scanning and monitoring heritage sites, including difficult-to-access areas (Agarwal, Agarwal, 2025, p. 118).

The application of AI in archaeological techniques is predicated on three technical pillars, which are data gathering, sophisticated data processing, and predictive modelling. "Technologies such as LIDAR, UAVs (Unmanned Aerial Vehicles) equipped with multispectral sensors, and high-resolution satellite imagery facilitate the collection of extensive spatial and spectral data, even in remote areas" (Casillo et al., 2025, p. 231). Furthermore, "AI technologies have transformed the methodologies used in the surveying and mapping of archaeological sites," conclude researchers in a study on *Artificial Intelligence in Archaeological Site Conservation* in 2025. The study states that funerary monuments, ancient infrastructures, and settlements have been identified with over 90% accuracy by analysing multispectral photos and using automated identification algorithms (2025, p. 231). By this result, which shows accuracy, it has to be mentioned that these AI-driven techniques bring ethical considerations and tensions between authentic restoration and speculative interpretation (UNESCO Independent Expert Group, 2025, p. 56).

Addressing these concerns, the following has been revealed from an analysis with hundred respondents: "The possibility of losing authenticity is the greatest worry, underscoring the necessity of transparency; more than half of respondents support labelling reconstructions as AI-generated. Respondents prefer maintaining authenticity or using data-driven approaches in conjunction with expert opinions when dealing with missing components. Physical restoration is still prioritized over virtual options, and human specialists are anticipated to take on a supervisory or collaborative role. In general, the results show cautious optimism towards AI, while stressing the importance of maintaining balance, openness, and historical integrity" (Agarwal, Agarwal, 2025, p. 123).

3. Current Practices and Institutional Approaches

3.1. Appreciations of AI-driven projects

A recent study and report mentioned above revealed that "[t]he integration of AI with disciplines like history, archaeology, and architecture enables cost-effective conservation and the creation of lasting digital records" (Agarwal, Agarwal, 2025, p. 118). Furthermore, it "can enhance our understanding and appreciation of historic assets." (UNESCO Independent Expert Group, 2025, p. 56). "Artificial intelligence and digital technologies are rapidly transforming the way cultural and artistic heritage is protected, understood and appreciated" (Al-Khazraji, Qassim, 2025, p. 307). In this case, how can we detect these transformations through the interpretation of the artifacts? On the other hand: "How far should technology go in *reimagining* the past?" (UNESCO Independent Expert Group, 2025, p. 56).

3.2. The nature of digitalized archives

In the digital age, traditional memory institutions like museums, libraries, archives, etc. (referring to the stored memory) transform because of the changes, as the digital is very different from traditional storage, where nothing is stored but code. "Digital information is constantly being updated, changed, and deleted" (Özhan Koçak, 2025, p. 12–13). Through digital platforms and devices, it is possible to access collective memory; for example, we can visit digital museums. Özhan Koçak argues, referring to Makhortykh, that AI systems are increasingly becoming 'gatekeepers of memory'. As Özhan Koçak concludes: "AI is the modern-day Mnemosyne associated with memory and recall" (Özhan Koçak, 2025, p. 13).

3.3. Institutional practices

The 2022 Commission AI study, which can be found in the research of the European Parliament (2023) under the name of *Artificial Intelligence in the Context of cultural heritage and museums*, "lists the following opportunities AI offers to museums and the cultural heritage:

- archival, cataloguing and information management applications enhanced by AI, which will help museums, archives, libraries and cultural heritage institutions to research and categorise digital collections more effectively;
- AI-assisted audience engagement activities, which will help to better communicate and engage with audiences, making interactive exhibitions more engaging;
- visitor experience management, which will help better manage museums and cultural heritage venues using AI applications; this will help track visitor numbers, forecast attendance, and analyse feedback from visitors (sentiment analysis). The São Paulo Museum is an example of such an initiative" (Pasikowska-Schnass, Lim, 2023, p. 9–10).

3.4. Examination of case studies

As the usage of AI tools like DALL-E and Midjourney for creative purposes has been widely known since the beginning of 2023, many projects have emerged in the art world to emphasize the significance of the original art pieces.

