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Promotion of Intangible Cultural Heritage in China during the Epidemic Using Modern Visual Technologies with Information Security

Xuanyi Wu

*Ph.D. Candidate, Faculty of Modern Languages and Communication, Selangor 43000, University Putra Malaysia
gs62261@student.upm.edu.my*

Megat Al Imran Yasints*

*Doctor, Faculty of Modern Languages and Communication, Selangor 43000, University Putra Malaysia
megat@upm.edu.my*

Karmilah Binti Abdullah

*Doctor, Faculty of Modern Languages and Communication, Selangor 43000, University Putra Malaysia
karmilah.abdullah@upm.edu.my*

Xiaoyu Jiang

*Ph.D. Candidate, Faculty of Modern Languages and Communication, Selangor 43000, University Putra Malaysia
GS61768@student.upm.edu.my*

Fan Zhao

*Ph.D. Candidate, Faculty of Humanities and Media, Pingxiang University, Jiangxi, 337055, China
fanceenz1211@gmail.com*

Article History	Abstract
<p>Received: 05 June 2023 Revised: 06 July 2023 Accepted: 01 August 2023</p>	<p>The transition from physical work to cyberspace has been happening in a very rampant phase in recent years, which has changed and transformed the notion of traditional physical museums into digital but more interactive museums. The worldwide shutdown due to the pandemic has led to the closure of museums and other cultural heritage artifacts. However, a major advantage that could be reaped from technological advancement is the protection and inheritance of age-old Intangible cultural heritage without disrupting its originality by deploying immersive technologies. This study proposes a holistic three-layered framework that considers the possible technologies, storage options, and user views without compromising information security. An overview of the widely deployed technologies is also presented in the work along with its potential usage. The work enumerates the popular technologies, software, and tools that can find their application in the establishment of digital museums. Finally, the work discusses the important challenges and limitations that should be confronted by the digitization of the elements of museums, which are the future research directions. These limitations are a blessing in disguise that can be convolved into the de facto design of the future digital museums to provide a more realistic and appealing experience to the visitors so that the ICH is preserved for generations.</p>

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Keywords: *Intangible Cultural Heritage, Information Security, Digital Museums, Virtual Museum, Virtual Reality, Augmented Reality, Mixed Reality, Holography*

1. Introduction

Digitalization of intangible cultural heritage is a major issue in the inheritance, protection, and development of the country's culture.[1] states that intangible cultural heritage plays a crucial role in fostering the diversity of national culture. It forms an indispensable pillar of the economy by fostering public access to varied cultural and heritage elements. This tightly couples the interaction between the public and the heritage. Cultural heritage acts as a bridge that connects the country's history and current life [2]. This houses economic, social, educational, and scientific value that forms the pride of a nation with a strong emotional connection with the people. They also sometimes bring about prosperity and economic development in a particular locale or region [3]. China has a rich cultural heritage from time immemorial [4], as the country has varied civilizations, with precious cultural heritage. The rural cultural heritage encompasses some tangible cultural elements like relics, local architecture, instruments, and tools while the intangible elements included as part of culture or folk arts, traditional dance and music forms, traditional skills, and clothes [5],[6]. These are seen as a reflection of local customs, lifestyles, and food and also record the agricultural history [7].

Understanding the cultural heritage is quintessential to appreciate the country's morals and other values. Despite these, the cultural elements are exploited by activities like industrialization, Land utilization, construction of cities, and urbanization which hinder the natural inheritance of these rich cultural elements [8]. Due to these activities, China has lost or abandoned the inheritance of culture which is an implication of decreased number of villages in China. Figure 1 shows the decline in the rural population between the years 2014-2021. A steady decrease is a warning sign for the authorities to take appropriate measures to preserve the culture.

