Title : Using Artificial intelligence for intangible cultural heritage

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# summary

The utilization of Artificial Intelligence (AI) for the preservation of intangible cultural heritage represents a cutting-edge approach to safeguarding the diverse and dynamic expressions that form the core of cultural identities around the world. As intangible cultural heritage encompasses a wide range of living expressions inherited from our ancestors—such as oral traditions, performing arts, social practices, rituals, and festive events—it poses unique challenges for preservation efforts. The integration of AI into these efforts has opened up innovative avenues for documenting, analyzing, restoring, and sharing these cultural expressions, ensuring they are not lost to time but instead are accessible for future generations.

In the realm of safeguarding intangible cultural heritage, AI technologies, including machine learning and digital tools, have demonstrated significant potential. These technologies facilitate the digitization and virtual restoration of cultural expressions, enhance the immersive experience of heritage through virtual and augmented reality, and improve the analysis and research of vast cultural datasets. Moreover, AI-driven tools have expanded the accessibility of intangible cultural heritage, making it possible for a broader audience to engage with and appreciate the richness of global cultures. This is achieved through AI-powered translation software, virtual reality experiences, and platforms that cater to individuals with visual or auditory impairments, thereby democratizing access to cultural heritage.

However, the application of AI in the preservation of intangible cultural heritage is not without its challenges and ethical considerations. Issues such as data privacy, cultural sensitivity, and the potential for bias in AI algorithms necessitate a careful and respectful approach to utilizing these technologies. Ethical frameworks and guidelines are critical to ensuring that AI serves to support and enrich intangible cultural heritage without misrepresenting or exploiting it. Continuous dialogue among technologists, cultural practitioners, and communities is essential to navigate these complexities and leverage AI in a manner that respects and honors cultural diversity.

The intersection of AI with the preservation of intangible cultural heritage is a dynamic and evolving field, promising transformative innovations and future directions. As this integration deepens, it is anticipated that enhanced digitization techniques, ethical AI deployment, and collaborative platforms for global participation will further revolutionize how we preserve and interact with the intangible cultural heritage of humanity. This article explores the role of AI in safeguarding intangible cultural heritage, highlighting technological advancements, ethical considerations, and the potential for future innovations that respect and celebrate cultural diversity.

# The Role of UNESCO in Safeguarding Intangible Cultural Heritage

The United Nations Educational, Scientific and Cultural Organization (UNESCO) plays a pivotal role in the protection and promotion of intangible cultural heritage (ICH) globally. The adoption of the UNESCO Convention for the Safeguarding of the Intangible Cultural Heritage in 2003 marked a significant milestone in recognizing the importance of cultural traditions beyond their tangible expressions[[1].](https://www.researchgate.net/publication/334735261_Intangible_Cultural_Heritage_and_New_Technologies_Challenges_and_Opportunities_for_Cultural_Preservation_and_Development) This Convention highlights the critical role of living heritage, encompassing traditions and living expressions passed down from generation to generation, including oral traditions, performances, social practices, rituals, festive events, knowledge and practices concerning nature and the universe, and the knowledge and skills to produce traditional crafts[[2].](https://en.ccunesco.ca/blog/2019/10/understanding-intangible-cultural-heritage)

## International Framework and Guidelines

Under the framework of the 2003 Convention, UNESCO has been instrumental in outlining operational principles and modalities for safeguarding intangible cultural heritage, especially in emergencies such as conflicts and disasters. In 2020, the General Assembly of States Parties to the Convention adopted specific guidelines to assist national and international stakeholders in effectively engaging with and protecting living heritage in these challenging situations[[3]](https://ich.unesco.org/en/project). This proactive approach demonstrates UNESCO's commitment to preserving cultural diversity under threat and ensuring the resilience of communities’ cultural expressions.

## Safeguarding Efforts and Global Engagement

UNESCO's efforts to safeguard intangible cultural heritage are comprehensive, involving the documentation, preservation, and promotion of living heritage around the world. The organization encourages countries to inscribe ICH elements on the Lists of Intangible Cultural Heritage and the Register of Good Safeguarding Practices. To date, 178 countries have ratified the Convention, contributing to a growing recognition of the value of intangible cultural heritage and the need for its safeguarding[[2]](https://en.ccunesco.ca/blog/2019/10/understanding-intangible-cultural-heritage).

