

Digital Library Framework for Heritage Preservation

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Abstract.

The paper highlights the need for heritage preservation with the aim of proposing a Digital Heritage Library Framework whereby digitized heritage collection (pictures, audio, and video) will be archived digitally. The paper demonstrates the process flow in a heritage digital library creation. The findings of the study will help in realizing the enormously powerful vision of ‘anytime, anywhere’ access to the best and the latest of human thoughts and culture, so that no individual or a society is isolated from knowledge resources of their indigenous region. The workflow, if adopted and applied can bring back the heritage and culture of past on the digital canvas, in a sustainable digital platform, for the future generations to come.

Keywords: *Digital library; Collection management; Digital preservation; Heritage; Cloud computing.*

1. Introduction

Heritage is the legacy of physical artifacts and impalpable attributes of a group or society that are passed on from past generations, sustained in present and conferred on the future generations for their benefit.

Internationally, the scope of heritage is agreed to include ‘*tangible*’ (such as buildings, monuments, books, works of art, and artifacts), and ‘*intangible*’ such as folklore, traditions, language, and knowledge), as well as ‘*environments*’ (including culturally significant landscapes, and biodiversity), but the finer terminology of ‘*heritage*’ has not been streamlined or

standardised, and thus no uniformity exists between countries (**Ahmad, 2006**).

Preservation of cultural and historic heritage and its presentation is a major research area on which scholars and researchers over the globe are committed to and have been continuously working on. Preservation is an umbrella term under which most librarians and archivists cluster all the policies and options for action, including conservation treatments of different formats of information materials (**Kalusopa & Zulu, 2009**). Every generation from centuries has aimed at keeping records about its culture and labour so that it could be preserved and explored by future generations. The information and multimedia technologies of modern era have introduced new methods of preservation, maintenance and distribution of these huge amounts of collected material (**Paneva, Pavlova-Draganova & Draganov, 2005**). There are various conceptual and technically feasible solutions available, such as digitalization of cultural and historical artefacts and creation of multimedia information archives, and 3D virtual realities aiding the conservation, restoration, storing and presentation of cultural and historic artefacts which has given rise to the concept of “*digital heritage*”. Digital heritage believes in virtual accessibility of culture. Digital heritage “consists of unique resources of human knowledge and expression. 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 analog resources” as commented by UNESCO (**as cited in Kalusopa & Zulu, 2009**)

The proposed framework intends to present digitization as one of the ways of safeguarding the cultural heritage which will in turn provide an extension to already present initiatives of heritage preservation. Digitization involves transformation of analog information into digital format (**National Mission for Manuscripts, n.d**). The process of digitization presents a new technique of managing information resources in today’s modern age. In heritage preservation, digitization involves conversion of historic artifacts into digital format using devices like scanners, camera’s, mike etc, whereby the converted format will then be stored and disseminated over world wide web for public accessibility. Digitization will not and cannot replace analog artifacts. To convert physical heritage to digital form would be wrong-headed, even if we could do it (**Smith, 1999**). The idea is to make those analog heritage materials more accessible using the powerful tool of digital technology, not only through conversion, but also through digital finding aids and linked databases of search tools over the web. The framework will guide through the process to collect, store, and organize heritage artifacts in digital forms and make it available for searching, retrieval, and processing via communication networks, all in user-friendly ways. The information and communication technology has made possible to make information available

to people anywhere and at anytime. Digitization improves public access to cultural heritage materials and enables teaching and research. In this whole process the development of high-quality digital content is central in improving public access to cultural heritage information, as well as to promoting preservation and research. Archivists, librarians and museum professionals are among the many groups that are increasingly involved in creating digital resources to improve access and understanding to their collections of digitized objects.

2. Problem:

Preserving the heritage for future generations has been an issue of priority for many years. The responsibility for its conservation and dissemination is admitted everywhere. Many initiatives have been taken in this regard. This paper highlights Digital preservation as one of the many initiatives for preserving heritage.

