IJIRCCE

e-ISSN: 2320-9801 | p-ISSN: 2320-9798

INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN COMPUTER & COMMUNICATION ENGINEERING

Volume 12, Issue 11, November 2024

INTERNATIONAL STANDARD SERIAL NUMBER INDIA

Impact Factor: 8.625

© 2024 IJIRCCE | Volume 12, Issue 11, November 2024| DOI: 10.15680/IJIRCCE.2024.1211102

www.ijircce.com | e-ISSN: 2320-9801, p-ISSN: 2320-9798| Impact Factor: 8.625| ESTD Year: 2013|

International Journal of Innovative Research in Computer and Communication Engineering (IJIRCCE)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

Artificial Intelligence Meets Ancestry: Transforming Culture and Heritage

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ABSTRACT: This review paper will investigate the role-played Artificial Intelligence (AI) in the preserving of cultural heritage and Heritage, and it focusses on its applications in documentation, damage detection that would occur due to lightning or natural calamities. By analysing and reviewing methods which include deep learning, computer vision, and AI models, the review paper identifies the potential for address challenges like structural deterioration and metadata generation. It highlights key improvement including AI-driven virtual tools and digital preservation techniques so to safeguard our culture. So, the review paper will give you an idea about the future of culture and Heritage mainly under artificial intelligence and ways AI enriches cultural heritage preservation.

KEYWORDS: Artificial Intelligence (AI), Cultural Heritage Preservation, Deep Learning, Damage Detection, Digital Preservation, Metadata Generation

I. INTRODUCTION

The preservation of our cultural and heritage (C&H) structures faces significant challenges around the world, mainly due to natural calamities and mainly lightning strikes, particularly concerning surface degradation. Traditional methods used for inspection, such as manual visual checks, are most often costly, and time-consuming, and are mainly prone to human error. Further inspections conducted by different operators can result in inconsistencies, and it would lead to inconsistency and require long-term monitoring.

In recent years, the use and the application of Artificial Intelligence (AI) has been a transformative solution to solve these challenges and problems. AI technologies, such as computer vision and deep learning, algorithms are now being used for damage detection in monuments, identify any issue in structure, and preserve and protect cultural and heritage for the future generation. These emerging technologies are helpful for fast, most efficient and accurate monitoring of sculptures and monuments, which are helpful for digital preservation and damage detection, even in remote or hazardous locations.

And in the recent years we have also seen how ai has been used as a tourist guide assistant helping foreign or outsiders to explore the culture and heritage of any area. It would be an interactive way for the tourist to know the history bout that particular historic sites. So, AI would play a curtail role for the maintaining, protection and transmission of our culture and heritage for the future generation

II. LITERATURE REVIEW

Generative Artificial Intelligence, Human Agency and the Future of Cultural Heritage (2024)
Indeed, generative AI unlocks enormous possibilities for the preservation of cultural heritage above all else-because it can make interactive experiences possible. Several recent studies now try to allow people to explore virtual environments around cultural landmarks, artefacts, or traditions, but in a purely digital fashion. Such environments mostly involve 3D models of historic sites, restored artefacts, and media that reproduce forms of art or stories. For instance, AI techniques are used for the restoration of damaged artefacts in digital form and for the production of virtual replicas. While originals are lost forever, their replicas can preserve not only the physical elements but also the

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myriad intangible aspects of folk performances or folklore, making them better accessible to larger audiences and thus saving endangered cultural practices.

This is even more intriguing within the creation of new experiences with AI-driven virtual reality, whereby a ritual, dance, or craft activity believed to be lost from everyday practice can now be experienced by the user. In this manner, heritage is not only conserved but honored through immersion: global audiences can engage with it in a new and meaningful way.

Context-aware chatbot using MLLMs for Cultural Heritage (2022)
Advanced usage of language models by AI-powered chatbots changes the way people connect to their cultural heritage. With AI-powered smart chatbots, advanced with real-time personalized interactions as virtual guides, cultural sites and traditions come alive.

The difference between these chatbots is that they use NLP and machine learning for the updating of responses based on a user's preferences, such as age, language, or cultural background, allowing visitors to receive the most relevant information based on their interest.