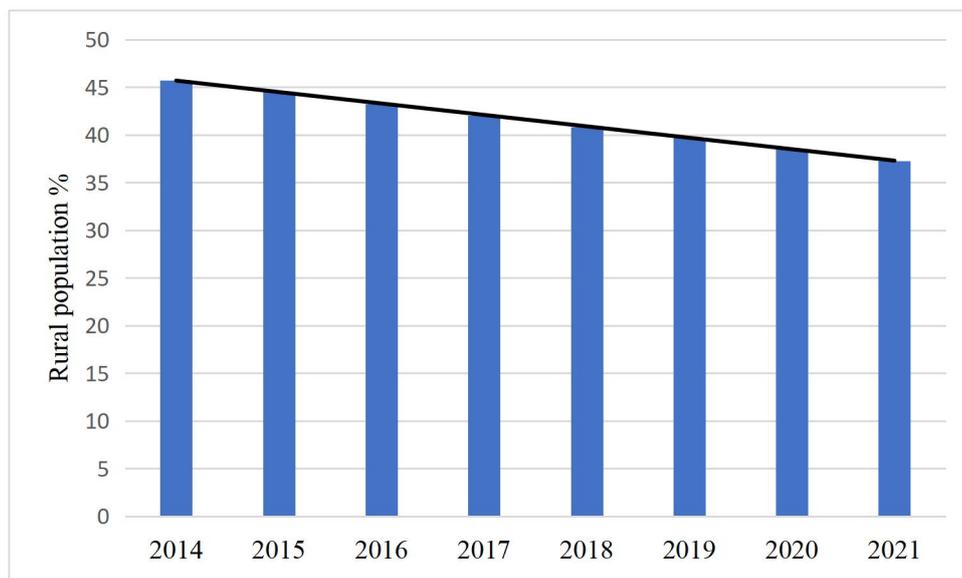


Figure 1. Decrease in the Rural Population of China

Protection of Intangible Cultural Heritage (ICH) focuses on establishing, researching, archiving, protecting, and promoting the elements pertaining to the culture. Preserving the ICH can be viewed from two perspectives: firstly, rescue and rehabilitation where the values are revived through proper planning, control, recovery, and response activities to conserve, preserve, restore, and even rehabilitate the resources post-disasters through best practices. This is done in accordance with incorporating heritage and environmental laws. Secondly, the development of ICH focuses on fostering and facilitating cultural activities, like art forms, to build a culturally vibrant society [9]. UNESCO's Convention was constituted in the year 2003 to protect the ICH in five domains namely (UNESCO's Convention, 2003):

- Expressions and oral traditions like storytelling
- Fine arts
- Rituals, Social practices, and other festive events
- Practices and knowledge pertaining to the universe and nature
- Traditional crafts and artistic structures

Figure 2 shows the share of various ICT in China.

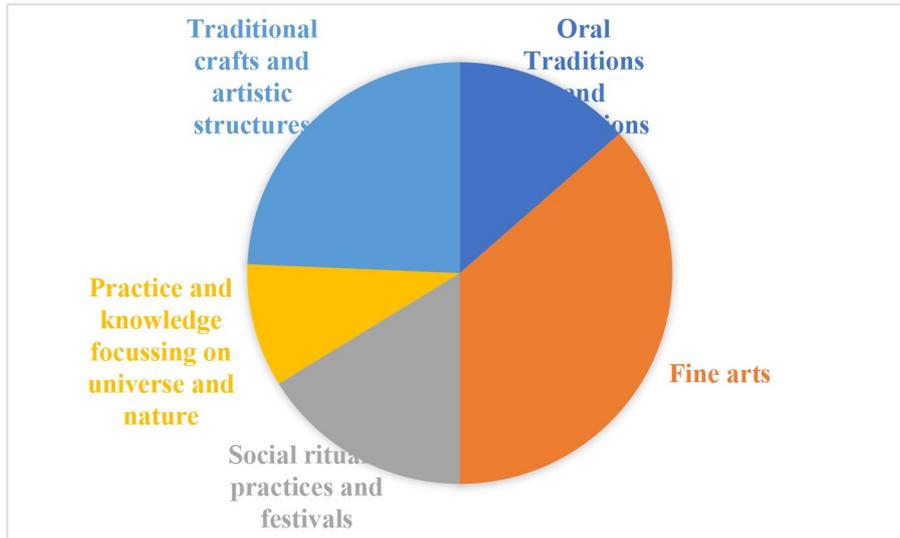


Figure 2. Various Forms of ICH in China

The deterioration of ICH is not confined only to China but is observed as a universal phenomenon. UNESCO in coordination with the UN World Food Programme is establishing a sequence of norms for protecting the ICH by promulgating the conventions [10]. A widely adopted strategy to preserve and promote the ICH is a win-win method, where the culturally rich elements are widely publicized and promoted either by attracting tourists or by establishing museums and monuments [11]. Figure 3 shows the increase in the number of museums in China.