3. Objective(s):

Heritage is our legacy, that informs us who we are and how our societies evolved. Its preservation and dissemination is our first priority. The paper highlights Digital Preservation as one of the initiatives for heritage preservation, thereby proposing a framework for digital heritage repository. The main aim of the framework is to aid in better understanding and creation of digital repository, and briefly describes the major process involved in its creation.

4. Scope:

By assessing the current and best practices for preservation of heritage wealth through the existing literature available in the area of heritage preservation, a digital framework is created.

5. Methodology:

The study uses previous literature as base for presenting a Digital Repository Framework for heritage preservation. The paper is designed to exemplify the workflow and tools used in creating a digital library for culture and heritage.

6. Review of literature:

6.1. Need for Digitisation:

The great part of cultural heritage consists of documentary heritage that preserves the intellectual memory of society and mankind. The documentary

heritage in the archives and libraries of the world are indispensable sources for many scholarly disciplines. They are also sources for more informal purposes: self-education, entertainment and general interest. No evaluation of politics, history, everyday life, music and performing arts would be possible without these documents (UNESCO, 2005). Every year a part of it is destroyed due to the natural ageing of materials: paper affected by acid and crumbling to dust becomes fragile photographic images lose their brightness, hand written texts become indecipherable, leather and parchment bindings are damaged (Reimo, 2006). The first and most urgent need is to ensure the preservation, using the most appropriate means, of documentary heritage of world significance and to promote that of the documentary heritage of national and regional importance. It is just as important to make this heritage accessible to as many people as possible, using the most appropriate technology, whether inside or outside the countries of its location UNESCO (as cited in Gorman, 2007). Access and preservation have been the driving forces behind the development of digitization projects (Lee, 2001). Mulrenin and Geser (as cited in Ekwelem, Okafor & Ukwoma, 2011) believe that the conversion into bits and bytes opens up a completely new dimension of reaching traditional and new audiences by providing access to cultural heritage resources in ways unimaginable a decade ago. As opined by Karim (2004) the immense appeal of digitization lies within its potential to facilitate greater access to all types of cultural heritage collections. It liberates the document from the constraints of traditional methods of access methods. Beyond access, digitization is advantageous in other areas. Digitization also facilitates preservation of precious materials. In many cases, high-resolution digital imaging projects enable the preservation of fragile original material, whilst enabling access to a wider audience (Jones, 2001; Spence, 2005; Fabunmi, Paris and Fabunmi, 2006; National Archives, 2008; Manaf & Ismail, 2010). Both preservation and increase in accessibility complement one another. Access incites protection and preservation ensures access. For example, digitized materials can be accessed by many people and demand for access can stimulate preservation work. (Abid, 2011).

6.2. Prominent Initiatives at International and National level: An Overview

Digital libraries and digitization are imperative for preserving and disseminating information and knowledge more effectively and ably. Cultural institutions at the local, regional, national and international levels now actively digitise the cultural and heritage resources in order to providing access, reflecting the history and culture of their respective countries, stabilise and protect those resources so that they will be permanent and durable besides being retrievable, readable and useable overtime (Britz & Lor, 2004; Manaf, 2007; Asogwa, 2011). Today's Library of Congress (LOC) is an unparalleled

