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Towards Designing a Digital Repository for the Cultural Heritage of Kashmir: Experiences and Challenges

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Abstract

Purpose: *The study attempts to explore, identify and document the rich cultural heritage of Kashmir valley with a focus on preserving and safeguarding cultural assets and enabling accessible digital collections for enhanced visibility, accessibility, sharing and Consultation through the implementation of an integrated digital repository framework.*

Design/methodology/approach: *A multi-phase methodology was adopted involving the identification, documentation, digitization, organization, and representation of cultural heritage resources. Data were collected through site visits, consultations with historians, artisans, manuscript custodians, and cultural institutions. Digital content were created using scanning, photography, and audio-visual recording technologies. Metadata standards and customized descriptive elements were applied to organize resources, while Greenstone open-source software was used for repository development and management.*

Findings: *The study reveals that diverse cultural heritage resources, including manuscripts, folklore, inscriptions, monuments, traditional music, arts and crafts, indigenous knowledge systems, and historical records, etc., can effectively integrate, within a single access platform. Metadata-driven organization and interoperable digital library technologies enhance discoverability, accessibility, and long term preservation. The study also highlights practical challenges related to resource identification, stakeholder cooperation, metadata customization, and digitization of rare and dispersed cultural materials.*

Research limitations/implications: *The repository testbeds represent selected cultural resources and may not fully represent the entire Kashmir's heritage. Challenges associated with access restrictions, ownership issues, and the absence of universally applicable metadata standards needs to be addressed for large-scale implementation. The study provides provisions for detailed assessment of important considerations and persistent issues concerning successful implementation of such efforts.*

Originality/value: *The study is an original effort towards preservation of cultural heritage items of Kashmir valley through the implementation of digital preservation technologies within a digital repository framework. It highlights practical approaches to digitization, metadata management, and interoperability that can support such implementations.*

Keywords: *Cultural Heritage; Heritage Preservation; Kashmir-Heritage; Cultural-Preservation; Digital-Heritage; Digital Preservation; Digital repository; Digital Curation.*

Introduction

According to the United Nations, Educational, Scientific and Cultural Organization (UNESCO), culture is "a set of distinctive spiritual, material, intellectual and emotional features of society or a social group that

encompasses, in addition to art and literature, lifestyles, ways of living together, values systems, traditions, and beliefs" (UNESCO, 2002, P.4). Cultural diversity reveals unique aspects and traits, marking the individual identities of different groups and societies. It is such an essential source of innovation, creativity, and exchange for humankind (Lamotte, 2002). Knowing, exploring, and nourishing cultural identity is crucial for fabricating historically significant events and developing prosperous nations. Therefore, safeguarding this Heritage is more significant mainly as an essential and valuable source of economy, thus involving society at large and primarily those individuals that bear such Heritage (Petronela, 2016).

Heritage plays a significant role in the community's development by attracting cultural industries and tourism to enhance learning and experiences about cultural Heritage through preservation and access to cultural items having emotional, intellectual, material, and spiritual significance (Ghirardello, 2022). Heritage preservation, as such, is deemed of utmost importance and has gained significant momentum throughout the world. The International Council on Monuments and Sites (ICOMOS) defines Cultural Heritage as "an expression of the ways of living developed by a community and passed on from generation to generation, including customs, practices, places, objects, artistic expression, and values and often expressed as either intangible or tangible cultural heritage" (Gorman, 2014). It includes rites, cultures, rituals, ceremonies, customs, beliefs, scientific and religious traditions, and arts and crafts (International Council on Monuments and Sites [ICOMOS], 2002, P.21). It thus also indicates a specific community's unique values and characteristics, depicting its historical richness and cultural diversity. Thus, there needs to be increased awareness about the importance of safeguarding both tangible and intangible Heritage for preserving traditional skills, knowledge, tools, and techniques for the long-term sustainability of cultural Heritage (Ghahramani et al., 2020).

Different global organisations focus on preserving cultural heritage in both tangible and intangible forms through identification, exploration, and preservation procedures. Preservation, access, and education about cultural Heritage are crucial to understanding people's evolution and culture (Drijfhout & de Boer, 2015). Cultural heritage, as such, is not only confined to monuments or objects but incorporates much more in the form of living expressions, oral traditions, social practices, knowledge and practices, and peculiar skills for producing traditional crafts (UNESCO, 2019). Cultural heritage preservation thus also plays a significant role in collecting and preserving the memory for the future (Nugroho & Hardilla, 2020). Therefore, efforts towards safeguarding this historically unique and valuable cultural diversity are in place for the successful implementation of heritage preservation initiatives. Mostly, the conservation of non-antiquities sites is taken at the local level. Efforts must clarify different aspects concerning

digital preservation, including storage standards, rights management, and creation of shared platforms and enriching digital content. The timely identification of threats to cultural heritage can help safeguard or revive efforts mainly focused on the conservation of local historical heritage items (Mekonnen, 2022).