The 2003 Convention delineates several domains in which intangible cultural heritage is manifested, including oral traditions, expressions, and language as vehicles of ICH. This broad definition underscores the diversity of cultural expressions and the importance of their preservation for future generations[[4].](https://www.mun.ca/ich/about/)

## Collaboration and Capacity Building

Recognizing the importance of both tangible and intangible aspects of culture, UNESCO facilitates collaboration among member states to focus on the intangible aspects of culture that contribute to the identity and continuity of communities[[5]](https://en.wikipedia.org/wiki/Intangible_cultural_heritage).

Since its inception, the Convention has fostered international cooperation and capacity building, enabling countries to develop policies and programs that effectively safeguard their living heritage. UNESCO's approach includes raising awareness, sharing knowledge, providing technical assistance, and mobilizing international cooperation.

## Digital Initiatives for Preservation

In response to the evolving landscape of cultural heritage preservation, UNESCO has also explored the role of digital technologies in safeguarding intangible cultural heritage. Initiatives such as "Digitizing Intangible Cultural Heritage: A How-To Guide" indicate a forward-thinking approach to utilizing artificial intelligence and digital platforms for the documentation, preservation, and accessibility of living heritage for educational and awareness-raising purposes[[6]](https://www.canada.ca/en/heritage-information-network/services/digitization/guide-digitizing-intangible-cultural-heritage.html).

# Technological Advances in the Preservation of Intangible Cultural Heritage

The preservation of intangible cultural heritage (ICH) is an evolving field that has seen significant advancements through the application of Artificial Intelligence (AI) and other digital technologies. These innovations offer promising solutions to the challenges of documenting, analyzing, and sharing the myriad aspects of intangible heritage, from traditional crafts and performances to languages and oral traditions.

## Digitization and Digital Preservation

The process of digitizing intangible cultural heritage involves capturing and converting various forms of cultural expressions into digital formats. This not only aids in the preservation of vulnerable heritage but also makes it more accessible to both researchers and the public[[6].](https://www.canada.ca/en/heritage-information-network/services/digitization/guide-digitizing-intangible-cultural-heritage.html) AI and deep learning technologies have been pivotal in enhancing these digitization efforts. For instance, AI algorithms can analyze and restore damaged images or recordings, making it possible to save otherwise lost elements of cultural heritage[[7]](https://www.sciencedirect.com/science/article/abs/pii/S1359178921001348). Furthermore, digital tools, supported by AI, allow for the automated annotation and completion of metadata, thus enhancing the accessibility and understanding of ICH resources[[8]](https://www.linkedin.com/pulse/lessons-we-learn-ai-cultural-heritage-digitising-worlds-ghatak)[[7]](https://www.sciencedirect.com/science/article/abs/pii/S1359178921001348).

## Virtual and Augmented Reality

AI-driven virtual and augmented reality technologies have emerged as powerful tools for the immersive experience of intangible cultural heritage. These technologies enable individuals to engage with cultural expressions in ways that were previously not possible, offering interactive experiences that can transcend geographical and temporal boundaries[[9].](https://medium.com/@OfentseManchidi/ai-and-cultural-heritage-preserving-and-promoting-cultural-diversity-with-artificial-intelligence-c24363570647) Whether through virtual tours of historic sites or through augmented reality applications that bring traditional performances to life, these technologies are expanding the ways in which intangible heritage is experienced and appreciated[[10]](https://www.mdpi.com/2571-9408/7/2/38).

