TECHNOLOGICAL APPLICATIONS IN SAFEGUARDING AND DISSEMINATING THE INDIAN KNOWLEDGE SYSTEM (IKS)

Kamala Mohanty
Research Scholar,
RTMNU, Nagpur

Prof. Shalini R. Lihitkar
Professor,
RTMNU, Nagpur

Abstract :

The Indian Knowledge System (IKS) holds a vast wealth of wisdom, philosophy, literature, science, medicine, and art, rooted in centuries-old traditions and texts. However, in the modern era, this invaluable heritage faces the twin threats of physical decay and diminishing accessibility. Recent advances in digital technologies—spanning artificial intelligence, blockchain, cloud computing, and immersive media—offer transformative opportunities for the documentation, analysis, and dissemination of IKS. This paper investigates the latest technological interventions within India aimed at preserving, authenticating, enhancing, and transmitting this knowledge. The research includes a review of best practices, key challenges such as linguistic complexity and ethical dilemmas, and recommendations for interdisciplinary collaboration and sustainable digital preservation.

Keywords : Technological Tools, Indian Knowledge System, Digital technologies.

Introduction :

India's intellectual tradition is one of the oldest and most diverse in the world, encompassing practices and treatises in Ayurveda, Yoga, mathematics, astronomy, architecture, and the arts (Rao, 2002). Recorded across millennia on palm leaves, birch bark, and fragile paper manuscripts, the IKS corpus has survived invasions, colonialism, and the passage of time. Many of these repositories are now facing serious dangers—they're not only at risk of being physically damaged or lost but are also threatened by the decline in traditional language abilities and dwindling institutional backing for age-old learning methods. At the same time, the rapid growth of digital technologies has given us new hope to safeguard and revive Indigenous Knowledge Systems (IKS). Tools like Artificial Intelligence, Blockchain, OCR, and cloud repositories now offer us opportunities to digitize records on a whole new scale, translate materials automatically, and involve more people in accessing this knowledge. However, using technology for this purpose is complicated and brings along its own set of ethical, technical, and social challenges (Saraswati & Sharma, 2018). With this in mind, this paper aims to map out different technological approaches used for IKS, offering a clear framework to weigh their strengths, weaknesses, and how they might evolve going forward.

Literature Review :

Pollock (2001) & Rao (2002) have emphasised how Sanskrit, along with other

traditional Indian languages, has played an important role in carrying forward India's rich traditions in philosophy, science, and culture. Miserably, many manuscripts that were once collected and cared for with great effort are now in fragile states—vulnerable to being ruined by neglect or environmental threats. The National Manuscripts Mission has recorded thousands of these priceless texts, making it clear that it's crucial to use modern methods to properly document and protect them for the future.

Digital preservation efforts have grown India, platforms like the National Digital Library of India (NDLI) and the Muktabodha Digital Library have led the way in digitizing rare Indian texts on a large scale (Ghosh, 2019). Technologies like Optical Character Recognition and Natural Language Processing have become crucial for converting these ancient materials into machine-readable formats, even though dealing with old scripts remains challenging (Smith, 2020). Artificial Intelligence driven tools now effectively reconstruct, categorise, and translate texts, helping to overcome language barriers that once limited access to this valuable knowledge. Dedicated machine translation models for Sanskrit, Pali, Tamil, and other classical languages are expanding engagement with Indigenous Knowledge Systems.

Recent studies highlight how blockchain technology plays a key role in confirming the authenticity and safeguarding the integrity of digitized manuscripts. Gupta and Verma (2021) showed that blockchain-based archives can ensure manuscripts remain untampered and maintain an unbroken record of ownership. Additionally, smart contracts provide ways to recognize copyrights and fairly share benefits with traditional custodians (Sen, 2021).

Managing and analyzing vast collections of data has found support through cloud storage and big data analytics. These tools offer secure and scalable storage solutions while enabling detailed analysis to uncover thematic or scientific links among various IKS fields. Cloud-based collaborative platforms also foster interdisciplinary research and improve public access (Ghosh, 2019).