Such initiatives become more critical when the risk factor involved in losing the heritage materials forever is much higher and calls for adequate and immediate safeguarding measures, especially in digital preservation programs (Kalusopa & Zulu, 2009). This scenario has led to well-coordinated and focused efforts using advanced digital preservation techniques and Information Communication (ICT) tools for the digitisation, description, and accessibility of cultural heritage items across the systems through successful initiatives like Europeana, Athena, etc. Besides, incorporating sustainable development in CH preservation emphasises adopting a more holistic approach (Oppio et al., 2021).

Despite the growing emphasis on the significance of digital preservation of cultural heritage through initiatives like Europeana, Athena Plus, Minnesota Digital Library, Online Archive of California, the Digital Public Library of America, Indira Gandhi National Centre for the Arts (IGNCA), etc., limited efforts have been reported towards the systematic identification, digitization, organization and long term preservation of cultural heritage resources of Kashmir valley like Intach Kashmir chapter, and few limited to the individual efforts confined to personal collections.

Existing literature primarily focus on documenting specific aspects of Kashmiri culture including geoheritage conservation and promotion (Irfan et al., 2025), folklore (Afridi et al., 2025), manuscripts (Lone et al., 2022), architecture (Paray, 2021), conservational practices (Sofi, 2025), oral traditions (Singh, 2022), Kashmiri cultural heritage under Hindu dynasties (Haq, 2019), and challenges (Dar, 2019), etc., without addressing the need for the development of an integrated digital repository capable of managing diverse cultural assets within a unified framework. However, there is a dearth of literature examining the metadata standards with a focus on user defined metadata sets, metadata crosswalks, interoperability requirements, and repository architecture suitable for preserving both tangible and intangible heritage resources of Kashmir. This study attempts to bridge this gap by proposing and implementing a framework for the development of a digital repository dedicated to the preservation and dissemination of Kashmir's cultural heritage.

Objectives

- To identify and document important tangible and intangible cultural heritage resources of Kashmir valley.

- To digitize selected cultural heritage resources with a focus on developing metadata frameworks for organizing and describing heterogeneous cultural heritage collections.
- To design and implement digital repository test beds using open-source digital library technologies.
- To identify challenges and opportunities associated with digital preservation and management of Kashmir's cultural heritage resources.

Digitisation in Cultural Heritage Preservation

Digitisation, as such, has now become an integral part of modern society. It is quickly being utilised in cultural heritage preservation using digital photogrammetry, 3D models, and allied methods driven by disruptive technologies to bridge the voids between cultural Heritage and tourism (Trcek, 2022). Such efforts are focused on digitising various types of cultural Heritage and provide provisions for carrying cross-collection searches across several cultural heritage repositories of participating members (data providers) using a single search interface. These collections are enriched with standard metadata describing the items at different modular levels, enhancing visibility. This increased visibility with the availability of enriched metadata associated with individual cultural items makes them harvestable by different harvesting systems and repositories, thus making accessibility smoother.

Cultural heritage, as such, is more than these creative works as it is a rich source of historical information (Lynch, 2002). Libraries and cultural archives are at the forefront of such preservation initiatives and frame different policies and guidelines for successful implementation. The major activities include identifying, collecting, enriching, and preserving these items in various formats. They also facilitate smooth access to these records by adopting defined procedures and policies and thus help express, share, and celebrate cultural heritage by organising various events and programs. Besides, they also train, educate, and equip community members with the skills required in creating and managing cultural Heritage (Roy, 2015). The Libraries, archives, and museums (LAMs) are collaborating for evolving strategies focused on the management of the physical as well as digital collections. These strategies mainly include initial investment and intervention strategies required to preserve digital resource value (Dempsey, 2000). The advancements in digital and open source technologies, coupled with the developments in digital libraries, have greatly simplified these efforts focused on facilitating information management and services (Zhen, 2010). These digital libraries comprehensively collect and host a variety of digital resources in various media types and offer varied services to their users using advanced technologies (Zhou, 2005). According to UNESCO, digital heritage "consists of unique human knowledge and expression

resources. It embraces cultural, educational, scientific, and administrative resources, as well as technical, legal, medical, and other kinds of information created digitally or converted into digital form from existing analogue resources"(UNESCO, 2003). The collaborative efforts at different levels in managing and hosting the digital heritage offer substantial benefits to the community regarding the range of available expertise and availability of shared ICT infrastructure and other tools for successfully implementing such projects (Hulse et al., 2007). These projects not only focus on preservation aspects but play a crucial role in minimising the cultural gap (Lee, 2010), as is evident in post-Soviet statehood, where cultural institutions are actively involved in the preservation and dissemination of cultural heritage information with a focus on indigenous ethnicity (Dowding, 2014). The critical concern is the protection of intangible cultural traits, especially inherent symbolism attached to unwritten or oral expressions, ideas, meanings, identity attributes, etc. (George, 2010).

