

Introduction to Heritages and Heritage Management: A Preview



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Abstract This chapter introduces heritage as a concept that acts as a bridge between the past and the present and one that brings pride from the past to the present. Heritages are classified based on various criteria, such as tangible versus intangible, natural versus cultural, portable versus immovable, and domain specific, among others. The management of heritages is a multidisciplinary and multisectoral undertaking. Stakeholders ranging from historians to archeologists, governments, scientists, and international organizations are playing an active role in heritage management and preservation. Of these groups, the contribution of scientists is most visible, especially in the development of scientific approaches, computer-based techniques, and information and communications technology (ICT) tools and platforms employed in the management, processing, sharing, conservation, and preservation of heritages, particularly digital heritages (DH).

Keywords Heritage · Digital heritages (DH) · Information and communications technology (ICT) · United Nations Educational, Scientific and Cultural Organization (UNESCO)

1 Introduction

Heritage is something that has historical, scientific, political, religious, or cultural significance and is of importance to groups of people, communities, countries, institutions, organizations, or individuals. The heritage of these entities is valued and protected in every possible way, since they trace history and connect it to the present. Heritages differ from place to place, from culture to culture, or from country to country. They come in many forms and classes, ranging from historical manuscripts to books, physical structures, natural sites such as mountains, traditions, cultures,

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and art, among others. The origin of the present is traced in the richness of heritages across the globe, and they have economic and aesthetic values and spearhead sustainable development and innovation. Some heritages are irreplaceable once destroyed. Globally, heritages are agents of social and international cohesion and integration. They are remembrances of the past achievements of man [1].

2 Classification of Heritages

Heritages are classified based on the following criteria:

1. **Tangible and intangible heritages:** Heritages can be physical or nonphysical. Physical heritages include manuscripts, natural sites, artwork, and museums, among others. Intangible heritages are nonphysical, for example some forms of culture, such as cultural dance or language.
2. **Natural and cultural heritages:** Natural heritages exist without any human involvement. They include physical sites such as mountains, rivers, and vegetation. Cultural heritages are in existence through the active involvement of groups of people, societies, communities, institutions, and organizations. They reflect the way of life of those who created them and value them. Examples are structures, monuments, manuscripts, artwork, and books.
3. **Portable and unportable heritages:** Portable heritages can be moved from one place to another, for example manuscripts, letters, artwork, and historical items. Unportable or fixed heritages cannot be moved from place to place. They are explored where they are located. Examples include mountains, rivers, caves, and forests, among others, though with virtual heritage technology, such unportable heritages can be remotely/virtually viewed or toured.
4. **Domain-based heritages:** Heritages fall into various domain classes, such as art, science, politics, business, governance, religion, linguistic, security, sport, and culture.
5. **Heritage classification based on status or level:** Heritages are classified depending on the extent or level to which they are significantly recognized. The various level-based classes are global, national, regional, local, institutional, and personal heritages. Global heritages have the global features of cultural and natural value, such as the heritages listed by the United Nations Educational, Scientific and Cultural Organization (UNESCO) in the World Heritage List [2]. National heritages are recognized by respective countries only and have relatively less recognition compared to global heritages. Regional heritages are valued and recognized by some parts or regions of a country. Local heritages are recognized within a society or community. Institutional heritages are recognized and protected by institutions and organizations such as schools, colleges, industries, government departments and ministries, and companies, among others. Personal heritages are created, valued, recognized, and protected by individuals or families.

3 Mapping of World Heritages

All countries, communities, and organizations have heritages unique to them. Some are minor and localized while others are major and spectacular. Governments all over the world, through their respective ministries and departments, have put considerable efforts toward the conservation and promotion of heritages within their territories. Various nongovernmental and international organizations have joined in these efforts to recognize and conserve various heritages across the globe. Among other organizations, UNESCO is at the forefront in identifying and listing cultural and natural heritages around the world. This helps create global awareness of various heritages across the world. As of July 2020, there were 1121 heritages in the UNESCO World Heritage List divided into three categories: cultural (869), natural (213), and mixed (39). The heritages in the list are distributed among 167 countries. The leading countries with the highest number of listed heritage sites are China (55), Italy (55), Spain (48), Germany (46), France (45), India (38), Mexico (35), the UK (32), Russia (29), Iran (24), and the USA (24) [2]. For some time now, there have been multidisciplinary efforts from fields such as ICT, computer science, engineering, chemistry, physics, mathematics, and social sciences, which are geared toward the better management of heritages.

4 Digital Heritage

Digital heritages (DH) are resources acquired by information and communications technology (ICT) tools for the purpose of knowledge and information. Such heritages cover the areas of education, entertainment, culture, science, administration, politics, art, religion, agriculture, medicine, and security, among others. DH resources include texts, images, audio, software, databases, graphics, and artworks, among others. The main merit of DH is to move heritages from their physical and analogue form to electronic or digital form such that they can be easily managed, maintained, stored, accessed, and shared among stakeholders and end users. Heritage in physical form is obtained using ICT tools in analogue form and/or directly converted to digital form, as shown in the DH system in Fig. 1. DH can be further subjected to computer-based processing for better management and other usages. With advancement in ICT tools, it is now conveniently possible to remotely view, manage, and tour heritages without physically being there. DH has revolutionized the management of natural and cultural heritages.