They may envision a museum where a chatbot recommends exhibits based on what one has previously viewed or even translates the descriptions of the artefacts into their native tongue. Breaking language barriers and providing customized insights with a new AI companion, these artefacts are sure to make cultural heritage better and more interesting for all.

Application of Artificial Intelligence Technology in Cross-Cultural Communication of Intangible Cultural Heritage (2022)
AI, therefore, plays a very important role in cross-border cultural communication and bringing traditions and knowledge from other cultures accessible geographically or linguistically. Traditional ways included travel and textbooks, whose reach was very limited. But new AI tools including machine translation and NLP change the way global cultural narratives are shared.

For example, AI translation tools will allow the instantaneous interpretation of oral traditions, folklore, and even endangered languages so they are not lost but have meaning for diverse audiences. This does not only protect cultural knowledge but also promotes understanding between communities.

This employment of AI can, therefore, help in removing more other communication barriers leading to the appreciation and cherishing of more cultural diversities. More-inclusive cultures can be created through these tools for dialogue between people from different backgrounds engaged in their heritage.

On the Preservation of Africa's Cultural Heritage in the Age of Artificial Intelligence (2023)
The climatic change and urbanization threats in Africa continue to touch the rich cultural heritage of Africa, which pertains to oral traditions, music, and dance. AI presents new avenues about how this is preserved and shared with the world.

Digitized oral histories are a good example of AI; archives are thus made and kept for future generations. Generative AI also comes in handy when it comes to preserving traditional African music and dance; digital versions that truly and aptly capture their essence are created. Besides, the newer generations of people have been inspired to interact with their heritage in new ways by the very existence of these AI tools. Additionally, it promotes culture-sensitive tourism by virtual touring since it provides opportunities for the global citizen to tour African traditions without necessarily being there. Such efforts not only preserve cultural heritage but also foster global appreciation for Africa's diverse and thriving culture.

AI AND CULTURAL HERITAGE PRESERVATION IN INDIA (2024)
Artificial intelligence’s applications in the culture and heritage usually include restoration and preserving our culture and heritage for the future generation. Documentation of our country's culture include Monuments and sculptures of our past. Technologies such as drones for site mapping, AI-based image processing, and chatbots for multilingual

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interpretation enhance preservation efforts. Examples like Google Cloud Vision highlight AI's potential for deep cultural analysis.

Artificial intelligence-assisted visual inspection for cultural heritage: State-of-the-art review (2024)
sculpture Damage Detection
AI detects sculpture surface damage like discoloration, efflorescence, and cracks. YOLOv5 had achieved a 93.7% accuracy in identifying damage, defects on heritage sites in New Delhi.
Structural Monitoring
AI models are used in long-term structural monitoring by creating digital records of damage progression occurred over time.
Component Recognition
AI models identify domes and stained glass, to enhance digital documentation of future use.
Case Studies
Dadi-Poti Tombs (India): Used YOLOv5 to identify surface damages.
Forbidden City (China): Was able to Detect spalling and cracks with an accuracy 94.3%.
Hampi (India): used Faster R-CNN for monitoring cracks and spalling.

Will Artificial Intelligence Affect How Cultural Heritage Will Be Managed in the Future? Responses Generated by Four genAI Models (2024)
Digitization and Preservation
genAI models usually facilitate the creation of high-quality digital replicas of manuscripts, ensuring long-term preservation and accessibility mainly for our future generations. It would help our future generation to know about them. Examples include 3D modeling and automatic transcription of fragile texts which preset generation people cannot understand.
Restoration and Reconstruction
AI tools help in restore incomplete or damaged sculptures or monuments by filling in missing parts based on existing damaged fragments, helps in recovery of cultural assets.
Interactive and Immersive Experiences
AI integrated with virtual reality (VR) and augmented reality (AR) applications usually help in recreating historical sites, helpful for public engagement through educational tools and personalized tours.