world resource. The LOC has made digitized versions of collection materials available online since 1994, concentrating on its most rare collections such as, photographs, manuscripts, maps, sound recordings, motion pictures, books, historic newspapers and those unavailable anywhere else (**Library of congress, n.d**). The Library of Congress American Memory project launched in 1994 provides access to more than 9 million digitised treasures of the Library's collections that document America's history, culture, and creativity. It is organized into more than 100 thematic collections based on their original format, their subject matter, or who first created, assembled, or donated them to the Library (**Library of congress-American Memory, n.d**). Calisphere, one of the projects of California digital library provides public access to more than 200,000 primary sources such as photographs, documents, newspapers, political cartoons, works of art, transcribed oral histories, and other cultural artefacts. These resources reveal the diverse culture and history related to California (**California digital library, 2012**). Another well known digitisation initiative which was started in 2006 is Arizona Memory Project. It gives access to the wealth of primary sources in Arizona libraries, archives, museums and other cultural institutions. The collection includes government documents, photographs, maps, and objects that chronicle Arizona's past and present (**Arizona Memory Project, n.d**). Among the digitisation initiatives for cultural heritage, The World Digital Library (WDL) is worth mentioning. WDL - a cooperative project of the Library of Congress, the United Nations Educational Scientific and Cultural Organization (UNESCO), and partner libraries, archives, and educational and cultural institutions from the United States and around the world, brings together on single website vast cultural treasures and unique documents – books, journals, manuscripts, maps, prints and photographs, films, and sound recordings. Examples of treasures featured on the WDL include oracle bones and steles contributed by the National Library of China; Arabic scientific manuscripts from the National Library and Archives of Egypt; early photographs of Latin America from the National Library of Brazil; the famous 13th century “Devil’s Bible” from the National Library of Sweden; and works of Arabic, Persian, and Turkish calligraphy from the collections of the Library of Congress (**Abid, n.d; UNESCO, 2009**). Another best known example is Europeana, which gives quick and easy access to over 23 million digitized items such as books, paintings, films, museum objects and archival records from more than 2200 institutions from 33 countries (**Europeana, n.d**).

In India, a small number of libraries and information centers have initiated digitization projects in order to sustain and preserve their legacy for posterity. **Shafi (2007)** while enumerating key projects taken over in western countries and also initiatives in India finds that the western countries have taken a lead in starting digital initiatives to preserve the manuscripts, but such initiatives in India are either poorly organized or in primitive stage of development.

The National Mission for Manuscripts was established in February 2003, by the Ministry of Tourism and Culture, Government of India. The project seeks to unearth and preserve the vast manuscript wealth of India. The Mission started with digitization of 5 caches of manuscripts as a Pilot project. In the first phase of the pilot project approximately 39 lakh pages of manuscripts were selected for digitization. Out of these selected pages about 25 lakhs pages have been digitized. Furthermore, digitisation of around 60000 manuscripts has been completed under the second phase of the digitization project. Till now the digitization of 70,053 Manuscripts (93, 97,422 pages) has been completed (**National mission for manuscripts, n.d**). Famous for its varied collection of Persian, Arabic, Urdu and other language Manuscripts, The Khuda Baksh Oriental Public Library has initiated digitization of manuscripts in September 2005. The whole project has been undertaken by National Informatics Centre. 10, 00,000 pages covering 3000 manuscripts, have been digitized. At present, 1,214 manuscripts, covering a little over 3,57,915 folios have been completed for use by readers. However, the work of hosting these on the Library's website is in progress (**Khuda Baksh.. n.d**).

National Library of India has initiated a pilot project entitled "Down Memory Lane" to digitize its rare and brittle books in late 90's. English books and documents published before 1900 and Indian publications before 1920 are considered for digitization (**Varatharajan & Chandrashekara, 2007**). To date, 9140 selected books in Indian and English languages have been scanned—a total of over 3, 20,000 pages. Moreover, digitization of rich collection of manuscripts available in Arabic, Persian, Urdu, Bengali, English, Bengali, Tamil and Hindi languages has also been taken up by the library. (**National library of India, n.d**).

