

Artificial Intelligence and the Archives of Memory: Preserving Culture and Heritage in the Digital Age

Dr.M.Samadhanam Emimal¹, Dr. Shagufta Parween², Mrs.Roshan Jameer MD³, Dr. Saloman Raju Yarlagadda⁴, Mr. V Temuzion Kumuja⁵

Assistant Professor, Department of English, Chaitanya Bharathi Institute of Technology, Gandipet, Hyderabad-500075,
Telangana, India, Email: drsamadhanamemimal@gmail.com
ORCID ID: 0000-0001-8905- 6964

Head & Assistant Professor, Department of English, Chaitanya Bharathi Institute of Technology, Hyderabad – 500075,
Telangana, India, Email: daisyazim@gmail.com
ORCID ID: 0000-0002-5221-4137

Assistant Professor, Department of English, Chaitanya Bharathi Institute of Technology, Hyderabad-500075, Telangana,
India, Email Id: roshanjameer.english@gmail.com
ORCID ID: 0009-0002-3298-0843

Assistant Professor, Department of English, Chaitanya Bharathi Institute of Technology, Hyderabad-
500075, Telangana, India, Email: solomonrajuyarlagadda@gmail.com,
ORCID ID: 0000-0002-3146-6327

Assistant professor, Department of English, Chaitanya Bharathi Institute of Technology, Hyderabad -500075,
Telangana, India, Email: temuzion@gmail.com,
ORCID ID: 0009-0009-8687-1504

Abstract

In an era marked with evolving technological advancement and global cultural shifts, artificial intelligence plays a pivotal tool in the preservation, interpretation, and dissemination of culture and heritage. This paper expounds on the multifaceted roles AI plays in preserving tangible and intangible cultural heritage aspect. By examining diverse applications such as intelligent archival systems, the revitalization of endangered languages, virtual reconstructions, AI-curated exhibitions, and personalized visitor engagement tools, the research showcases the role played by AI in enhancing the efficiency, accessibility, and interactivity of the cultural heritage conservation. which in turn deconstructs the way history is preserved and experienced. AI also enables the democratizing access to heritage through the development of multilingual and user-friendly digital platforms that make archives and exhibitions accessible to global audiences. Through case studies and critical analysis, this research paper explores how AI technologies contribute to more dynamic, inclusive, and interactive cultural spaces. The paper also addresses the ethical concerns surrounding authenticity, cultural sensitivity, and algorithmic bias. By synthesizing insights from digital humanities, this paper highlights both the prospect and limitation of integrating AI in the context of culture and heritage. The global cultural landscape calls for an interdisciplinary, community-centered approach to ensure that AI not only preserves the past but also empowers diverse voices in shaping the future of cultural memory.

Keywords: Artificial intelligence; Culture; Heritage; Preservation; Digital Age; Archiving.

1. Introduction

Culture and heritage form the bedrock of a society's identity, encompassing the collective memory, values, traditions, languages, rituals, artifacts, and artistic expressions of communities across time. Broadly categorized into tangible elements—such as monuments, manuscripts, and artworks—and intangible aspects—like oral histories, folklore, languages, and performing arts—heritage plays a critical role in preserving the continuity of human civilization. Preserving this wealth is essential not only for cultural continuity and identity formation but also for intergenerational knowledge transfer, intercultural understanding, and sustainable development. Preserving cultural heritage is important “to ensure the continuity of history and human identity. The diversity of tangible and intangible cultural assets represents the shared memory of previous generations, and it is essential to transfer this memory to future generations”. (Akyol, Gamze & Avci, Berkay 95)

The past few decades have seen a "digital turn" as the heritage sector embraces new technologies. By digitising collections, 3D scanning artifacts, creating online databases and virtual museum experiences, digital technologies have become common approaches for operationalizing the protection of both tangible and intangible heritage. This digital turn has opened up heritage protection beyond physical spaces so that knowledge about people, things, events, and histories can circulate beyond boundaries, latitudes, time zones, and socio-economic strata. And, the role of artificial intelligence (AI) in digital change is to ensure that it is treated as more than just an adjunct to or tool for protecting heritage but as a dynamic and participatory heritage practice.

With the explosion of AI, machine learning, computer vision, natural language processing, and virtual reality, the possibilities for curating, interpreting, experiencing, and representing cultural narratives have changed dramatically. If AI algorithms can decipher old texts, digitally reconstruct destroyed sites, transcribe oral history, and create immersive reconstructions of heritage sites, our relationship with the past becomes reimagined. In turn, these technologies also shape how culture is produced, consumed, and disseminated blurring the boundaries between preservation and innovation.