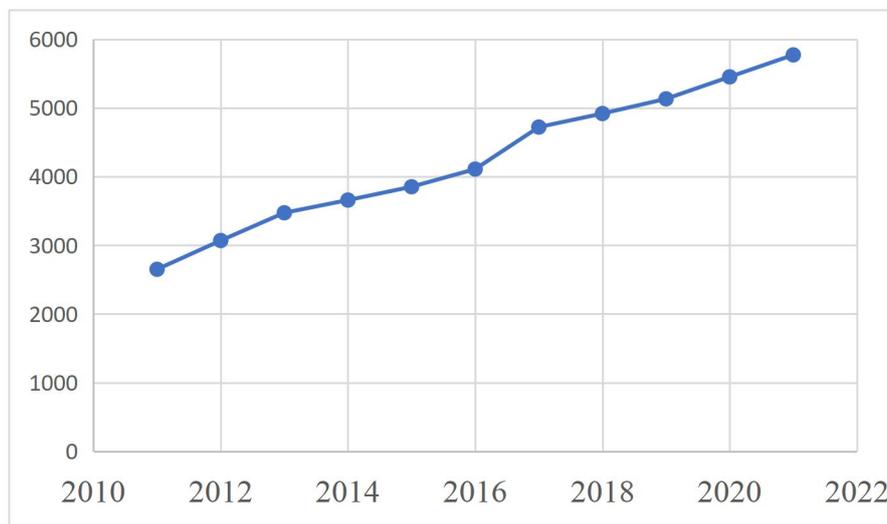


Figure 3. Increase in the Number of Museums in China

The government of China has inaugurated a series of Rural Museums Construction projects in order to protect as well as inherit the ICH. For example in the year 2013, a Rural Cultural Auditorium was launched in Zhejiang province by building cultural halls which portray the culture, etiquette, heritage, and also entertainment [12]. In the subsequent year, Shandong province opened a Rural Memory project that focuses on building museums, which serve as a comprehensive collection and exhibition of ICH of China with special mention to local characteristics like vernacular architecture, heritage, agricultural production methods, rural customs, and etiquette [13].

The conventional methods of establishing museums have some inevitable disadvantages. First, it is very tedious to preserve and conserve artifacts due to aging and natural degradation. Secondly, the construction of museums and maintaining them incur costs as physical space and provisioning of funding to the same is very difficult. Thirdly, it is difficult for tourists and common people to visit these museums from a long distance. Hence, building and maintaining traditional museums cannot satisfy the cross-regional cultural needs, communication, innovation, integration, and foster cultural exchange and inheritance. This necessitates supplementing the traditional methods by exploring contemporary virtual technologies. Figure 4 shows one of the cutting-edge virtual technologies adopted by China at Tongling, China.



Figure 4. A Virtual Exhibit of Bronze Statues at the Digital Museum of Copper and Bronzes, Tongling, China.

A Virtual Museum (VM) is a comprehensive digital entity that is in cyberspace by leveraging the computing technologies that inherit the characteristics of a traditional museum, that complement, augment, or enhance the human experience. The common technologies used in the establishment of VM are Human-Computer Interaction (HCI) and Virtual Reality (VR) [14]. These VMs can effectively portray the ICH without any loss with minimal maintenance and management costs [15]. As they do not have geographical boundaries like time and space they can have an increasing number of visitors as days go by [16]. Many rural Chinese villages have harnessed the influence of the technologies to establish VMs that portray rural culture, history, culture, and customs [17]. Despite these advancements, China is still in its stage of infancy in building VMs due to its early lag in socio-economic development and lack of effective frameworks that guide the establishment of VMs to inherit their cultural significance. This contrasts with the percentage of the Chinese population using mobile phones which reached a new peak of 1.57 billion in the year 2018 [18].

Present-day technologies foster many genres of Virtual and Digital museums. Some of the popular categories are shown in Figure 5. A brochure museum is a website with basic information and details about the museum including the types of artifacts, collection, contact details, historical lineage, etc. This serves the primary goal of informing and attracting visitors [19]. The content museum is also a website that displays the collections in an object-oriented way. This is immensely helpful for common people to effectively portray the elements and collections of museums [20]. A typical learning museum has multiple digital access points based on the profile and age of the visitors. The details are presented in a more context-oriented manner. This website is information-rich and is enhanced with loads of information so that it urges visitors to revisit [21].

The virtual museum: the next step from the learning museum is to provide not only information about the institution's collection but to link to the digital collections of others. In this way, digital

collections are created which have no counterparts in the real world. This is the implementation of André Malraux's vision of the "museum without walls".