In 2023, in their project called the *UnArtificial Art* the Vienna Tourist Board took the opportunity to reimagine works by Gustav Klimt, Egon Schiele, and Pieter Bruegel the Elder, using AI tools. The idea of this project was, as they highlight, to "see the art behind the AI art". To demonstrate this, art expert Markus Hübl analysed the AI-generated images alongside the originals that inspired Ultimately, the campaign promotes Vienna's art tourism by providing an edifying history of Viennese art and by delving into the intersection of AI art and art history in a short film (Artnet Gallery Network, 2023).

Although this project aimed to draw inspiration and thus reinterpret classic masterpieces, there was another significant AI project with the aim to reconstruct lost artworks by the era-defining artist, Klimt. The Belvedere Museum in Vienna and Google Arts & Culture reconstructed the *Faculty Paintings* by Gustav Klimt with the help of AI tools. The paintings were destroyed nearly 75 years ago, and with AI, they were able to bring them back to life in full colour using black-and-white photos that existed of the works (Vienna Tourist Board (n.d.). "Researchers leveraged sophisticated algorithms trained on Klimt's oeuvre to meticulously restore the original colours and compositions..." (UNESCO Independent Expert Group, 2025, p. 56).

In the same year, the PERCEIVE research project funded by the EU aimed to transform the way in which we study, reproduce, and exhibit coloured artworks, while securing their legacy and cultural value for future generations. One of the highlights was the enhancement of the famous painting *The Scream* by Edvard Munch. "The project employs a multidisciplinary approach and novel AI technologies to capture and simulate the artwork's unique history and colour degradation" (Munchmuseet, n.d.). The project aimed to reestablish the painting's artistic significance and the scientific skill that goes into the preservation by utilizing photographic, spectroscopic imaging, and colorimetric techniques. The interdisciplinary team consists of specialists across science, innovation, research, and learning, thus offering new ways of preserving and displaying artworks (Munchmuseet, n.d.).

It is also worth mentioning a Hungarian-related project realized with the help of artificial intelligence by István Gábor Hatvani, who is the great-grandson of the Hungarian painter Ferenc Chiovini, a Munkácsy Prize-winning artist, Meritorious Artist, and long-standing member of the Szolnok Artists' Colony. The project involved the reconstruction of a fresco design. Hatvani first employed AI for data analysis in academic publications, using it to increase the resolution of his illustrations. This experience led him to recognize that AI-based tools could also be suitable for other purposes. He used a function of Topaz Labs' Topaz AI software, which is based on convolutional neural networks. While processing the artist's estate and improving the quality of surviving press photographs, the researcher conceived the idea of applying this technique to reconstruct a lost painting for which only a contemporary press photograph remains. As Hatvani explains, "this was an entirely practical application; by this I mean that there was no intention to artistically reinterpret or alter the original photograph, but merely to increase its resolution, that is, the number of pixels." (Manzenreiter, 2025) It is worth emphasizing that the entire reconstruction relied solely on the original black-and-white photograph, as the researcher did not wish to imitate artistic creation.

One version of the 1938 fresco design *Saint Stephen's Missionary Journey* was lost during the Second World War. The work was originally created in two versions. The smaller composition, measuring 70 × 170 cm, survived the war and is today owned by the Chiovini (Hatvani) family; it is regularly exhibited. The larger version, approximately 1.5 × 2 meters, was destroyed during the war, when Soviet troops occupying Szolnok converted the Chiovini studio into a vehicle repair facility and used the painting as a storage box for spare parts. Today, this version can only be viewed in its digital reconstruction (Figure 1) (Hatvani, 2025).