Digital curation of heritage resources facilitate active management and preservation of these resources with a focus on accessibility, usability, authenticity and reusability. The widely adopted digital curation frameworks like Digital Curation Centre (DCC) lifecycle model includes activities such as conceptualization, creation, appraisal, preservation planning, storage, access, transformation, and reuse of digital assets (Lee, 2025) and the Open Archival Information System (OAIS) model ensures that digital records remain reliable, accessible and authentic over time, despite the rapidly changing technological landscape (Balogun, 2026). The adoption of FAIR principles ensures resources are Findable, Accessible, Interoperable, and Reusable and are relevant for heritage repositories with distributed resources across institutions primarily focusing on integrating through metadata interoperability (Nicholson et al., 2023).

The Kashmir valley has always been world-famous for its rich and unique historical culture, scenic beauty, and a place of attraction for great learners and thinkers. The facts that add to this uniqueness include its world-famed arts and crafts, architectural designs, monumental structures, and cultural traditions. Many artisans and learned men visited Kashmir from different parts of the world and settled there, especially during the reign of Sultan Zain-ul-Aabidin. These included many famous artisans from central Asia and Iran invited by the king to impart training to local men in their crafts (Hassnain & Chopra, 1992). The world-famed arts and crafts include rugs, paper machie, embroidery, wood carving, carpets, shawls and wicker works, etc., that showcase unique, attractive designs, functional utility, and high-quality craftsmanship (Department of Industry & Commerce, Jammu & Kashmir, 2021). Cultural diversity can also be seen in lifestyles and living patterns, including costumes and dressing patterns, folklore and music, customs, and traditions. This cultural heritage is on the verge of extinction if adequate steps

are not taken to safeguard this valuable fabrication of our present with the past. Therefore, efforts are in place to explore, identify, enrich and design proper procedures for safeguarding these assets and enabling accessible digital collections for broader visibility, sharing, and consultation. It is in this background the present work showcases the process undertaken to create digital testbeds for preserving and managing diverse collections of historical importance.

Different Phases in Preservation Process

The main focus of the work was to evolve a mechanism for preserving the cultural heritage of Kashmir valley through digitising various tangible and intangible cultural items, revealing the cultural diversity of the valley. Therefore, the survey method was adopted for exploring and identifying cultural heritage items scattered across the valley. A thorough literature survey also helped to identify and collect added information about various cultural assets. The work was carried out in a phased manner involving identification, documentation, and representation of varied forms of cultural heritage items in digital form.

Phase I: Since the scope of the work is broad and incorporates different types of heritage collections, the primary objective was to identify different heritage items and the available information from various sources. Therefore, different places, including the monuments, artisan clusters (designated locations for dominant traditional crafts and artisans), cultural institutions like J and K Cultural Academy, Craft development Institutes, museums, radio and television station libraries, college museums, shrines, graveyards, etc. were visited and surveyed for identifying and collecting relevant information about culturally essential items.

Phase II: After identifying appropriate cultural heritage collection items, the pertinent information was gathered through different available resources, including historical documents, conversations with reputed historians, and caretakers of monumental and historical sites. In the case of arts and crafts, short interviews were conducted with artisans and master craftsmen to document information about different stages of craft design and development. Similarly, for manuscripts, eminent manuscript scribes and orators with sound personal collections were consulted to reveal the authenticity, time period, authority, etc.

Musical scores available at television and radio station libraries were also identified and considered for traditional music collections, especially folklore. These collections were also incorporated into the digital repository, retaining the original format to ensure minimum data loss.

The stone inscriptions in different languages, mainly Arabic and Persian, from different historical periods were identified by visiting graveyards, shrines, and other monumental structures. The collection of ethnobotanical tools

available at the ethnobotanical museum in Srinagar was also considered and included in the heritage preservation. The collection also documented and incorporated the efforts to preserve the information about indigenous fruit and flower varieties available at Sheri Kashmir University of Science and Technology-Kashmir.