As the present society becomes digitized/globalized, heritage conservation practices in a “traditional” sense are being threatened by resource constraints, climate change, political instability, and cultural homogenization. Traditional and static forms of documentation often lack the ability to capture the increasingly complex and diverse cultural expressions embodied in tangible and intangible heritage. In this regard, AI-powered adaptive preservation approaches provide resilient, scalable, and holistic frameworks for safeguarding cultural heritage considering all the high stakes to protect endangered

languages, traditions and objects and offers new possibilities for community engagement, intercultural dialogue, and participatory memory-making in the digital age.

2. Research Objectives

This research paper aims to examine the transformative potential of artificial intelligence (AI) in the preservation, interpretation, and dissemination of cultural and heritage elements.

This paper aims to:

1. Assess the various roles of AI in heritage ensurement, specifically its application in safeguarding of anchors both tangible and intangible cultural elements through particularly natural language processors, machine learning, or virtual reconstruction.
2. Appraise the effectiveness of AI application specifically in terms of accuracy, cultural sensitivity, accessibility, and ethical challenges such as authenticity and algorithmic bias.

Methodology

This paper employs a qualitative and interdisciplinary methodology to examine how artificial intelligence (AI) is being used in the preservation of culture and heritage. Case studies are employed to examine examples of the use of AI in cultural institutions (e.g. museums) and ventures (e.g. digital archives, language preservation) which bring tangible evidence of the role of AI technologies in preserving both tangible and intangible heritage. There is also an interdisciplinary literature review from the field of digital humanities and cultural studies that provides a coherent overview of the ever-changing relationship between technology and heritage. Multiple methodologies allow for a critical assessment of the effectiveness and inclusiveness of AI technological in all heritage activities.

3. Literature Review

The use of Artificial Intelligence (AI) to assist with cultural heritage preservation represents a move away from traditional processes of maintaining our histories and heritage. Within the wealth of research done within digital humanities, AI is reconceptualizing how texts and resources are archived, interpreted, and shared. Burdick et al. (2012) identify in Digital Humanities that digital humanities do not simply digitize physical archives, but reconstruct knowledge systems, including cultural inquiry through the use of computational tools. So, whereas digital humanities reconceptualizes how we work with archives through the use of computational tools, AI is valuable in large-scale pattern recognition, data analysis, and interpretative modeling. Berry (2011) connects how these technologies, in the forms of machine learning, natural language processing (NLP), and computer vision, allow us to see new ways of thinking about texts, objects, and oral histories when studying the

past. However, as Drucker (2011) reminds us, while algorithmic systems can be useful, we should critically analyze those algorithmic systems, especially because through a humanistic lens, the interpretive and the quantitative cannot be fully disentangled when working with culturally deriving data.

Traditionally, cultural and heritage conservation strategies depended on physical conservation, oral traditions, and community rituals. While institutions focused on conserving tangible heritage in the form of manuscripts, monuments, and artifacts, intangible heritage, including languages, rituals, and related forms of music, are transmitted across generations. The rise of the digital age provided the world with initiatives such as Europeana and Google Arts & Culture that democratize access to collections of global heritage. Although Europeana and other similar projects increased access to heritage materials, they faced criticism for being Eurocentric and engaged in historical and institutional biases (Cameron & Kenderdine, 2007). The inclusion of AI has allowed digital heritage initiatives to expand beyond storage and archival procedures, into engaging and interpreting interactions. AI not only allows systems to curate and conserve but enables systems to also personalize the experience, to create cultural systems and contexts as well as to change the historic top down modes of engagement that have dominated heritage institutions.

The recent uses of AI in cultural heritage mark the enormous impact of AI on cultural heritage. For example, intelligent archival systems like Transkribus and READ-COOP apply machine learning to automate the transcription and annotation of historical manuscripts. These technologies could massively enhance efficiency and access, futurepective for mostly paleographic types of manuscripts that are otherwise completely unopened. However, these models often work just "fine" with dominant scripts and languages and, therefore, do not consider minority traditions (Stutzmann et al., 2021). Another significant contribution of AI is in language conservation. Technology platforms like Wikitongues and Google's Endangered Languages Project using speech recognition and neural translation to capture and regenerate endangered languages. Bird (2020) believes this has real potential for language revitalization; however, also reiterates the necessity for collaboration with native speakers, rather than the later imposing or just creating outside stakeholder approaches.

AI has also affected heritage reconstruction and understanding. With tools like 3D modelling, photogrammetry, and generative algorithms, digitisation affords the ability to reconstruct destroyed or inaccessible built forms like Palmyra or Notre-Dame, into a digital built environment form. While these digital representations serve to enhance education and memory, apart from their cultural sense-making and context they become even more questionable artefacts – who owns them and what is their true heritage value when obtained separately from the socio-political and cultural moments they live

in (Remondino & Rizzi, 2010). Institutions and museums are also using AI for curation of dynamic content – e.g. emotion adaptive interface, recognition and tailored content delivery - representing a major step towards personalised multilingual experiences. For example, the Cooper Hewitt Smithsonian Design Museum provides an interactive pen for user to change their experiences/experiments within the exhibition (Proctor, 2019)! With forms of personalised experiences being "better", there are also important ethical questions concerning the data privacy and the curatorial authority of the museum and their content.