Exploring the Factors Influencing Heritage Tourism Development: A Model Development (2023)
Brand Value Enhancement
Promoting cultural significance and managing heritage sites efficiently increases brand value. Examples include using unique characteristics of sites like the Taj Mahal which help strengthen a nation's identity and attract tourists.
Destination Reputation
Strategies like ensuring accessibility, high-quality hospitality, and media publicity play a very crucial role.
Tourist Experience
Offering memorable experiences for the visitors by organizing cultural events, workshops, and sustainable practices, helps in creating positive memories and encourages revisits by the tourists.

Cultural heritage preservation by using blockchain technologies (2022)
Ledger Layer It uses lightweight and yet robust operation by using one-way hash functions to solve that problem.
Integration of Blockchain with Tourism Creating digital platforms of heritage sites for interactive exploration helps tourists interact with the Ares and gain new experiences. Preserving and storing and protecting heritage digitally for educational purposes and future generation.

III. METHODOLOGIES

Investigation Design: The paper focuses on reviewing existing AI applications and their impact on cultural and heritage preservation in India. The investigation Design usually involves the analysing of case studies (e.g., AI at Hampi and the National Rail Museum) and technology been used are like VR, AR, and drones. Using Drone Tech, deep learning models to identify damaged heritage sites.

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Include AI techniques, such as drone-based inspections and deep learning models, to identify damage in heritage structures.

Quantitative Components: Data includes the percentage of damaged monuments or the number of culture or heritage sites that are been digitally documented. Example: "9% of centrally protected monuments in India are untraceable". **Forbidden City (China):** Was able to Detect spalling and cracks with an accuracy 94.3%.

Qualitative Components: explained of how AI help in preservation, such as using chatbots or creating 3D models of artefacts. Example: AI-driven virtual reconstructions of Hampi city ruins helped to restore our history for our future generation. So, by using AI Tourist Chatbots it would help the tourists explore the heritage sites efficiently.

Sample Estimation: Thousands of images of heritage sites have been collected to train AI models like CNNs help it helpful for user to interact with it.

How Estimations Were Collected: Information from "India Today" and "The Hindu" about monument loss and technological initiatives. Also, many published papers from GOOGLE Schloer, IEEE,and any other were useful to estimate the collection. Use of drones, cameras, and online databases to capture and store high-resolution images of monuments and sculptures.

Information Analysis:
It has taken the information from numerous research papers been published and case studies and uses examples to explain AI's role in preservation our culture and heritage.
Example: Grouping AI applications or models which are pretrained into themes like documentation, restoration, and visitor experience enhancement. Deep learning algorithms are being used for images to identify and classify damage types like cracks or discoloration.
Sanskrit Analysis: AI helps in the study of ancient Indian scripts, enhancing linguistic preservation
As most of our ancient scripts are usually Sanskrit.

Quantitative Analysis:
It would usually Include metrics like the number of cultural and heritage sites been preserved or AI's efficiency in restoration tasks in cultural sites.
Example: AI's ability to categorize damage patterns in monuments and the use of AI software Chatbots to help the tourists and travels to explore the heritage sites in an ease manner.
Evaluating AI performance based on metrics like precision (e.g., 94.3% for masonry damage detection)

Qualitative Analysis:
It Focus in on descriptive outcomes, like the emotional value of preserving cultural heritage or the impact of VR on visitor engagement and what impact the cultural sites create in the people's life.
Example: Visitor feedback on virtual tours using AI technologies would help other people to explore more efficiently the cultural sites in an easier manner.
We can Understand the impact of AI-assisted inspections which helps in reducing inspection time and increasing accuracy as compared to humans.

Moral Considerations:
Ethical concerns about data privacy, intellectual property, and inclusivity are the thing's which comes under consideration. Respecting data privacy, ensuring inclusivity in access to AI tools, and reducing bias in AI models.
Example: Ensuring AI doesn't disproportionately benefit elite groups while marginalizing rural communities.

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IV. RESULTS/DISCUSSION

Quantitative Outcomes

Damage Detection Accuracy: Utilize results such as the Forbidden City achieving 94.3% accuracy in damage detection as a benchmark at the culture and heritage sites. Compare these to AI-powered analysis in India for heritage sites like Hampi or the National Rail Museum will be very efficient and helpful.

Extent of Digital Documentation: Provide the percentage or number of sites digitally documented using AI technologies like drones, VR, and AR. For instance, if "thousands of images" were collected for CNN training, detail how this translated into preservation efforts.

