

FROM CANVAS TO CODE: HUMAN-CENTERED AI IN THE PROTECTION OF INDIA'S ARTISTIC HERITAGE

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ABSTRACT

The integration of Artificial Intelligence (AI) into the domain of cultural heritage has opened new possibilities for the preservation, interpretation, and protection of paintings in India. However, the application of AI in such culturally sensitive contexts necessitates a human-centered and ethical framework that respects artistic authenticity, cultural diversity, and societal values. This article explores how human-centered and ethical AI contributes to understanding and safeguarding Indian paintings, drawing on recent research by Indian scholars. It argues that AI must be aligned with indigenous knowledge systems, cultural ethics, and participatory approaches to ensure responsible and sustainable heritage conservation.

INTRODUCTION

India possesses a vast and diverse tradition of paintings, ranging from Ajanta murals and Mughal miniatures to folk and tribal art forms. These artworks are not merely aesthetic objects but carriers of historical memory, spiritual values, and community identity. With increasing threats such as environmental degradation, urbanization, and neglect, there is a pressing need for innovative preservation strategies.

Artificial Intelligence has emerged as a powerful tool in cultural heritage conservation, enabling automated analysis, restoration, and digital archiving. For instance, AI techniques can analyze deterioration patterns and assist in the reconstruction of damaged artworks . However, purely technological approaches risk overlooking the human, cultural, and ethical dimensions embedded in Indian paintings. Therefore, a human-centered and ethical AI framework becomes essential.

NEED FOR THE STUDY

The growing adoption of AI in cultural heritage conservation has largely been technology-driven, often overlooking the socio-cultural and ethical dimensions of heritage artifacts. In the Indian context, paintings are deeply embedded in religious beliefs, local traditions, and community identities. Existing AI models, frequently trained on Western datasets, may fail to capture the nuances of Indian artistic traditions, leading to misinterpretation or cultural bias.

Moreover, issues such as digital ownership, authenticity of AI-restored artworks, and equitable access to digitized heritage necessitate a structured ethical framework. There is a clear need to examine how human-centered and ethical AI can address these challenges while enhancing the understanding and protection of Indian paintings. This study fills that gap by focusing on culturally grounded AI applications informed by Indian scholarship.

OBJECTIVES OF THE STUDY

The study is guided by the following objectives:

- To examine the role of AI in the understanding and preservation of Indian paintings

- To analyze the importance of human-centered design in AI applications for cultural heritage
- To explore ethical considerations in the use of AI for artistic and cultural preservation
- To identify challenges and propose culturally sensitive AI frameworks for protecting Indian paintings

METHODOLOGY

- This study adopts a **qualitative research methodology** based on secondary data. It involves a systematic review of academic literature, policy documents, and case studies related to AI in cultural heritage, with a particular focus on contributions by Indian authors and institutions.
- The research follows an analytical approach, synthesizing insights from interdisciplinary fields such as computer science, art history, and ethics. Case examples of AI applications in restoration, digitization, and analysis of artworks are examined to understand practical implications. The study also incorporates theoretical perspectives from Indian Knowledge Systems (IKS) to frame ethical considerations in AI.

DATA ANALYSIS AND DISCUSSION

- The analysis reveals that AI technologies such as computer vision and deep learning are increasingly used to analyze artistic styles, detect deterioration, and assist in restoration processes. For instance, AI-based image processing techniques can reconstruct damaged portions of paintings while maintaining stylistic consistency.
- However, the data also indicates that purely algorithmic approaches often lack contextual understanding. Indian paintings frequently contain symbolic, mythological, and spiritual elements that require human interpretation. Studies by Vats and Bhattacharjee (2026) emphasize the importance of integrating cultural knowledge into AI systems to ensure meaningful outputs.
- Ethical analysis highlights concerns related to authenticity, bias, and ownership. AI-generated restorations may alter the original intent of the artist if not carefully supervised. Additionally, the digitization of paintings raises questions about intellectual property and community rights. Singh (2026) suggests that ethical AI in India should be guided by principles such as Dharma and collective well-being, ensuring that technological advancements benefit society as a whole.
- The findings also underline the importance of participatory approaches, where artists, historians, and local communities collaborate with technologists. This ensures that AI systems remain aligned with cultural values and human needs.

FINDINGS

The findings of the study indicate that Artificial Intelligence has considerable potential in enhancing the understanding and preservation of Indian paintings. AI-based tools such as computer vision and deep learning enable detailed analysis of artistic styles, color compositions, and structural patterns, which support art historians and conservators in identifying origins, techniques, and periods of artworks. These technologies also facilitate high-quality digital documentation, making rare and fragile paintings more accessible for research and education without risking physical damage.

At the same time, the study finds that a purely technology-driven approach is insufficient for accurately interpreting Indian paintings. The richness of Indian art lies in its symbolic, spiritual, and cultural meanings, which cannot be fully captured through algorithms alone. Human-centered AI, which incorporates inputs from art historians, cultural experts, and local communities, plays a crucial role in ensuring that interpretations remain contextually accurate and culturally sensitive. This highlights the necessity of combining computational efficiency with human insight.