Phase III: High-resolution digital cameras, scanners, and audio/video recording equipment were employed for capturing best-resolution images, recording audio, and shooting onsite videos. The manuscripts were scanned using flatbed or handheld scanners to carryout digitisation procedures for creating full-text searchable PDFs. The deciphered information was collected by general observation, conversations with the owners or caretakers, and consulting other primary sources.

Phase IV: Based on the availability of varied forms of cultural heritage items, small testbeds were created for designing miniature digital collections of different elements, and appropriate metadata schemas were identified for the enrichment and representation of collections wherever available. However, in certain instances where proper representation using existing metadata schemas was impossible, user-defined metadata based on standard flexible metadata frameworks was created and used with provisions to facilitate interoperability through OAI-PMH compliance and metadata crosswalks with other widely used metadata standards.

Phase V: This phase was associated with identifying an appropriate Open Source solution for creating the mini digital library collections of heritage items. A comparative analysis of various open source digital library software was undertaken and Greenstone, was chosen for building and managing the collections using its various user-friendly features for gathering, enriching, customising, and distributing digital collections in different formats. The software also supports metadata harvesting through OAI-PMH, facilitating interoperability with other repositories and aggregators.

Phase VI: The last step focuses on customisation of the user interface for such collections to enable a cross-collection search based on successful interoperability procedures and metadata mappings.

The Progress So Far

The testbeds for managing different collections were created, and various aspects facilitated smooth searching and effortless browsing by creating adequate search indexes based on maximum metadata enrichment. Available plugins were considered for processing different types of files with varied formats. Greenstone, was used for building and managing collections, and the user interface was customised to incorporate the required functionality for browsing and search patterns simpler, more appealing and user-friendly. The repository testbed collections will help to act as a foundation stone for evolving a prototype digital archiving facility to host

cultural heritage items across different collection types irrespective of format, type or domain for enabling a standard facility for cross-collection browsing and searching.

Table 1 provides examples of different cultural items under various categories and the collection type depicting different formats included in the process.

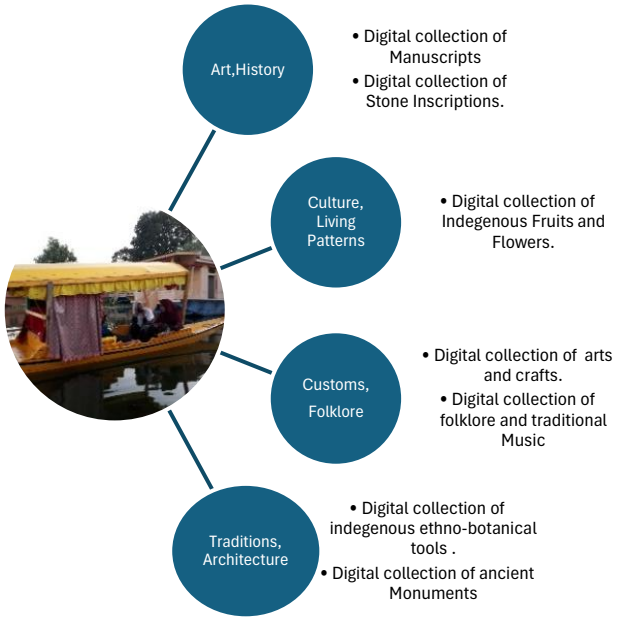
Table 1: Different types of selected cultural heritage Items

Category	Example	Collection Type
Art and Culture	Folklore, Indigenous songs in different genres.	Audiovisuals
	Biographies of artists and singers.	Pdfs
Tools and Techniques	Ethnobotanical Tools, Utensils. Etc.	Images / Audios / pdfs
Architecture and Art	Monuments, Shrines, Inscriptions	Images / Pdfs / Audios
Knowledge Assets	Manuscripts/Inscriptions/engravings	Images / Pdfs / Audios
Agriculture and Floriculture	Fruit and Flower varieties	Images / Pdfs
Arts and Crafts	Carpets, Paper Machie, Shawls, wicker works, etc.	Images / Pdfs / Audio Visuals
	Biographies of artisans	Pdfs
Special Collection	Marsia Manuscripts	Audios / Videos
	Biographies of Marcia Writers and Orators	Pdfs

Digital Curation Framework

The present work adopts a digital curation framework consists of six interrelated stages: identification, acquisition, digitization, metadata enrichment, preservation, and access. Cultural resources are first identified through surveys and stakeholder consultations. The selected resources are then digitized using appropriate technologies and enriched with adequate metadata to ensure long term preservation, sustainability and accessibility through the implementation of a centralized cultural heritage repository.

Fig. 1: An illustration of digitised collections of heritage items.