## Analysis and Research

Machine learning algorithms are increasingly being applied to analyze large datasets of cultural artifacts and historical documents. This analytical capability allows researchers to uncover patterns, trends, and insights that might have remained undiscovered, thereby contributing to a deeper understanding of cultural heritage[[9]](https://medium.com/@OfentseManchidi/ai-and-cultural-heritage-preserving-and-promoting-cultural-diversity-with-artificial-intelligence-c24363570647). Such technologies not only support the preservation of ICH but also foster its continued evolution by facilitating the creation of new works inspired by traditional knowledge[[11].](https://www.sciencedirect.com/science/article/pii/S0167865520300532)

## Accessibility

AI is also enhancing the accessibility of intangible cultural heritage. Through AI-powered translation software and tools designed for people with visual or auditory impairments, a wider audience can now access and appreciate the richness of the world's cultural diversity[[9].](https://medium.com/@OfentseManchidi/ai-and-cultural-heritage-preserving-and-promoting-cultural-diversity-with-artificial-intelligence-c24363570647) This is particularly important for ensuring that the benefits and joys of intangible cultural heritage are shared inclusively, respecting cultural values and fostering global understanding[[8].](https://www.linkedin.com/pulse/lessons-we-learn-ai-cultural-heritage-digitising-worlds-ghatak)

## Ethical Considerations

The integration of AI and digital technologies in the preservation of intangible cultural heritage raises important ethical considerations[[12]](https://ich.unesco.org/en/ethics-and-ich-00866). The potential for these technologies to alter or misrepresent cultural expressions necessitates a careful and respectful approach. As such, ongoing dialogue and collaboration among technologists, cultural practitioners, and communities are essential to ensure that these technological advances serve to support and enrich intangible cultural heritage rather than to diminish or exploit it[[8].](https://www.linkedin.com/pulse/lessons-we-learn-ai-cultural-heritage-digitising-worlds-ghatak)

### Privacy and Data Security

The digitization and virtual restoration of artifacts and cultural practices through AI raise significant concerns about privacy and data security[[13]](https://www.researchgate.net/publication/371900342_ARTIFICIAL_INTELLIGENCE_AND_CULTURAL_HERITAGE_DESIGN_AND_ASSESSMENT_OF_AN_ETHICAL_FRAMEWORK). Ethical considerations necessitate the safeguarding of sensitive information associated with cultural heritage, ensuring that digital replicas and data do not lead to exploitation or misuse. AI algorithms must be designed to protect the identity and integrity of the cultural heritage, prioritizing privacy and data security in all operations[[10].](https://www.mdpi.com/2571-9408/7/2/38)

### Cultural Sensitivity and Bias

AI applications in cultural heritage must also navigate the complexities of cultural sensitivity, avoiding the reinforcement of stereotypes or the misrepresentation of cultural narratives[[14].](https://www.unesco.org/en/artificial-intelligence/recommendation-ethics) The potential for gender bias and other forms of discrimination in AI algorithms poses a challenge to fair and inclusive representation of intangible cultural heritage. Efforts must be made to design AI systems that are aware of and sensitive to the diverse cultural contexts they engage with, mitigating biases and promoting an inclusive approach to cultural heritage preservation[[10]](https://www.mdpi.com/2571-9408/7/2/38)[[14].](https://www.unesco.org/en/artificial-intelligence/recommendation-ethics)

# Case Studies of Successful AI Applications in Cultural Heritage Preservation

The integration of Artificial Intelligence (AI) into the preservation of cultural heritage marks a revolutionary advancement in how we approach the safeguarding of the world's historical and cultural treasures. Through various innovative applications, AI not only aids in the physical restoration of artifacts and sites but also plays a crucial role in preserving intangible cultural heritage, ensuring that the knowledge, traditions, and expressions that have shaped human history are passed down through generations. This section explores some of the most notable case studies where AI has been successfully applied in cultural heritage preservation.

## AI-aided Digitization and Virtual Restoration

One of the profound impacts of AI in cultural heritage preservation is seen in the digitization and virtual restoration of artifacts. The use of AI technologies allows for the digital restoration of artifacts that are too fragile or damaged to be physically restored[[15]](https://www.researchgate.net/publication/373336885_AI_APPLICATIONS_IN_CULTURAL_HERITAGE_PRESERVATION_TECHNOLOGICAL_ADVANCEMENTS_FOR_THE_CONSERVATION). This process not only preserves the physical appearance of these items but also makes them accessible to a global audience, promoting cultural tourism and engagement. Heritage tourism, significantly supported by digital technologies, plays an essential role in preserving cultural heritage and promoting local development[[15]](https://www.researchgate.net/publication/373336885_AI_APPLICATIONS_IN_CULTURAL_HERITAGE_PRESERVATION_TECHNOLOGICAL_ADVANCEMENTS_FOR_THE_CONSERVATION).