Integration of AI with cultural heritage also incites ethical concerns. Scholars such as Safiya Noble (2018) argue that algorithmic systems often reproduce structural inequalities due to biases embedded in their training data. In heritage contexts, this means that marginalized cultures and voices risk being omitted or misrepresented. However, digital reconstructions and archives developed without community input can be another form of digital colonialism, where cultural materials are extracted, reformulated, and circulated without consent or benefit to the originating communities (Giaccardi, 2012). Ethical frameworks for AI in heritage must therefore include principles of cultural sensitivity, consent, transparency, and co-authorship.

Despite increasing interest in AI and cultural heritage eminent research gap is existing. As most research emphasize tangible heritage like monuments and artifacts, while intangible forms such as oral traditions and social practices remain overlooked due to their fluid, contextual nature. Research is often fragmented, lack of integration between technical, cultural, and ethical perspectives exists, this also limits the development of inclusive frameworks. Many AI projects follow top-down approaches without involving local communities, leading to reduced originality and sustainability. Moreover, there is limited critical analysis of how AI shapes collective memory or personalizes heritage narratives. Research on AI's impact on accessibility and inclusivity, especially for marginalized groups, also remains scarce.

This research paper aims to address these gaps by providing an interdisciplinary, ethically grounded, and community-centered examination of AI's role in preserving both tangible and intangible heritage. Through a critical analysis of case studies and applications, it seeks to explore not only the technological possibilities but also the cultural responsibilities involved in using AI to shape the collective memory of human civilization.

4. Applications of AI in Cultural Heritage

Artificial Intelligence (AI) has introduced transformative tools and methodologies that are reshaping how cultural heritage is preserved, interpreted, and experienced. This Artificial intelligence

technologies have also “ushered in a transformative era in cultural heritage conservation, offering innovative solutions at different stages of the conservation process”. (96)

As institutions grapple with the challenge of making cultural materials accessible and meaningful to a global, digital-first audience, AI serves as a powerful enabler of innovation. From intelligent archival systems to interactive exhibits and language revitalization efforts, AI not only supports the conservation of the past but also makes heritage increasingly relevant to contemporary audiences. The following sections examine key applications of AI in cultural heritage, focusing on their functions, implications, and challenges.

4.1 Intelligent Archival and Retrieval Systems

One of the major ways AI has changed cultural heritage is through intelligent archival and retrieval systems. Archives have historically acted as static storage, but there are an abundance of factors that can act as a barrier to accessing archives such as language, local modes of attention, and notably physical deterioration or lack of digitization. AI works to reduce such barriers by facilitating and improving the automated digitization, categorization, and indexing of historical datasets that formerly could not be handled at scale. In this way, AI could utilize natural language processing (NLP) for metadata creation, which is primary to digital archiving. Traditional archives will generally have metadata which AI systems can extract related metadata attributes such as dates, names, places, and relevant thematic keywords to allow for faster cataloguing and search.

AI has been instrumental in providing for semantic searches where users are able to not only acquire materials via keyword searching but also conceptually similar materials. Machine-learning models can be trained with corpus-specific data, allowing queries to extract meaning based on associative patterns in archival collections. In this way, AI can provide new interpretive strategies that were once inaccessible initially, allowing connections to be established that would not be considered solely by manual methods.

Despite the advances made, ethical and operational issues continue to persist. Often the effectiveness of these systems relies entirely on the quality and availability of training data - so there is a risk that accuracy remains low in underrepresented languages and cultures, and therefore perpetuates archival inequities. Furthermore, automated classification can also impose rigid conventions on fluid historical contexts which may distort the significance of culturally sensitive materials.

4.2 Revitalization of Endangered Languages

Another important area where AI plays a significant role is in the revitalization and documentation of endangered languages. As Language is not only “a means of communication but also a powerful symbol of cultural identity and resilience” (39). According to UNESCO, nearly half of the world’s approximately 7,000 languages are at risk of extinct in the coming period of time. Language loss not only threatens of linguistic diversity but also erosion of oral traditions, cultural knowledge, and worldviews which are embedded in the indigenous speech.

AI technologies, particularly speech recognition and neural machine translation, are used to document, and even teach endangered languages. Speech-to-text and text-to-speech models can process and synthesize oral narratives, changing them into written formats while retaining the phonetic accuracy and regional dialects. Projects such as Google’s Endangered Languages Project and the Living Tongues Institute for Endangered Languages uses AI to compile multimedia resources like audio recordings, lexicons, and annotated text which is based on community-submitted data. Large language models (LLMs) are also being trained to comprehend and create text in minority languages.