6.3. Digital Preservation:

Research over various dimensions of digital preservation has been carried out from time to time. **Strodl, Becker, Neumayer and Rauber (2007)** have discussed over previous strategies focusing more on different requirements and goals in the various preservation settings. A critical discourse on theorizing digital cultural heritage by the use of digital technology in safeguarding the cultural heritage has also been researched by **Cameron and Kenderdine (2007)**. The role of digital preservation has also been highlighted by **Ross (2007)**. An array of techniques used in digital preservation have also been researched by **Lee, Slattery, Lu, Tang and McCrary (2002)**. The National Science Foundation and DELOS, the European Commission sponsored Network for Digital Libraries, supported a working group to define a research agenda for digital archiving and preservation (DAP-WG) within the context of digital libraries. The report of this group, *Invest to Save*, has laid out a range of research challenges that need to be addressed if we are to make progress in the development of sustainable digital libraries (**Ross &**

Hedstrom, 2005). An extended digital framework to preserve the digital media has been researched by **Rauch and Rauber (2005)**. Problems faced in digital preservation and tools offering solutions to such problems have been highlighted by **Becker, Kulovits, Guttenbrunner, Strodl, Rauber and Hofman (2009)**. Challenges for the preservation of digital documents on standard formats has been elucidated by **Becker, Kolar, Küng and Rauber (2007)**. A service oriented architecture (SOA) based on Web services technology designed to assist cultural heritage institutions has been deciphered by **Ferreira, Baptista and Ramalho (2007)**. A framework for the long-term digital preservation of 3-D data has been presented by **Doyle, Viktor and Paquet (2009)**.

7. Framework Design:

Preservation of cultural heritage resources has gained momentum worldwide. Conservation and preservation of artifacts of historic and aesthetic value is now acknowledged everywhere (**Sax, 1990**). The documentary heritage needs to be made available and interpreted not to the few but to everyone. The duty to preserve is fundamental, but the duty to interpret is the ultimate objective and preservation management for libraries, archives and museums, is a step to achieve that (**as cited in Heidari & Sichani, n.d**). Individuals, institutions, archives, galleries, museums, libraries and nations have collected the cultural and natural heritage for thousands of years and each of them assumes the responsibility for its own holdings (**Liston, 1993**). However, the environment in which cultural heritage institutions operate has been radically changed by the associated phenomenon of information technologies, digitization, and the web. Digital technologies have opened new prospects for cultural institutions to carry out their traditional functions of preserving and providing access to their holdings, as well as to offer new services to their users (**Tariffi, Morganti & Segbert, 2004**) in the digital environment.

The framework for cultural heritage is an inception for securing and protecting the cultural wealth of nation. It will help to boost the already present initiatives of cultural heritage preservation and conservation.

To framework setup will initiate with the process of identifying and creating geographic scope of the heritage to be digitized. That will include the priority heritage artifacts. As the process continues, the scope will gradually increase depending upon the need. To ease out the process of creating geographic scope and choosing heritage artifacts for digitization, the classification of artifacts into types helps out. The heritage is broadly classified into three types:

- **Tangible Heritage:** Buildings, structures, monuments, precincts, areas/sites, artefacts, sculptures, paintings, handicrafts, manuscripts etc.
- **Intangible Heritage:** like music, dance, drama, performing arts, poetry, living traditions like crafts and cuisine, traditional knowledge systems, folklores, spiritual traditions like yoga and Sufism.
- **Natural heritage:** Like Ethnobotany etc

The setup will then move on to the process of selecting items for digitization. Selection of digital objects begins with identifying material for accessioning, assessing its long-term value, ensuring its completeness and authenticity, determining the most appropriate formats for acquisition, and considering the impacts of various preservation strategies, such as migration or emulation, on the longevity of the digital object (**Liston, 1993**). Organizational collection policies are also included in the selection process along with defining and coordinating responsibilities among key stakeholders. From the selected heritage content the artifacts will be collected. The collected artifacts will be collected in any of the three type's audio, video or picture. For example the calligraphic artifacts can be collected in pictorial form and that of folk songs and religious speeches can be collected in the form of audio/video. **Fig 1** shows different forms of a digital object that will be stored in for preservation. The object can be representative of traditional books, paper manuscripts, oral collection, and image/video collection of historic events; each preserved in the format that can best describe the artifact i.e. audio video or picture format.