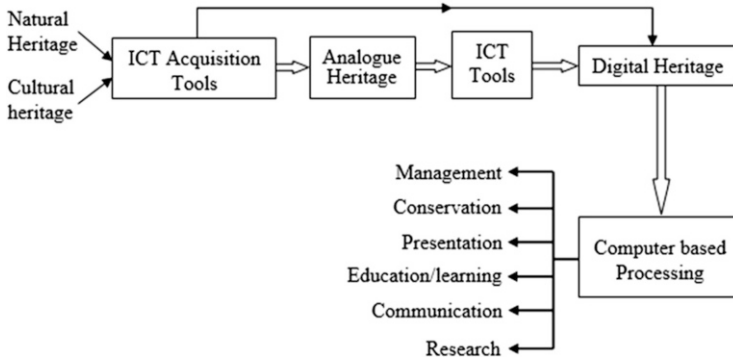


Fig. 1 Digital heritage system

5 Public, Classified, and Personal Digital Heritage

Public heritage is created by individuals, organizations, groups, and institutions and is accessible and used by the general public. Classified digital heritage is created by institutions or groups and is not accessed by the public. It is confidential and is only for official use, and access is granted to authorized people only. Examples of classified digital heritage are medical records, government records, and security systems' intelligence data. Personal digital heritage is created by individuals and is for personal use only, such as personal photos.

6 Science and Digital Heritages

Science and its subdisciplines have contributed significantly to the management of heritages of all forms such as analogue forms of heritage, DH, and physical heritage (natural or cultural). This multidisciplinary approach has significantly contributed to heritage management aspects such as acquisition, documentation, analysis, presentation, communication, and conservation. In acquisition and documentation of heritages, ICT methods such as photographing and manual taping are used. Other heritages such as architecture are preserved using engineering methods such as AutoCAD [3, 4].

7 Computer-Based Processing of Digital Heritage

1) *Digital Reconstruction (DR) of Digital Heritage*

Digital reconstruction is a computer vision task where the shape and appearance of an object are reproduced when information such as depth is supplied. The main

aim of DR is to preserve the original physical form, appearance, geometry, color, and texture of a heritage item that is damaged, lost, or interfered with in any way. DR also helps multiple end users avail DH conveniently through virtual museums and communication technologies such as the Internet. Some information on heritages such as dimensions, geometry, and texture is easier to obtain from the DR output [5].

Examples of where DR has been used to obtain a digital model of natural and cultural heritages are the digitization of statues by Michelangelo [6], the restoration of Buddha statues [7], a project by Rushmeier [8] in establishing virtual museums created from the DR of artifacts from ancient Egypt, and a project by Allen et al. [9] involving the creation of a digital model of the Cathedral of Saint-Pierre in Beauvais, France. In all these DR tasks, ICT tools such as depth sensors, laser scanners, and digital cameras have been used to obtain information to create 2D or 3D models of heritages.

2) *Image Processing and Computer Vision*

These areas are especially used in enhancement, noise filtering, recognition, and classification of heritages.

3) *Artificial Intelligence (AI)*

AI is mostly applied in heritages for enhancement, recognition, virtual reconstruction, classification, and clustering. In this book, AI methods have been specifically applied in heritage restoration, recognition, filtering, and enhancement.

4) *Virtual Heritage*

ICT tools in conjunction with concepts from other disciplines, such as psychology, engineering, computer science, chemistry, physics, and mathematics, have successfully enabled remote viewing and experiencing tangible and physical heritage without physically being where they actually are. Heritages are virtually viewed.

5) *ICT and Realities*

The reality of an environment can be represented in one of three domains: augmented reality (AR), virtual reality (VR), or mixed reality (MR).

(a) *Augmented Reality (AR)*

This is a technology-based enhancement of reality by superimposing on it additional digital content such as text, lines, graphics, and images so as to provide a better outlook, view, or understanding. In AR, computer-based processes such as computer vision, image processing, speech recognition, and object recognition are used to generate virtual digital information integrated with the real-world environment to give it a better look. An example of where AR is applied is during games (such as soccer or cricket) where game analyzers use AR to superimpose virtual lines on the pitch to better illustrate a point. In the medical field, AR is used to obtain a 3D view of body organs for deep studies and diagnostic tasks. In all these

AR tasks, viewing is done through helmet visors, AR glasses, computer screens, or smartphones with AR apps.

(b) *Virtual Reality (VR)*

This is a computer-based simulation of the real world. VR can be a complete animation of a real-world environment or images of the real world infused into a VR platform. With VR, one can interact with the world environment as if it were real, where the platform running the VR system responds to the user's actions, such as the movement of the eyes, head, and hands, and gives varying displays accordingly. This stimulates the body senses, especially the hearing and visual senses. VR gives a feeling of actually touring the site being virtually viewed via screens, smartphones, VR viewers, and other VR-viewing platforms. With VR, you can tour places you have never been to or places that are otherwise impossible or risky to tour, such as the inside of an active volcano, the surface of the sun, distant planets, and stars. VR is applied in the fields of exploratory science, astronomy, medicine, and virtual museums.