However, the ethical limitation of these technologies demands careful consideration. Community participation is essential to avoid extractive practices where language data is harvested without consent of that particular community or shared benefit. AI systems must also account for the contextual richness of oral languages, which often encode meaning through the other meters like tone, gesture, and situational usage, which are the elements that are difficult to capture using text-based models alone. Collaborative frameworks, of AI tool and the native speakers are very essential to preserving linguistic heritage in culturally respectful ways.

4.3 Virtual Reconstructions and Immersive Technologies

The digital reconstruction of heritage sites and objects has long been a part of the cultural heritage toolkit, but the integration of AI has taken these efforts to new heights. Through 3D modeling, machine learning, and computer vision, AI enhances the accuracy, interactivity, and scale of virtual reconstructions. These tools are especially valuable for sites that have been destroyed, damaged, or are geographically inaccessible due to conflict, climate change, or urban development. “The initial and classical approaches concerning immersive technologies were oriented towards very concrete functional and visual proposals aiming to replicate physical reality as closely and as faithfully as possible, there is a significant evolution aiming” (Benaben, Congès & Fertier 2)

AI-driven photogrammetry and LiDAR (Light Detection and Ranging) allow researchers to capture and reconstruct detailed spatial models of monuments, landscapes, and structures. One prominent

example is the digital reconstruction of the ancient Syrian city of Palmyra, whose ruins were partially destroyed during armed conflict. By analyzing photographic archives and satellite imagery, AI algorithms helped recreate highly detailed 3D renderings of temples and tombs, providing valuable records for both scholars and the general public.

Immersive technologies like Augmented Reality (AR) and Virtual Reality (VR), supported by AI, are changing the way we tell stories about the past. AI technologies, in VR contexts such as museums, can also create an artificial reproduction of a historic setting and allow the user to go explore the environment, such as walking the streets of ancient cities or historic sites of ceremonial gathering, in reality. The AI powered user experience can transform the environment by changing the virtual characters, the natural light, and the environmental sounds based on user interaction. AR demonstrates embedded and lived experiences with past history and to their historical periods, while enabling emotional engagements with users.

Despite their potential, virtual reconstructions must grapple with concerns over authenticity and representation. AI-generated reconstructions can risk oversimplifying complex cultural narratives or presenting conjectural visuals as historical fact. It is crucial that such projects maintain transparency about what is based on archaeological evidence and what is algorithmically inferred or artistically interpreted. Moreover, community consultation and scholarly oversight are necessary to ensure that reconstructions are respectful of cultural meanings, particularly in sacred or contested spaces.

4.4 AI-Curated Exhibitions

Museums and galleries are increasingly turning to AI for curatorial assistance, using algorithms to both organize collections and tailor exhibition experiences. Traditional curation relies on curators' scholarly judgment, institutional priorities, and audience expectations. While these remain vital, AI introduces new capabilities that enhance both the operational and experiential dimensions of curation. "Curating is a professional practice of organising, presenting and interpreting works of art or cultural materials with the aim of communicating specific themes and narratives through the design and layout of an exhibition". (Sheng 132)

Algorithmic curation allows museums to identify thematic patterns across collections, create data-driven narratives, and optimize the placement of exhibits for maximum educational impact. AI can cluster artworks or artifacts based on stylistic similarities, historical provenance, or visitor preferences, suggesting new relationships that may not have been previously considered. This supports the development of dynamic exhibitions that evolve over time based on feedback and interaction data.

Personalization is another major advantage of AI in curation. Museums will be able to create personalized tours and recommend exhibits that are rooted in the visitor's prior preferences through user analytics. There is also the ability to adjust or customize the interpretative content in relation to the visitor's category or type. Despite the great prospect of AI, and its properties as curator, there are some significant issues involved in AI use in museums, as with the potential for algorithms to privilege popularity over significance, where the capabilities of algorithms select on the basis of clicks, and not exhibition exhibition's larger culture or educational purpose. Additionally, if personalization is promoted based purely on user data in any museum context, this might deny visitors other types of cultural encounters and turn museums into points of consumption, as opposed to points of intellectual exploration. Nevertheless, curators need to take responsibility for personalisation and retain a level of oversight and ethical responsibility, to ensure that AI promotes the experience, and does not take the place of curatorial efforts.

4.5 Personalized and Inclusive Engagement Tools

Apart from curation, AI plays a role in building personalized and inclusive interfaces, providing broader access to cultural heritage. Digital tools including chatbots, virtual assistants, and AI-based guides, are common features of larger cultural institutions. These digital tools provide depth to deepen the engagement of visitors in real-time by providing answers to questions, articulating stories, providing context, and with different modalities and using multilingual choices.

Multilingual interfaces are essential to reducing barriers to access global heritage collections for non-native speakers. AI-based translation services that encompass local dialects and locution means that users are able to access the content accurately without the necessary advanced navigation of the language or needing to understand it proficiently. Text to speech and speech to text, inclusive design capabilities encourage users with visual or hearing impairments, also.