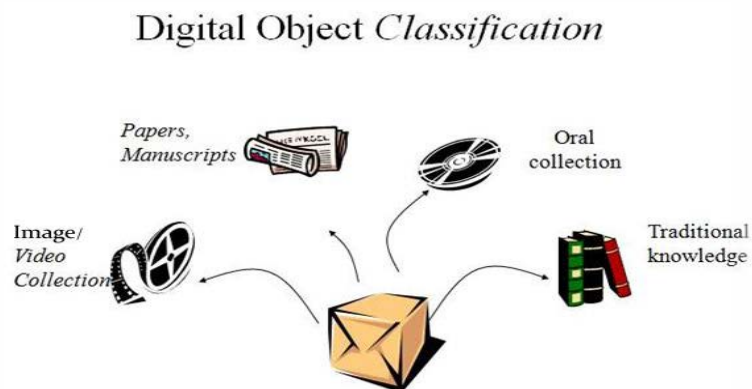


Fig 1

The digitized heritage artifacts will then be divided into respective collections. The collections will be explicitly designed as per defined collection policy of an organization/institution involved in digitization. The policy will be drafted as per economic, social, and legal aspect of the artifacts. Management of digital artifacts becomes easy because of division into collections. For example the collection, *Tangible* will have those digital objects defined in its category that may include picture, video or audio. Likewise, the community non-tangible will have digital objects of items defined in the category non-tangible. **Fig 2** presents the flowchart of processes involved in digital library creation.