(c) *Mixed Reality (MR)*

This is a combination of the aspects of both AR and VR, that is, both real-world and computer-simulated virtual environment are integrated together.

8 Threats to Digital Heritage

As long as DH is far better than heritage in analogue form, it faces some dangers. Being supported and created by scientific technologies, DH is threatened by the rapid growth of new technologies, hardware, and software where there is incompatibility between old and new technologies. Another threat is concerned with the methods of maintenance and preservation, some of which are costly and need skills training before use. There is a lack of legislation regarding the management of DH, especially in the areas of cyber theft and crime [10]. Incompatibility between technologies hinders sharing and integration of DH. This is evident especially where DH created or acquired by one ICT tool may not be accessed or handled by another ICT tool if it is run by a different system. Issues of transparency and integrity impact virtual heritage, especially where a DH item, for some reason, is manipulated using modern technologies so as to look different from the actual physical item on the ground. There is a lack of standard formats and methods for heritage conservation. Various science scholars have different interests that bring disharmonious approaches to heritage management. Insufficient capacity-building for digital heritage preservation and lack of collaborative and mutual approaches in multidisciplinary-based heritage conservation often hinder the work of better heritage management.

9 Motivation for Digital Heritage

Digitization is a systematic and efficient scientific method for the management of cultural and natural heritages. As shown in Fig. 1, the digitization process involves conversion of the actual heritage to electronic form using ICT tools such as digital cameras, video cameras, and scanners. Electronic heritage can either be in analogue or digital form. Heritages in analogue form are converted to digital formats. The digital form of actual heritage is referred to as digital heritage (DH). A major advantage of DH is its easier heritage management, such as processing, retrieving, archiving, concurrent sharing by many people, digital reconstruction, virtual viewing, and contribution to research and education. The management of DH relies heavily on computer-based processing techniques such as digital reconstruction (DR), artificial intelligence (AI), and virtual heritage and computer-based representations of DH such as augmented reality (AR), virtual reality (VR), and mixed reality (MR), among others. Digital heritage management is a wide research area with many computer-based techniques. There is no single technique in any one domain of DH management that is universally suitable for all application areas. Various computer-based techniques and approaches are domain and application specific, that is, a technique suitable for one application may not be suitable for another. For example, a technique for 3D architectural reconstruction of monuments such as temples may not be suitable for a similar task with natural heritages such as rivers.

References

1. Sullivan, A.M.: Cultural heritage & new media: a future for the past. *J. Marshall Rev. Intell. Prop. Law.* **15**, 11 (2016)
2. UNESCO World Heritage. UNESCO World Heritage Centre-World Heritage List. <https://whc.unesco.org/en/list/>. Retrieved 6 July 2020
3. Fischer, A., Manor, A.: Utilizing image Processing Techniques for 3D reconstruction of laser-scanned data. *CIRP Ann. Manuf. Technol.* **48**(1), 99–102 (1999)
4. Fontana, R., Greco, M., Materazzi, M., Pampaloni, E., Pezzati, L., et al.: Three dimensional modelling of statues: the Minerva of Arezzo. *J. Cult. Herit.* **3**(4), 325–331 (2002)
5. Gomes, L., Bellon, O.R.P., Silva, L.: 3D reconstruction methods for digital preservation of cultural heritage: a survey. *Pattern Recog. Lett.* **50**, 3–14 (2014)
6. Levoy, M., Pulli, K., Curless, B., Rusinkiewicz, S., Koller, D., Pereira, L., Ginzton, M., Anderson, S., Davis, J., Ginsberg, J., Shade, J., Fulk, D.: The Digital Michelangelo Project: 3D scanning of large statues. In: *Proceedings of the Conference on Computer Graphics and Interactive, Techniques*, pp. 131–144 (2000)
7. Ikeuchi, K., Oishi, T., Takamatsu, J., Sagawa, R., Nakazawa, A., Kurazume, R., Nishino, K., Kamakura, M., Okamoto, Y.: The great Buddha project: digitally archiving, restoring, and analyzing cultural heritage objects. *J. Comput. Vision.* **75**(1), 189–208 (2007)
8. Rushmeier, H.: Eternal Egypt: experiences and research directions. In: *International Workshop on Recording, Modeling and Visualization of Cultural Heritage*, pp. 22–27 (2006)

9. Allen, P.K., Troccoli, A., Smith, B., Stamos, I., Murray, S.: The Beauvais Cathedral Project. Conference on Computer Vision and Pattern Recognition Workshop, IEEE. (2003). <https://doi.org/10.1109/CVPRW.2003.10004>
10. Charter on the Preservation of the Digital Heritage. 32nd session of the General Conference of UNESCO, 17 October 2003. <https://unesdoc.unesco.org/ark:/48223/pf0000179529.page=2>