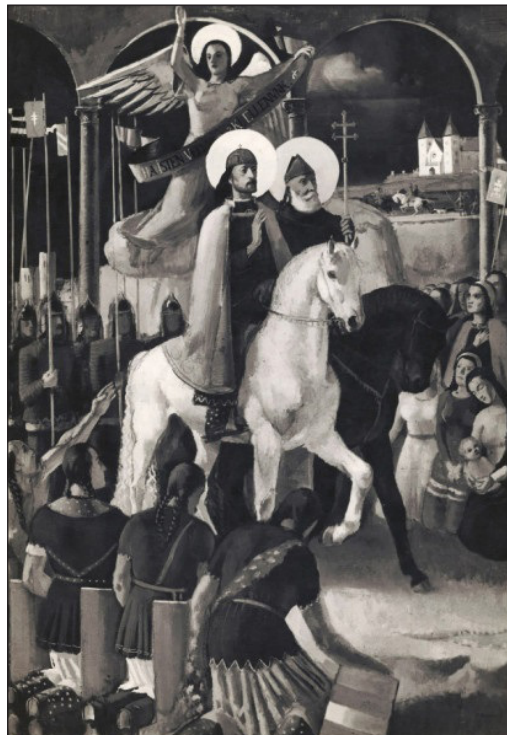


Fig. 1: Reconstruction of Ferenc Chiovini's fresco design *Saint Stephen's Missionary Journey* (1938), based on a high-quality press photograph²

The fresco designs were created by the artist for the 900th anniversary of the death of Saint Stephen, commemorated during the Saint Stephen Memorial Year. Based on current research findings, it can be stated that Ferenc Chiovini intended the award-winning work for the wall surface behind the altar in the sanctuary of the Árpád-House Saint Margaret Church at Lehel Square in Budapest (Figure 2) (Hatvani, 2025).



Fig. 2: The wall surface behind the altar in the sanctuary of the Árpád-House Saint Margaret Church and Ferenc Chiovini's wall-painting design *Saint Stephen*.³

4. Possible risks

As István Gábor Hatvani concluded, he aimed not to create a new artwork and tried to protect the original piece for ethical reasons. While AI introduces many ways for preservation and restoration, there are new risks that have to be taken into consideration when we speak about the protection of historical artifacts. "Generative AI can be used to create deepfakes and manipulated reconstructions, fabricating artifacts, cultural misrepresentations, altering historical events, or producing architectural simulations that advance specific ideological agendas" (UNESCO Independent Expert Group, 2025, p. 59). Regarding the nature of AI-generated content, it has to be mentioned that these are disseminated rapidly and widely while making an impact on the public perception and shaping historical narratives. That is why implementing ethical guidelines and transparent methodologies is necessary to avoid misinterpretation in the context and to identify risks and biases in restoration planning (UNESCO Independent Expert Group, 2025, p. 60).

5. Conclusions

According to the recent publications and projects revealed, it can be concluded that today's transformations have brought significant changes not only for the public and the whole creative industry but for museum and cultural heritage experts as well, by altering the restoration, preservation, and curatorial processes.

AI technologies can transform how cultural heritage is understood, moreover, how cultural stories are told and shared, and give possibilities of exploration by preserving cultural memories. "AI plays a crucial role in preserving endangered languages and ancestral knowledge, utilizing sophisticated linguistic modelling and archival techniques to expand metadata and extract deeper meaning" (UNESCO Expert Group, 2025, p. 61). As AI tools evolve, they have the potential to reshape cultural memory and support cultural continuity. For these reasons, the opportunities and the risks have to be examined and require attention to be aligned with global policies (UNESCO Independent Expert Group, 2025, p. 62). By integrating AI tools into cultural heritage preservation, it is more important than ever to engage with this area respectfully and to ensure the world's cultural heritage and diversity. Returning to Ferenc Chiovini's words: "It cannot be the subject of art, in which there is no humanity!" As we embrace digital tools, the human element must remain the guiding principle of preservation.

Notes

¹ „Nem lehet a művészet tárgya, amiben nincs humánus!” – Chiovini Ferenc (Hatvani, 2025. trans. G.M.)

² Photo by István Gábor Hatvani, 2024. (1.5 × 2 m, wood panel, tempera, reproduction) Source: Hatvani, 2025. © Chiovini Family Archive® Used with permission.

³ Photo by István Gábor Hatvani. Source: Hatvani, 2025. Used with permission.

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