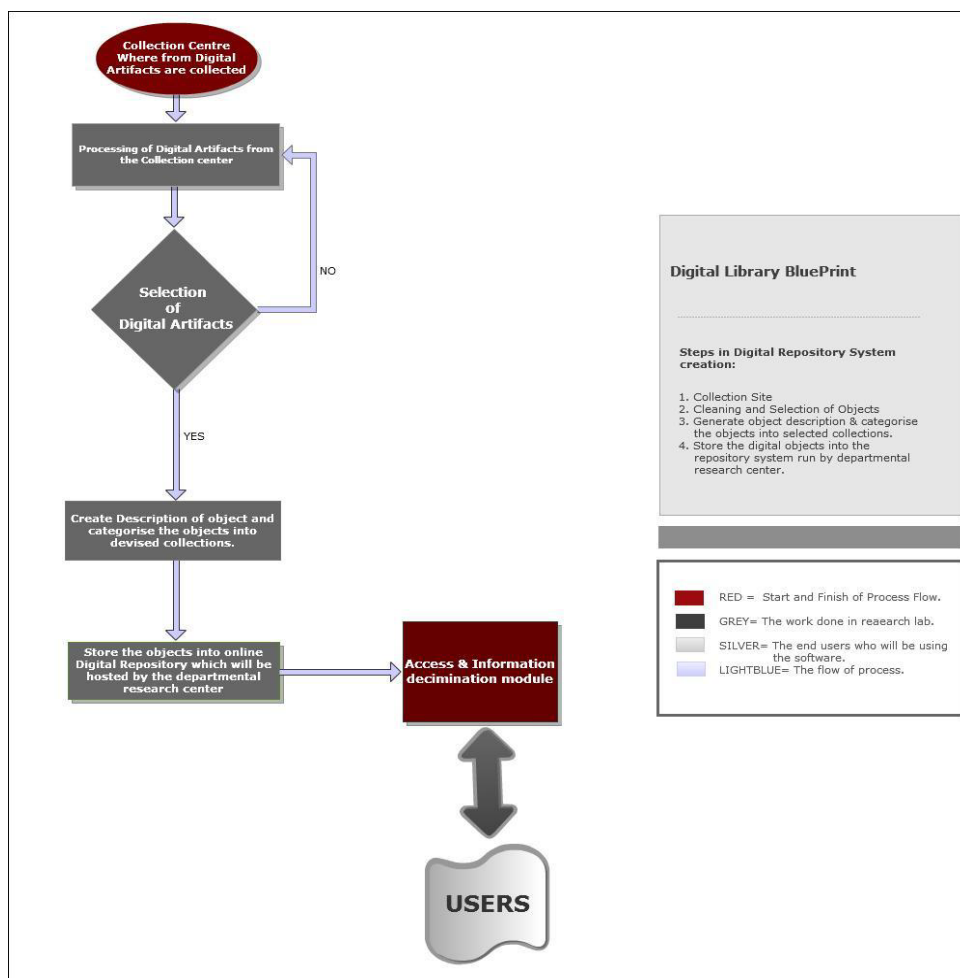


Fig 2

After the collection, the collected artifacts will undergo cleaning and other necessary processing. Process of cleaning and direct contact with the artifacts should be minimized in order to reduce damage to the artifacts. Cleaning will present a positive, clean image to visitors of digital heritage. After this the collected and processed digital artifacts have to pass through a selection procedure. The selection procedure may vary between different regions, although the main criteria for deciding what digital materials to keep would be their significance and lasting cultural, scientific, evidential or other value. “*Born digital*” materials should be given priority. Subsequent reviews and selection decisions need to be carried out in an accountable manner, and should be based on defined principles, policies, procedures and standards. This process will also include the concern of the authorities, who will decide whether the particular digital object is properly processed for storage or not. When the selection procedure will be over the selected digital object will undergo a process where they will be placed into particular designed collection and then their description (metadata) will be created which will facilitate their discovery. A successful description should satisfy needs of users, cataloguers and administrators. Thus it should be flexible, extensible and forward looking which allow easy searching and browsing by the user at different points of access to online collection. With the completion of above specified processes the objects will be ready to be injected into digital library management system for storage and dissemination purpose. The digital library management software will provide the access and dissemination module that will facilitate the process of widespread access and dissemination of stored digital objects.

For digital repository management system setup there are a number of management software’s available including the ones that belong to flagship of open source software. Some of top open source softwares available are DSpace, EPrints, and Greenstone etc. These softwares allow storage and dissemination of digital objects. Furthermore, they allow long term preservation. These softwares differ in some of their functionality but basic functionality is same, that of storing and disseminating. D Space is fairly powerful software as it is a choice of 874 open access repositories globally and 72 repositories in the field of Fine and Performing Arts make use of D Space for their content management (**Open DOAR, 2012**). The major advantage of D Space is that it allows submission of digital documents by its members. Presently the DSpace does not support Metadata Encoding and Transmission Standard (METS) (**Mandalli, Barve & Amin, 2012**). METS if implemented will add powerful feature to DSpace.

For open access, stored digital content must be easily shared between users and supported by consistent methods for discovery and interaction. It should also be managed using well-understood practices, and supported by services that can be re-combined to meet new user needs. There is need of

authoritative mechanisms for the identity of content, services, and users interacting within the information environment, as well as to manage intellectual property rights and privacy, and to secure the integrity and authenticity of content and services. The long-term future of digital resources must be assured, in order to protect investments in digital collections, and to ensure that the scholarly and cultural record is maintained in both its historical continuity and media diversity (Abdelaziz, n.d).

The layered architecture of proposed framework is shown in Fig 3. This architecture provides an overview of the modules of the digital repository framework used to access the digital objects. The architecture comprises of four layers. First being the interface layer, this layer provides a GUI to the users for accessing the digital repository over the web. It is an easy to use web interface provided by the digital library management software for accessing the repository. The interface is followed by a collection layer which contains list of stored digital items that will in turn be listed in the interface part to display the items over web to the users. The items in collection list will be linked to the items in the repository, where the actual items reside. The access to the repository is via a layer called gateway that provides protection and control for the repository. The gateway can be also be used to provide one route access to many repositories in a networked repositories scenario, where it will help in access control, synchronization and security of items. Layered approach is analogous to traditional museum or library set ups, where the people have access to the digital archive stored in the repository accessible via web.