Another important finding relates to the ethical challenges associated with AI applications in cultural heritage. Issues such as authenticity of AI-assisted restoration, algorithmic bias, and questions of data ownership emerge as significant concerns. AI-generated reconstructions, if not carefully monitored, may unintentionally alter the original artistic intent. Furthermore, the use of datasets that are not representative of Indian art traditions can lead to misinterpretation or marginalization of indigenous styles. These concerns underline the importance of developing transparent and accountable AI systems.

The study also reveals that Indian Knowledge Systems (IKS) offer a valuable ethical framework for guiding AI applications. Concepts such as Dharma (ethical responsibility) and collective well-being emphasize the need for technology to serve societal and cultural interests. Integrating these principles into AI design can help ensure that technological interventions respect the cultural and spiritual significance of paintings while promoting sustainable preservation practices.

Finally, the findings emphasize the importance of collaborative and interdisciplinary approaches in the use of AI for protecting Indian paintings. Effective implementation requires the combined efforts of technologists, conservation experts, policymakers, and local communities. Such collaboration not only improves the accuracy and reliability of AI systems but also fosters inclusivity and shared ownership of cultural heritage. Overall, the study concludes that ethical, human-centered AI can significantly contribute to the preservation of Indian paintings when guided by cultural sensitivity and responsible innovation.

ETHICAL AI AND INDIAN KNOWLEDGE SYSTEMS

Ethical AI involves principles such as fairness, accountability, transparency, and respect for human rights. In India, ethical AI is increasingly being framed through indigenous philosophical concepts. Singh (2026) argues that Indian Knowledge Systems (IKS), rooted in ideas like Dharma (ethical duty) and Sarvatma-bhava (universal well-being), provide a valuable foundation for developing human-centric AI systems .

Applying these principles to paintings implies that AI systems must:

- Respect the cultural and religious significance of artworks
- Avoid bias in representation and interpretation

AI FOR UNDERSTANDING PAINTINGS

AI technologies such as computer vision, deep learning, and generative models are increasingly used to analyze paintings. These tools can identify artistic styles, detect forgeries, and uncover hidden layers beneath the surface.

Research indicates that AI can enhance cultural narratives by generating or reconstructing visual elements while preserving stylistic coherence (Khan et al., 2025) . Additionally, AI

systems can assist in documenting paintings by creating detailed metadata, enabling better cataloguing and accessibility.

However, understanding paintings through AI requires careful consideration of interpretative bias. Indian art often contains symbolic and spiritual elements that may not be easily captured by algorithmic models. Therefore, integrating expert knowledge from art historians and local communities is essential to ensure meaningful interpretation.

AI FOR PROTECTION AND PRESERVATION OF PAINTINGS

AI plays a transformative role in the protection and conservation of paintings. Techniques such as image in painting, pattern recognition, and predictive modeling allow for non-invasive restoration and monitoring of artworks. For example, AI can digitally reconstruct damaged sections of paintings, preserving their original texture and aesthetic without physical intervention .

Furthermore, digitization initiatives supported by AI enable the creation of high-resolution archives, ensuring long-term preservation. Sharma et al. (2025) emphasize that AI-driven digitization is crucial for safeguarding fragile cultural materials in India, which are vulnerable to climate and environmental factors .

Despite these advantages, ethical concerns arise regarding authenticity and ownership. Over-reliance on AI-generated restoration may alter the original artistic intent. Thus, ethical guidelines must regulate the extent and manner of AI intervention.

CHALLENGES AND ETHICAL CONSIDERATIONS

The deployment of AI in the preservation of paintings raises several challenges:

- **Authenticity vs. Reconstruction** – AI-generated restorations may unintentionally distort original artworks.
- **Cultural Bias** – Algorithms trained on Western datasets may misinterpret Indian artistic styles.
- **Data Ownership** – Digitization raises questions about who owns and controls cultural data.
- **Accessibility and Inclusion** – Ensuring that local communities benefit from AI applications is crucial.

Research on AI ethics in India highlights the importance of privacy, security, and accountability in AI systems . These principles must be extended to cultural heritage contexts, where sensitivity to community values is paramount.

FUTURE DIRECTIONS

The future of human-centered and ethical AI in protecting Indian paintings lies in interdisciplinary collaboration. Integrating computer science with art history, anthropology, and philosophy can create more holistic AI systems.

Key directions include:

1. Development of culturally adaptive AI models trained on Indian art datasets
2. Community-driven AI systems that involve local artists and stakeholders
3. Policy frameworks that balance innovation with ethical responsibility

4. Use of explainable AI to enhance transparency in art analysis and restoration

Such approaches will ensure that AI not only preserves paintings but also sustains the cultural ecosystems they belong to.

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CONCLUSION

Human-centered and ethical AI offers a promising pathway for understanding and protecting paintings in India. By aligning technological innovation with cultural values, ethical principles, and human participation, AI can serve as a powerful tool for heritage conservation. However, its success depends on maintaining a balance between automation

and human judgment, ensuring that the richness and authenticity of Indian paintings are preserved for future generations.

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