AI also facilitates personalized experiences based on needs and preferences; for example, applications can modify content complexity based on a few different factors, such as age groups, cultural relevance, geographic origin, or simplify an interface for a user with cognitive disability. Personalization increases not only accessibility but emotional appeal, as users can feel a connection to heritage content as it connects to an aspect of their identity and values.

However, creating inclusive AI systems should be established through participatory design. Input from users with disabilities, children, elders, and culturally diverse communities can be leveraged so that the tools are both technically effective and socially responsive. Alongside developed tools, cultural institutions must navigate the complexity of balancing data collection and privacy; keeping

transparency at the forefront as it relates to the tracking of user behavior and how that information is used.

5. Case Studies

Examining the interfacing and the applied use of Artificial Intelligence in cultural heritage through case studies that emphasize the strengths and weaknesses of technology in real contexts, will facilitate best understanding. The different case studies that will be examined here involve large digitization projects in Europe, AI-assisted language tools in Indigenous communities, showcasing case study, approaches, methods and results. There has been notable progress from these initiatives and all case studies have contributed to greater accessibility, engagement, preservation, however, they have also embedded ethical, inclusivity and sustainable challenges. Therefore, there are four specific case studies selected for review here to provide critical assessment on the successes and failures of AI-based heritage interventions.

5. 1. Europeana and AI in European Digital Archives

In 2008 the European Union initiated Europeana, one of the largest digital heritage projects and a vast aggregation of cultural content that includes texts, images, video, and objects from over 3,000 European institutions, and it would not have been possible or its continued development, without a wealth of AI technologies, including machine learning and natural language processing (NLP). In addition to automating metadata generation, record retrieval, and results improvement, NLP has enabled cross-lingual/multilingual discovery. Another major advancement is the collaboration between Europeana and the Time Machine initiative to use AI in reconstructing urban metaprojects and timelines. These animated visualizations offer a compelling and immediate understanding of cultural evolutions in space and time.

In spite of these efforts, Europeana encounters many obstacles. As for artificial intelligence models which mostly rely on structured and ‘adequate’ quality metadata, this also favours the institutions with established digitisation practices. This has manifested in the fact that collections from institutions that are under-funded, or even non-Western institutions or collections are usually at risk of being under-represented. Moreover, AI is struggling to accurately process low-resource languages and handwritten documents across the networks. The possibility of algorithmically-generated metadata reducing or simply misrepresenting complexities of cultural meanings cannot be ruled out. This calls for increased emphasis on human mediation of significance, along with more equitable data inclusion.

5. 2. Google Arts & Culture (GAC) and Machine Learning

Google Arts & Culture (GAC) started in 2011 to partner with museums and other organizations around the world to digitize their collections and provide individuals public access to collections and collections using engaging and experiential tools. AI is infused throughout the features and tools within GAC, such as "Art Selfie," "Art Transfer," and gigapixel images. This feature understandably uses machine learning powered by AI image recognition using visual dimensionality to recognize brush strokes and colour pallets in order for the user to recognize aesthetic relationships across time and space in individual works of art without limitations on both.

AI also powers augmented and virtual reality experiences, which provide a rich experience to users such as moving through the Palace of Versailles in real time exploring an application setting with contextual commentary. GAC's tools help create these elements and promote multilingual options for users around the world.

Nevertheless, GAC has received criticism on two fronts: biased curatorial elements of its platform, and algorithmic opacity. Issues can arise when curators, mediated by user-based curation and selection, do not have clear decision-making processes in selecting and ranking content, which can develop algorithmic bias through favoring users at Western institutions who are more familiar with the language of digital literacy. Although gamified heritage projects like face-matching through Art Selfie used a number of culturally-specific objectives, the specter of overly playful communication can undermine specificity, fidelity, and priority of the cultural pieces, deviating them into entertainment modalities while displacing the historical meanings and contextualized considerations tied to those cultural artifacts. For the primarily digitally framed GAC with its social media and visual conjectures, mediated culture builds tension for both innovative engagement and culturally-sensitive practices of digitized heritage projects.

5.3. UNESCO and Intangible Cultural Heritage (ICH)

UNESCO is at the forefront of developing artificial intelligence to safeguard intangible cultural heritage (ICH). ICH encompasses all practices that re-animate or re-embody specific performances and representations, be they oral histories, performing arts, or knowledge systems among Indigenous people. UNESCO's Memory of the World programme is one of its flagship initiatives where it employs AI tools, including text-to-speech and machine translation, to digitalize, transcribe, and translate oral and other audiovisual heritage of cultures, particularly those without written traditions. These applications create searchable repositories for folk songs, storytelling traditions, ceremonial dialogues, and more.

Similarly, in both East and Southeast Asia, UNESCO piloted analyzable applications, such as computer vision, to study ritual performances by analyzing patterns of movement in dance, rhythm in music, and dress in costuming. While these applications are proving useful for helping to protect, preserve, and extend the legacy of ephemeral traditions that are often difficult to capture using more traditional means of documentation, they also have ethical and technical limitations.