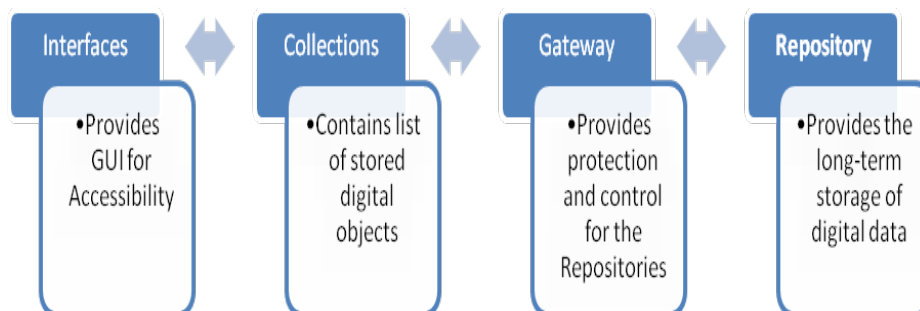


Fig 3

Future perspective of this framework will be to have multiple repositories networked to provide people access to a wide range of digital objects accessible via a single interface. The control and protection over access of the networked repositories will be provided by the gateway as

shown in **Fig 3**. In order to provide users to access information from a wide range of repositories, Open Archives Initiative (OAI) has developed a protocol for metadata harvesting which allows sites to programmatically retrieve or 'harvest' the metadata from several sources, and offer services using that metadata, such as indexing or linking services (**Open Archives Initiative, 2012**). Also to increase preservation, accessibility, and to mitigate the technology failure we can use cloud software as a service (SaaS). One such service is DuraCloud software platform developed by DuraSpace, a not-for-profit organization (**DURASPACE, 2012**). DuraCloud will help in providing easy access to the cloud infrastructure by providing data storage, data replication and services to support data preservation, data transformation, and data access (**Kimpton, Payette 2010**). With DuraCloud the organization/institution can send data to multiple cloud storage providers for storage to take the advantage of cost effective web based storage. In addition to the storage being provided by the underlying storage providers the DuraCloud adds value to them in terms of services from which users can choose e.g. replication, file format transformation, image viewing, video streaming and bit integrity. The services provided by DuraCloud are in particularly focused on providing preservation support, services and access services for academic libraries, academic research centers, and other cultural heritage organizations. With cloud services enabled, we can not only ensure long term storage ratio but also ensure long-term access and durability which in turn will allow unlocking the value of digital content stored in the cloud.

8. Conclusion

The proposed framework will provide an easy to use setup for digital preservation whereby artifacts will be digitized and stored for access and dissemination. Accordingly, access to digital heritage materials, especially those in the public domain, should be equitable and free of unreasonable restrictions. At the same time, the security of sensitive and personal information should be protected from any form of intrusion. Creating a digital heritage platform will ensure long term preservation and accessibility of heritage artifacts. The cultural digital assets will help in reflecting the foundation for the future of memory. The cloud service mentioned will not only help in storage and higher uptime for accessibility but will leverage other useful value-added services like replication, format transformation etc. The model will help to boost the already present initiatives of cultural heritage preservation and conservation. With this project we will not only be able to extend the preservation and conservation initiative of cultural heritage, but will be able to showcase our cultural heritage to the audiences around the globe.

Further, much research is to be carried for designing new techniques, including long terms support with new infrastructure designs, standards, metadata format transformation etc, in order to realize the opportunities and challenges for creating better digital libraries reflecting heritage and culture. The key research areas include intellectual property, economics, interoperability, global discovery, metadata and multilingual access. Future digital libraries will require integration of all sorts of components and aspects (software, methods, evaluation, content etc) that belong to different disciplines as well as different geographic origins.

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