Objectives :

- To critically examine technology-assisted initiatives in the preservation and promotion of IKS.
- To explore key tools—such as AI, blockchain, digitization, and cloud technology—used in Indian digital preservation projects.
- To analyze the major challenges (technical, linguistic, social, and ethical) facing large-scale IKS digitization.
- To provide recommendations for developing sustainable, scalable, and culturally sensitive frameworks for IKS in the digital era.

Methodology :

This paper pursues a qualitative and analytical approach. Primary and secondary

sources, including scholarly articles, official reports, and case studies from leading Indian institutions (e.g., NDLI, IGNCA, BORI) are systematically reviewed. Quantitative insights from recent user surveys and institutional evaluations (IAJESM, 2021) supplement the analysis. Attention is focused on peer-reviewed research and practitioner perspectives published within the last decade and case examples from government-backed and privately funded projects. The review considers both technology implementation and the human dimension stakeholder participation, ethical engagement, and sustainable impact.

Results and Discussion :

Digitization and Digital Libraries : The conversion of physical manuscripts to digital formats via OCR and high-resolution imaging is central to the IKS preservation movement. Projects like the NDLI and Digital Library of India offer open access to thousands of digitized Sanskrit, Pali, and Tamil texts. Enhanced metadata and indexing using semantic technologies vastly improve discoverability and retrieval (Ghosh, 2019). Yet, digitization faces hurdles such as inconsistent quality of ancient scripts, incomplete or damaged texts, and the high costs of manual correction.

AI, NLP, and Machine Learning : Artificial Intelligence and Machine Learning are revolutionising text processing and contextual understanding in IKS collections. Robust NLP models trained on ancient Indian grammars have shown promise in translating complex concepts and reconstructing fragmented content (Saraswati & Sharma, 2018). AI-powered chatbots and virtual tutors enable contemporary researchers and students to learn from ancient texts, democratizing access and interpretation. However, existing AI models often falter with the nuanced meanings in philosophical texts, indicating the need for continued innovation and partnership with language scholars.

Blockchain for Authenticity : Manuscripts, providing an immutable ledger that documents the scanning, storage, and access transactions. This feature addresses growing concerns over unauthorized alteration, commercial exploitation, and misattribution. Recent pilots in India have tested the use of blockchain-enabled smart contracts for copyright management, ensuring fair recognition and compensation for traditional knowledge holders (Gupta & Verma, 2021; Sen, 2021). These tools enhance trust in the digital archive ecosystem, a critical requirement for broader acceptance.

Cloud Computing and Data Analytics : Modern cloud infrastructure supports the secure dissemination and storage of large IKS datasets for educational institutions, researchers, and the public. Big Data analytics complement preservation by aggregating and correlating massive volumes of data, revealing new relationships across Ayurvedic case histories, mathematical treatises, and astronomical logs (Ghosh, 2019). Collaboration between technologists, historians, and traditional knowledge holders really thrives when cloud platforms make it easy for everyone to work together at the same time.

Notable Case Studies:

- The Muktabodha Digital Library has developed a dedicated digital platform to preserve texts related to Kashmir Shaivism by utilizing technologies like OCR, NLP,

and AI-powered indexing.

- Google's Sanskrit OCR project and Microsoft's AI translation tools for Indic languages have set high standards in language technology for Indigenous Knowledge Systems (IKS).
- Institutions such as the Indira Gandhi National Centre for the Arts (IGNCA) and the Bhandarkar Oriental Research Institute (BORI) have also been actively digitizing fragile palm-leaf manuscripts, with valuable collaboration from traditional scholars and technology experts.

Challenges :