For example, AI in projects related to ICH may fail to fully appreciate fluid, contextual elements of performance or performance ritual and simply reduce the rules, complexity, and context of the ICH—much less its cultural meaning—to a simple data point. There are equally important ethical issues related to rights and consent, if the community is uncomfortable digitizing elements of their sacred or private traditions, even operating under a framework of free, prior, and informed consent. All of these challenges, and others, suggest that meaningful and ethical application of AI for ICH protection requires culturally sensitive partnerships and longterm custodianship.

5.4. AI for Indigenous Language Revitalization

Grassroots AI initiatives that honor Indigenous languages signify some of the most culturally intentional applications of technology. In North America, the Partnership on AI Language Preservation has developed AI services including speech recognition apps and digital dictionaries for revitalizing endangered languages including Ojibwe, Navajo, and Cherokee. These services are frequently co-developed with community members to assure cultural integrity and relevance.

In Canada, the FirstVoices platform, supported by the First Peoples' Cultural Council, employs AI for storing and teaching First Nations languages through audio, video, and text. Features including pronunciation correction and predictive typing support students and fluent speakers alike, enabling learners from diverse age ranges to learn from each other's use of the Indigenous language and cultural knowledge.

The types of projects described above are now designed using principles related to data sovereignty and Indigenous control over language resources. Meanwhile, the technical challenges persist—many Indigenous languages are considered “low-resource” by AI standards, which means that there is not enough data to train AI models for learning more about the Indigenous languages. Correspondingly, deep community concern exists that Indigenous culture language data might be exploited for commercial use or appropriated for a different purpose. Organizations like the Indigenous AI Working Group advocate for ethical AI considerations grounded in community benefit and control.

In sum, these case studies highlight the significant opportunities presented by AI for the preservation, promotion, and sharing of cultural heritage in a range of settings. Europeana and Google Arts &

culture mean to reflect large, institutional collections, UNESCO depicts an international preservation model, and Indigenous-led language-focused tools are meant to reflect contextualized, local – community-first – approaches. In all cases, evidence shows promise for developing new pathways for access and engagement with cultural heritage; all the more, only if it is possible for going forward as honouring ethical principles, cultural sensitivities, and inclusive distance to design. As the role of AI in heritage continues to expand, success will depend not only on innovation but on responsible stewardship and a commitment to cultural justice.

6. Ethical and Cultural Considerations

As AI becomes an increasingly central player in cultural heritage preservation, critical ethical and cultural concerns must be addressed to ensure that the technologies enhance rather than undermine the integrity, diversity, and community ownership of cultural materials. One of the most pressing ethical issues is authenticity and representation. AI-generated reconstructions of heritage sites, digital restorations of artwork, or reanimations of oral traditions may offer new forms of engagement, but they often raise questions about historical accuracy. While machine learning can fill in gaps based on pattern recognition, these outputs risk presenting speculative or stylized versions of history as factual. As Fiona Cameron notes, “Digital reproductions are not neutral: they are interpretations shaped by the choices, values, and limitations of those who create them” (Cameron & Kenderdine, 2007, p. 50). For instance, when AI recreates a destroyed temple or missing piece of artwork, whose interpretation is embedded in the algorithm? Without rigorous documentation and scholarly input, such recreations may distort the original context, leading to misrepresentation of cultural narratives.

Moreover, the question of who decides what is preserved—and in what form—is crucial. AI systems are typically developed by external institutions, researchers, or corporations with little to no representation from the source communities. This imbalance shifts control over cultural memory away from the communities to whom it rightfully belongs. As Kylie Message argues, “When heritage is digitized without the active involvement of its stewards, the result is often a form of digital colonialism—replicating historical patterns of appropriation in the digital realm” (Message, 2014, p. 121). As a result, what gets digitized, highlighted, or archived often reflects the interests of institutions rather than the priorities of cultural stakeholders.

Cultural sensitivity and ownership are closely linked to these issues. There is a real risk that AI applications, especially those developed without community consultation, may result in cultural appropriation. For example, digitizing sacred songs or rituals for public display can strip them of their spiritual significance and context. The act of transforming intimate, lived heritage into datasets for training algorithms can be a form of cultural extraction, especially when local communities have

limited control over how their traditions are recorded or shared. To counteract this, the active involvement of communities in heritage AI projects is essential. Community participation must go beyond consultation to genuine co-creation—ensuring that local knowledge, values, and protocols shape the project's goals and processes. As Duarte and Belarde-Lewis emphasize, “Communities must not only be consulted, but must be empowered as co-creators and custodians of their digital heritage” (Duarte & Belarde-Lewis, 2015).