Issues and Challenges

Many challenges were faced during all these phases, and appropriate steps were taken to address them. The problems mainly faced were concerning access to the items, sites, and related information and the diversified nature of the heritage collections, besides other issues related to collection management in an online environment like the choice of appropriate digital library software, metadata formats, and customisation. Few most specific problems are discussed herein:

(a) Access to Different Types of Heritage Sites/Monuments

Many monumental sites deemed heritage sites are maintained and preserved by the Archeological Survey of India and are mostly restricted to the general public. The government has also secured and protected many monumental structures, and these sites are also inaccessible to the masses. Therefore, the most important consideration was to seek proper permissions from the concerned authorities for site visits, and data collection and efforts were put in to convince them through deliberations about the aims and goals of the project.

(b) Identification and Approaching the Master Artisans and Craftsmen

The identification of artisan clusters, particularly related to carpet weaving and paper-mâchié, was carried with utmost care to include the master artisans and craftsmen who have a reputation in particular art and have

gained a lot of fame over time. It was again an uphill task to convince them to share their expertise and knowledge by sparing their valuable time for interviews and documentation at their convenience.

(c) Issues in Building Ethno-Botanical Collections

Since prehistoric times, ethnobotanical tools have been predominantly used in Kashmiri society and have sharply disappeared with time. A personal ethnobotanical collection in the form of a museum maintained by a professor from one of the colleges of Kashmir valley includes some of the unique tools of cultural value. Efforts were put in to convince the college authorities, particularly the professor, to make the collection available for building its digital library. Similarly, other collections in the private capacity of different families or individuals are almost inaccessible as most are hesitant to provide access.

(d) Issues in Building Manuscript Collections

Rich manuscript collections in various languages are maintained in library archives and scattered across society as a part of personnel collections of different households. Many people feel reluctant to make their collections available for the said purpose, and convincing them as such becomes more challenging. Kashmiri Marsiya manuscripts are unique because the orators often use them to read in big gatherings by adopting different rhythms and stressing different words to make them more convincing. Therefore, besides digital copies of manuscripts, audio files of different marsiyas are also incorporated to preserve the natural way the traditional marsiyas are orated.

(e) Metadata Concerns

Assigning collection-specific metadata poses many challenges for digital curators, especially in choosing an appropriate metadata schema with a rich metadata element framework that could easily be mapped with other schemas for facilitating interoperability and, ultimately, cross-collection searching. In many collections, the standard metadata schemas or encoding systems were used, and in other instances, user-defined metadata based on an existing scheme was created and used for managing the collections.

(f) Copyright and Ethical Issues

One of the important challenges encountered during the study was the copyright and usage rights associated with varied cultural resources. Many manuscripts, oral traditions, folklore recordings, and personal collections are maintained by families, groups, religious institutions, or individual custodians, etc. This situation results in the absence of documented ownership records that often complicates the digitization and dissemination of these resources. Utmost care was taken to obtain informed consent from the stakeholders particularly from the collection owners before digitization to enforce a dissemination mechanism with access control using defined intellectual property rights policies to safeguard the interests of collection

holders and simultaneously ensuring broader access to these cultural assets.

Conclusion

Cultural Heritage, in tangible and intangible forms, depicts the uniqueness of a particular society and showcases its diversity. The Cultural heritage is inherited from a rich historical past and needs to be preserved through the best possible means for the benefit of future generations. Digital Preservation plays a pivotal role in the safeguarding of cultural Heritage by not only preserving heritage through digitisation but also through the application of allied procedures for managing, hosting, and distributing such collections. Cultural heritage preservation initiatives in modern times are deemed of utmost importance globally as we witness collaborative heritage projects like Europeana, Athena Plus, etc., hosting cultural heritage from across Europe. The present work along the same lines attempts to create a digital collection of cultural heritage items of Kashmir for facilitating collaborative efforts towards the long-term preservation of cultural collections. The digital repository will facilitate a single interface for searching and browsing articles by including cross-collection search and increased visibility through OAI-PMH compatibility. Many issues associated with the process will be addressed through consultation with different experts through open forums so that broader perspectives can be considered based on experience and real-time testing environments. The integrated access to varied resources will thus be facilitated through adequate metadata schema mapping for ensuring interoperability between different subsystems for facilitating federated searching. The future thrust areas may also include large-scale timely digitization of cultural assets, multilingual interfaces implementation, linked open data and artificial intelligence integration for automatic metadata generation, and 3D visualization technologies for monuments and artefacts. Collaboration with national and international cultural heritage networks can further enhance visibility, accessibility, and preservation of this rich cultural legacy.

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