- Digitizing ancient Indian manuscripts is a complex task that involves various hurdles. One major challenge is the lack of structured metadata and cataloging, which makes it difficult to organize and retrieve these texts efficiently (Web:15). Additionally, the diversity of scripts in classical Indian languages, such as Sanskrit, Pali, and Prakrit, creates linguistic and technical complexities for OCR and machine translation tools, which are still evolving and not error-free for all scripts (Web:11, Web:12, Web:14).
- Another significant issue is physical degradation: many manuscripts are centuries old and suffer from damage due to environmental factors, requiring urgent conservation efforts before digitization can even begin (Web:11, Web:15). Coupled with this, cultural resistance from traditional knowledge holders concerns over the digitization and sharing of sacred or confidential materials, which necessitates sensitive handling and ethical considerations (Web:16).
- Legal and ethical issues also pose challenges, especially related to copyright, ownership, and benefit sharing, which complicate the process of digitization and access (Web:12). The sheer volume of manuscripts, many of which are large and handwritten, demands high resource investments, including advanced hardware, software, and skilled personnel, which are often limited due to resource constraints (Web:12, Web:14). Moreover, technological limitations mean that current OCR systems often cannot guarantee perfect recognition accuracy across all scripts and formats (Web:11, Web:14).
- Sustainable funding and institutional support are crucial for large-scale digitization projects. Without continuous support, maintaining and expanding digitization efforts becomes difficult, hindering the broader goal of making cultural heritages accessible globally (Web:12, Web:17, Web:18).

These challenges highlight the necessity for strategic policies, advanced technologies, ethical frameworks, and adequate funding to protect and popularize India's invaluable manuscripts and cultural heritage.

Future Prospects and Recommendations :

1. Advancing AI and NLP: There is a need to develop AI and NLP models attuned to ancient Indian languages and scripts, with collaborative input from linguists and

technologists. The focus should be on achieving high-accuracy translation and content reconstruction (Saraswati & Sharma, 2018).

2. Expanding Blockchain Applications: Blockchain implementation should be extended for manuscript authentication and secure copyright management. Smart contracts could safeguard recognition and remunerate knowledge custodians (Gupta & Verma, 2021).
3. Integrated Digital Repositories: Centralized, government-backed repositories—developed in partnership with academic and private organizations—will promote open access while authenticating and indexing content (Ghosh, 2019).
4. Standardization and Interoperability: Uniform protocols for digitization, metadata, and digital archiving are needed to ensure sustainability and cross-platform compatibility.
5. Ethical Engagement: Central to all technological interventions must be dialogue and partnership with traditional scholars and local communities. Ethical frameworks should codify consent, participation, and benefit sharing (Krishna, 2017).
6. Capacity Building and Digital Education: Investment in training programs for both technology developers and cultural practitioners is essential to foster mutual understanding and drive sustainable impact.
7. Policy and Infrastructure Support: Enhanced government and institutional investment is vital for funding infrastructure and incentivizing private-sector engagement.

Conclusion :

The integration of technology with the Indian Knowledge System marks a paradigm shift in the preservation and evolution of India's intellectual heritage. Through digitization, artificial intelligence, blockchain, and cloud computing, IKS is not just being saved from obsolescence but made dynamic and accessible to future generations. The journey, while promising, is beset with challenges technical, cultural, and ethical. The sustainable preservation of IKS calls for continuous innovation, robust funding, and earnest collaboration between technologists, historians, policymakers, and traditional knowledge bearers. Through such united endeavors, India can not only safeguard its past but inspire new frontiers of interdisciplinary research and knowledge sharing for the world.

References :

- Ghosh, S. (2019). Digitizing India's Intellectual Heritage: A Case Study of NDLI. Journal of Digital Humanities, 7(2), 45-59.
- Gupta, P., & Verma, R. (2021). Blockchain-based Frameworks for Authenticating Historical Texts. International Journal of Blockchain Research, 4(2), 112-123.
- Krishna, A. (2017). Ethical Considerations in Digital Preservation of Ancient Texts. Journal of Cultural Studies, 9(3), 21-37.
- Pollock, S. (2001). The Language of the Gods in the World of Men: Sanskrit, Culture, and Power in Premodern India. University of California Press.
- Rao, N. (2002). The Intellectual Traditions of India: An Overview. New Delhi:

Oxford University Press.

- Saraswati, P., & Sharma, R. (2018). Artificial Intelligence in Cultural Preservation: Challenges and Opportunities. International Journal of Digital Archives, 5(1), 33-48.
- Sen, B. (2021). Intellectual Property and the Digitalization of Traditional Knowledge. Indian Journal of Technology & Ethics, 12(4), 77-91.
- Smith, J. (2020). Blockchain and Digital Preservation: A New Paradigm for Authenticity. Journal of Emerging Technologies, 8(3), 15-30.