Another significant ethical concern is algorithmic bias and exclusion. AI systems are only as good as the data on which they are trained. If the training datasets lack cultural diversity, include historical inaccuracies, or reflect colonial biases, the resulting models will reproduce these distortions. In the context of heritage, this means that AI might overlook, mislabel, or simplify minority narratives, reinforcing dominant historical interpretations while silencing others. For instance, facial recognition tools in some museum exhibits have struggled to accurately identify non-European features, leading to skewed user experiences. Ruha Benjamin observes that “Bias in AI is not just a technical flaw; it is a reflection of social inequality embedded into data and design” (Benjamin, 2019, p. 6). Bias in these systems not only limits access but also distorts representation, further marginalizing underrepresented groups.

7. Challenges and Limitations of AI in Heritage Work

While AI offers unprecedented capabilities in cultural heritage preservation and dissemination, it is accompanied by several technological, institutional, and socio-cultural challenges that hinder its effective and ethical implementation. From a technological standpoint, AI systems rely on large volumes of high-quality data to function effectively. In the heritage sector, data often comes from fragmented, fragile, or analog sources—ancient manuscripts, oral stories, damaged artifacts—that are not easily digitized or standardized. This influences the precision of models and restricts the viability of AI to produce reliable outcomes, particularly with non-Western voices or historically marginalized cultures that lack a digital representation. In addition to the above concerns, to establish and maintain an AI infrastructure often requires both a considerable computational investment and the related technical investment that cultural institutions, especially in the Global South, might not have access or capacity to absorb.

Institutionally, there are no reasonable and coherent frameworks and policies that guide the upkeep and use of AI. Many cultural organizations are often functioning without guidelines around intellectual property rights, ethical use of AI, and data governance in general; this leaves organizations vulnerable to a misappropriation of heritage, violate the privacy of individual heritage holders, or have culturally-based ownership conflicts. Of course, funding continues to be an ongoing barrier as,

although some technology companies extol the possibility of short-term grants or partnership work, the long-term projects in maintaining and sustaining AI infrastructure still require a long-term stable public investment and interdisciplinary commitments. Many institutions--especially in museums, libraries, and cultural organizations--also do not have sufficient technical (potentially including AI) training for their staff, making engaging AI tools difficult without the dependence of external technology companies.

Social and community resistance complicates the use of AI in heritage contexts as well. In many communities, especially those with a strong oral tradition, or knowledge systems based on rituals or cultural practices, they or their political leaders may view digital technologies with skepticism or distrust. The idea of transforming lived heritage into data or code challenges certain values and perspectives. In some instances, members of communities may feel that digitization erodes the sacredness or privacy of their heritage. As a result, the ethical implementation of AI must be accompanied by respectful dialogue to articulate cultural literacy and create frameworks for dialogue that promote local epistemologies and agency.

8. The Future of AI in Cultural Heritage

Notwithstanding the preceding concerns, the future of AI in cultural heritage is full of great promise when it navigates inclusive, ethical, and community-centered development. A significant trend is the movement towards participatory design and community-centred AI. Rather than treating local communities as data sources, emerging concepts highlight the significance of local communities as co-creators, curators, and interpreters of their heritage. There is an increasing interest in citizen archivist projects where community members contribute oral histories, photographs, or language recordings. These projects, often through an open-source AI platform, are grassroots initiatives where members of communities document and preserve culture on their own terms. The success of projects such as First Voices in Canada or Living Dictionaries in Africa illustrate how technological advances have provided support for this vital form of decentralized, cultural heritage work.

A further notable development is that there are more and more examples of interdisciplinary collaboration as a means of sharing knowledge and norms. Most heritage AI projects are informed by computer science, history, linguistics, anthropology, design, and local communities' representatives/historians. The nature of this interdisciplinary collaboration means that technical innovations can be grounded in cultural appropriateness and ethical accountability. Universities, museums, and international organizations have also now begun forming cross-sectoral types of collaborations to address the complex wicked problems related to heritage/community engagement and the development/application of AI (e.g., to address bias, to community cultural rights, etc.).

Public policy development, will represent a key dimension for the future of AI for cultural heritage. Global ethical frameworks and governance frameworks are needed to regulate AI in domain culturally and socially-sensitive domains. As UNESCO emphasizes, in its Recommendation on the Ethics of Artificial Intelligence: "Ethical frameworks for AI...should be rooted in cultural rights and not just technological efficiency..." (UNESCO, 2021, Article 23). The formulation of public policy also represents a challenge for national governments, which all must invest in digital infrastructure, education, and public policy development in a way that is inclusive and to ensure that AI benefits are equitably distributed.

9. Conclusion

Artificial Intelligence (AI) is a groundbreaking figure in the preservation, interpretation, and dissemination of culture in a way that we could not have even imagined a short time ago. AI brings exciting prospects for intelligent archiving, revitalization of language, virtual reconstruction, and personalized experiences in museums - resulting in a depth and expanse of potential reach, and approaches to heritage, in ways we had not previously imagined. AI offers scalable solutions to access, documentation, and interactivity challenges that have persisted for years, and it provides completely different options for ideas related to storytelling and sharing culture.