## Preservation of Architectural Heritage

The preservation of architectural heritage has also benefited from AI applications, particularly in challenging projects such as the Great Wall of China. Due to its extensive reach and the inaccessibility of certain areas, the preservation of the Great Wall presents a daunting challenge. Intel's collaboration with the China Foundation for Cultural Heritage Conservation exemplifies how AI, through the use of drone technology and data analysis, can pinpoint exact areas that require restoration, making the preservation process more efficient and cost-effective[[16]](https://www.forbes.com/sites/cognitiveworld/2019/03/28/artificial-intelligence-for-good-preserving-our-cultural-heritage/).

## Robotics and AI in Archaeological Reconstruction

The RePAIR project, led by scientists at the Italian Institute of Technology (IIT), showcases the intersection of robotics, AI, and cultural heritage preservation. Focused on the archaeological reconstruction of Pompeii, the project leverages robotics, 3-D scanning, machine learning algorithms, and artificial intelligence to aid in the labor-intensive reconstruction process[[17]](https://amt-lab.org/blog/2022/5/how-can-technologies-help-with-culture-heritages-restoration-and-preservation). This not only speeds up the restoration efforts but also contributes to a more accurate understanding of historical sites.

## Virtual and Augmented Reality for Immersive Experiences

AI-powered virtual and augmented reality technologies have opened new pathways for experiencing cultural heritage. These technologies provide immersive experiences that allow individuals to explore cultural heritage sites and artifacts in ways that were previously impossible[[9]](https://medium.com/@OfentseManchidi/ai-and-cultural-heritage-preserving-and-promoting-cultural-diversity-with-artificial-intelligence-c24363570647). Furthermore, AI-powered recommendation systems have the potential to personalize cultural experiences, helping users discover artifacts and experiences that match their interests and preferences[[9].](https://medium.com/@OfentseManchidi/ai-and-cultural-heritage-preserving-and-promoting-cultural-diversity-with-artificial-intelligence-c24363570647)

## Preservation of Intangible Cultural Heritage

The preservation of intangible cultural heritage, such as oral traditions, languages, and expressions, is another area where AI has shown significant promise. Oral traditions, which include proverbs, tales, legends, and more, are essential for passing on knowledge, cultural values, and collective memory[[18]](https://ich.unesco.org/en/oral-traditions-and-expressions-00053). AI and language technology, applying machine learning and deep learning techniques, have the potential to preserve these intangible aspects of cultural heritage by optimizing their promotion and ensuring their longevity in a digital form[[19]](https://www.researchgate.net/publication/362253484_Role_of_Artificial_Intelligence_in_Preservation_of_Culture_and_Heritage).

# Challenges and Ethical Considerations in AI-Powered Heritage Preservation

The integration of Artificial Intelligence (AI) in the preservation of intangible cultural heritage presents a revolutionary advancement in how societies preserve their historical treasures. However, this integration is not without its challenges and ethical considerations that must be addressed to ensure a responsible and sustainable approach to cultural heritage preservation.

## Challenges in Implementation

### Technological Limitations

One of the main obstacles in the application of AI for cultural heritage preservation is the technological limitation of current hardware and software[[20].](https://amt-lab.org/blog/2020/3/a-digital-future-for-cultural-heritage) Many cultural heritage organizations lack the necessary updates in technology to fully utilize AI capabilities, hindering the potential impact of digital preservation efforts. Addressing these limitations requires investment in technological infrastructure and training for cultural heritage professionals[[21].](https://www.europarl.europa.eu/thinktank/en/document/EPRS_BRI(2023)747120)

### Interoperability and Copyright Issues

The digital preservation of cultural heritage also faces challenges related to data interoperability and copyright issues. Ensuring that digital data is interoperable and accurately described with metadata is crucial for the effective use of AI in cultural heritage[[21]](https://www.europarl.europa.eu/thinktank/en/document/EPRS_BRI(2023)747120). Furthermore, navigating copyright laws and securing the necessary permissions for digitization and virtual restoration projects can be complex, requiring skilled professionals who understand both the legal and technical aspects of digital heritage preservation[[21].](https://www.europarl.europa.eu/thinktank/en/document/EPRS_BRI(2023)747120)