Qualitative Outcomes: AI in Visitor Engagement: Highlight examples such as AI-driven chatbots enhancing visitor experiences. Describe how virtual reconstructions (e.g., Hampi city ruins) impacted public understanding of history and culture.

Emotional and Educational Impact: Discuss feedback on VR tours or interactive chatbots, emphasizing their role in making cultural heritage accessible and engaging.

Discussion

Comparison with Previous Research

Global Benchmarks: Compare AI's applications in Indian heritage sites to global examples like the Forbidden City. Highlight similarities and unique challenges in implementation.

Use of Deep Learning Models: Discuss the effectiveness of models like CNNs in identifying damage and categorize the findings by type (cracks, discoloration, etc.).

Technological Insights

Role of AI Tools: Elaborate on how drones, VR, AR, and chatbots overcome traditional limitations in heritage preservation, such as slow manual inspections or lack of public engagement and interest these things happen when human does it.

Improvement Areas: Highlight any gaps or disadvantages in AI applications, e.g., ensuring inclusivity for rural communities or addressing ethical concerns in data usage.

Moral Considerations

Reflect on ensuring equitable access to AI tools and minimizing bias in models. Provide examples of ethical implementations in cultural heritage AI systems.

Visual Presentation

Incorporate:

Tables: Accuracy rates, documented vs. undocumented sites, AI application categories.

Graphs: graph analysis of AI usage in preservation over years.

Figures: Before-and-after images of heritage sites that are analyzed using AI.

V. CONCLUSIONS

This review paper will give you an idea of the potential of Artificial Intelligence (AI) in preserving and promoting cultural and heritage sites all around the world. AI has a vast variety of applications, ranging from damage detection and structural monitoring to visitor engagement and guidance through chatbots and virtual reality, demonstrating significant improvements in efficiency, accuracy, and accessibility. And protect and preserve our culture and heritage for the future generation

Key findings of this review paper include:

1. **Enhanced Preservation Techniques**: AI tools or models like YOLOv5 and Faster R-CNN have high accuracy in identifying damage and deterioration in heritage sites and old monuments, ensuring timely identifying and solving the issue.
2. **Digital Documentation**: AI models or algorithms integrated with Technologies such as drones, deep learning, and AR/VR helps in creating digital replicas of monuments, sculptures, temples, ensuring that our future generation could experience its availability.

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3. **Visitor Experience Improvement**: AI-powered chatbots and virtual tours bridge are helpful in providing personalized and interactive cultural and heritage experiences.

AI digital preservation and engagement strategies are usually a revolutionary shift in how cultural heritage is managed and protected. By leveraging deep learning, computer vision, and interactive AI-tools, AI would actually ensure that the stories, structures, and traditions of the past are safeguarded for the enrichment of future generations. This review lays the foundation for continued exploration and integration of AI into cultural heritage preservation efforts.

ACKNOWLEDGEMENTS

We want to extend our heartfelt thanks to everyone who supported us during the process of conducting and completing this research paper. We author(s) express our sincere gratitude to Ranjana Thakuri, Assistant Professor, Department of CSE, Sri Venkateshwara College of Engineering, for their invaluable guidance and support throughout the development of this paper. First and foremost, we are grateful to the authors who took part in this review paper. Their willingness to engage and share their experiences was crucial in shaping our research. Without their input, this study would not have been possible. We also owe a great deal of thanks to our academic advisors and mentors, whose guidance and insightful feedback were vital in refining our research methodology and analysis. Their expertise and encouragement played a key role in helping us navigate the complexities of this study. Special thanks go to our institution for providing the necessary resources and ethical clearance to conduct the research. The support from the administration and the review board ensured that we adhered to the highest standards of academic and ethical integrity. We would also like to recognize our peers and colleagues for their assistance, whether through technical support, discussions, or brainstorming ideas. Their collaboration enriched our understanding and perspective, and we are truly appreciative of that. Finally, we express our gratitude to the tools and software that aided our data analysis and helped bring our findings to life. This paper is the result of the collective efforts of everyone involved, and we are thankful for each contribution that made this research possible.

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