This radical innovation potential brings a significant challenge or two with it. There are unresolved ethical questions of authenticity, representation, and ownership. In addition, there are barriers as well, such as access to technologies, gaps in institutions, and community resistance on the other end. AI must also have representative and diverse coding systems and data sets, including an evaluation of AI outputs, for evidence of bias and distortion. What is most paramount, is continuing to situate cultural communities at the centre of conversations around design and implementation of any AI initiative.

In looking forward, it will be important to find ways to connect future AI innovations to accountability across the social spectrum. If we can forge links between disciplines, advocate for participatory practices, and develop equitable ethical frameworks that engage members of cultural communities in collaborative building of AI solutions, then AI can become a vehicle for ensuring that we not only preserve the past but improve prospects for a more equitable and inclusive cultural future. This also arguably contributes to the idea that cultural heritage is not simply about memory, but is also an important expression of culture, identity, belonging and the opportunity to imagine new ways of connecting with one another.

10. References

Akyol, Gamze & Avci, Ali Berkay. (2023). AI applications in cultural heritage preservation: technological advancements for the conservation. DOI: 10.6084/m9.figshare.24077862

Benjamin, R. (2021). Race After Technology: Abolitionist Tools for the New Jim Code. *Science & Technology Studies* 34(2):92-94 DOI:10.23987/sts.102639

Burdick, Anne & Drucker, Johanna & Lunenfeld, Peter & Presner, Todd & Schnapp, Jeffrey. (2012). *Digital Humanities*. MIT Press. DOI:<https://doi.org/10.7551/mitpress/9248.001.0001>

Berry, D. M. (2011). *The philosophy of software: Code and mediation in the digital age*. Palgrave Macmillan.

Bird, S. (2020). Decolonising speech and language technology. *Proceedings of the 28th International Conference on Computational Linguistics*, 3504–3519.
<https://aclanthology.org/2020.coling-main.311/>

Burdick, A., Drucker, J., Lunenfeld, P., Presner, T., & Schnapp, J. (2012). *Digital_Humanities*. MIT Press. <https://mitpress.mit.edu/9780262018470/digital-humanities/>

Cameron, F., & Kenderdine, S. (Eds.). (2007). *Theorizing digital cultural heritage: A critical discourse*. MIT Press.

Caramiaux, Baptiste. (2023). AI with Museums and Cultural Heritage. 10. 107-011.

Chaika, Oksana & Sharmanova, Natalia & Makaruk, Olha. (2024). Revitalising Endangered Languages: Challenges, Successes, and Cultural Implications. *Futurity of Social Sciences*. 2. 38-61. 10.57125/FS.2024.06.20.03.

Duarte, M. E., & Belarde-Lewis, M. (2015). Imagining Indigenous Digital Futures: An Introduction. *The Journal of the Native American and Indigenous Studies Association*, 2(1), 1–10.

Drucker, J. (2011). Humanities approaches to graphical display. *Digital Humanities Quarterly*, 5(1). <http://www.digitalhumanities.org/dhq/vol/5/1/000091/000091.html>

Frederick Benaben, Aurélie Congès, Audrey Fertier, A prospective vision of the evolution of immersive technologies: Towards a definition of metaverse, *Technovation*, Volume 140, 2025. <https://doi.org/10.1016/j.technovation.2024.103154>.

Giaccardi, E. (2012). Heritage and social media: Understanding heritage in a participatory culture. Routledge.

Message, K. (2014). Museums and Social Activism: Engaged Protest. Routledge.

Noble, S. U. (2018). Algorithms of oppression: How search engines reinforce racism. NYU Press.

Remondino, F., & Rizzi, A. (2010). Reality-based 3D documentation of natural and cultural heritage sites—Techniques, problems, and examples. *Applied Geomatics*, 2(3), 85–100.
<https://doi.org/10.1007/s12518-010-0025-x>

Stutzmann, D., Springmann, U., & Vieira, J. (2021). Automated transcription of medieval manuscripts: Progress and prospects. *Digital Scholarship in the Humanities*, 36(Supplement_2), ii176–ii193. <https://doi.org/10.1093/llc/fqab065>, doi.org/10.1093/llc/fqab065

Sheng, Yan. (2024). AI-assisted Curatorial Research: New Perspectives from Photography to Exhibitions. *International Journal of Social Sciences and Public Administration*. 4. 131-138. 10.62051/ijsspa.v4n3.18.

The Routledge Handbook of Museums, Media and Communication (pp. 433–443). Routledge.

UNESCO. (2021). Recommendation on the Ethics of Artificial Intelligence.

<https://unesdoc.unesco.org/ark:/48223/pf0000381137>