### Ethical Framework and Guidelines

Despite the recognized importance of ethical principles in AI use, there is a lack of comprehensive, sector-specific guidelines that address the unique ethical risks and opportunities in cultural heritage preservation[[13].](https://www.researchgate.net/publication/371900342_ARTIFICIAL_INTELLIGENCE_AND_CULTURAL_HERITAGE_DESIGN_AND_ASSESSMENT_OF_AN_ETHICAL_FRAMEWORK) The development and implementation of such ethical frameworks are essential for guiding the responsible use of AI in this field, balancing technological innovation with ethical considerations to ensure that cultural heritage is preserved in a manner that respects and honors its source communities[[13]](https://www.researchgate.net/publication/371900342_ARTIFICIAL_INTELLIGENCE_AND_CULTURAL_HERITAGE_DESIGN_AND_ASSESSMENT_OF_AN_ETHICAL_FRAMEWORK)[[10].](https://www.mdpi.com/2571-9408/7/2/38)

# Future Directions and Innovations in AI for Intangible Cultural Heritage Preservation

The utilization of Artificial Intelligence (AI) in the preservation of intangible cultural heritage is witnessing transformative innovations and evolving future directions. The convergence of Machine Learning (ML), Deep Learning, and digital technologies opens new horizons for safeguarding the world's historical and cultural narratives. This section delves into the anticipated advancements and innovative approaches that could further revolutionize the field of intangible cultural heritage preservation through AI applications.

## Enhanced Digitization and Virtual Restoration Techniques

AI-aided digitization and virtual restoration stand at the forefront of preserving intangible cultural heritage. The progress in AI technologies enables the creation of digital replicas of cultural artifacts and historical documents with unprecedented accuracy and detail[[15].](https://www.researchgate.net/publication/373336885_AI_APPLICATIONS_IN_CULTURAL_HERITAGE_PRESERVATION_TECHNOLOGICAL_ADVANCEMENTS_FOR_THE_CONSERVATION) Future innovations may introduce more sophisticated algorithms capable of generating high-fidelity 3D models of cultural sites and artifacts, allowing for an immersive exploration experience that goes beyond physical boundaries. These advancements could facilitate a deeper understanding and appreciation of cultural heritage among global audiences[[8]](https://www.linkedin.com/pulse/lessons-we-learn-ai-cultural-heritage-digitising-worlds-ghatak).

## Ethical AI Deployment in Cultural Heritage

As AI applications become more integral to cultural heritage preservation, ethical considerations are gaining prominence. Future developments in AI must prioritize ethical guidelines that ensure the respectful and sensitive handling of cultural artifacts. Innovations in AI could lead to the establishment of frameworks that balance technological advancements with the cultural and historical significance of artifacts, thereby promoting sustainable and inclusive preservation practices[[15].](https://www.researchgate.net/publication/373336885_AI_APPLICATIONS_IN_CULTURAL_HERITAGE_PRESERVATION_TECHNOLOGICAL_ADVANCEMENTS_FOR_THE_CONSERVATION)

## Integration of Machine Learning and Deep Learning

The intersection of Machine Learning (ML) and Deep Learning with cultural heritage preservation is set to expand. Comprehensive analyses of cultural heritage and

ML literature suggest a growing taxonomy of ML algorithms and their application in cultural heritage preservation[[11]](https://www.sciencedirect.com/science/article/pii/S0167865520300532). Future directions include the enhancement of these algorithms for better accuracy in artifact recognition, restoration, and interpretation. Deep Learning models, in particular, offer the potential for breakthroughs in understanding complex patterns and stories embedded within cultural artifacts, providing richer, contextually-aware insights into intangible heritage[[11]](https://www.sciencedirect.com/science/article/pii/S0167865520300532).

## Collaborative Platforms for Global Participation

Innovation in AI for intangible cultural heritage preservation is also moving towards more collaborative, participatory platforms. Such platforms could leverage AI to enable contributions from global communities, allowing for the preservation of a diverse range of cultural expressions. These platforms might harness crowd-sourced information, supported by AI tools for verification and enrichment, to create comprehensive databases of intangible cultural heritage that are accessible worldwide.

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