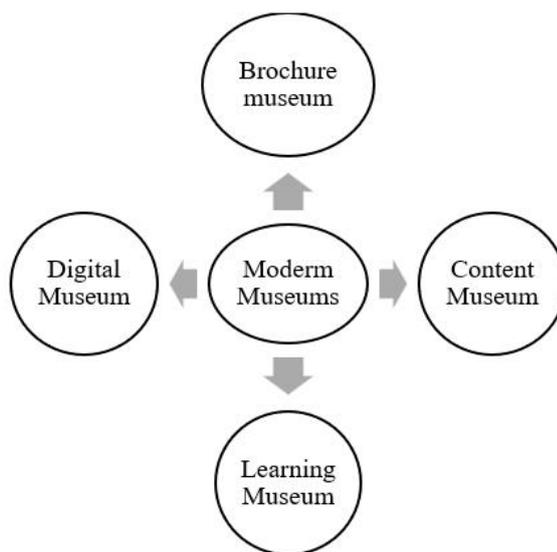


Figure 5. Type of Modern Museums

1.1 Notable Virtual Technologies Deployed to Relish the VMs

Modern ways to inherit and preserve ICT are greatly dependent on Virtual Reality Technology (VRT) along with Augmented Reality (AR). They have evolved a novel way to replenish the aging ICT through a variety of ways. Some of them are mentioned here:

3D dynamic display:

This model of ICH is constructed using VRT by simulation to render 1D, 2D and 3D models for the viewers, which is immensely helpful for researchers [22]. Augmenting to this, the 3D animation technology can be integrated with this, to display 3D models that attract the interest of the tourists. This method can be adopted for displaying and inheriting material heritage.

Digital museum:

The notion of conventional museums that conserve historical artifacts has changed after the advent of VRT. A wide range of technologies are used in the construction of digital museums ranging from graphics and texts to 3D virtual scene creations in museums supported by VRT. These technologies can even give a roaming feel inside museums, ancient relics, historical monuments, etc.

Virtual reality system:

These systems have enabled multimedia-based interactive roaming scenes by tapping the VRT, which gives a more realistic experience to the visitors of the museums [23]. This facilitates the visitors to make themselves very close to cultural heritage so that they can appreciate the historical, cultural, and artistic values of ICH. This method is more appropriate for the inheritance and protection of material ICH. This technology provisions people to experience role-play through games and be a part of the ancient culture.

Somatosensory Technology:

This is a fresh technology that controls the computer's operation by monitoring human body postures and movement of body parts arm movements, and movement trends [24]. This attracts people's interest and is very useful in acting as a simulation tool. This technology can be deployed to foster the inheritance of all genres of ICH. In particular, this technology can be integrated with VRT to construct a digital model of virtual museums so that users can easily learn, appreciate, understand, learn, and practice the age-old heritages through their body gestures. Augmenting to this, the classic characters, dance movements, and other gestures can be recreated using 3D animation.

3D printing:

By adding suitable material, the 3D model can be recreated with considerable precision and accuracy [25]. The so-constructed 3D model closely resembles the physical entity model which is created through software by means of stratified numerical and discrete controlled molding. This technology employs a laser beam, hot melt nozzle, and other components on the metal or ceramic powder which are then stacked and combined to produce solid objects. Thus, 3D printing technology is seen as a savior for the inheritance and protection of ICH.

Advantages of the technologies:

- The technologies enhance the visual effect with a greater degree of accuracy and preciseness.
- It is an easy way of propagating intangible cultural elements and artifacts to people across geographical barriers.
- These technologies are capable of rendering a realistic vision in a deeper manner.
- These technologies have higher storage capacity with better feasibility.
- They are easily comprehensible even for illiterate people.

Disadvantages of the technologies:

- Initial establishment is difficult.
- Cost of establishment is more.
- Demands more trained professionals for installing and using these technologies
- Incomplete implantation will hinder the overall objective.

Despite all these technological advancements, the number of digital museums is very low in China, which hinders the inheritance of the ICH. As mentioned earlier, the lack of a more channelized virtual framework is one of the major hurdles in the development and deployment of digital museums, which demands the integration and coordination of multiple technologies. This work proposes a secure holistic framework that guides the establishment of digital museums supported by contemporary computing technologies to aid the inheritance and protection of ICH in fast-developing countries like China without compromising information security.

2. Related Works

In the digital era with advanced web and computing technologies, more people are actively using cutting-edge technologies like advanced mobile phones and computers for faster access to resources for a variety of purposes. These adaptive technologies have transformed the traditional museums grounds into virtual spaces which is seen as a major breakthrough. This section highlights some of the prominent works that acquire special importance in establishing virtual and digital museums.

The possibilities offered by Immersive virtual technologies are extensively studied by Clini et al.. This work describes a clear workflow of digital documentation and interactive elements of ICH in virtual reality spaces [26]. Two case studies are also explored namely the National Archaeological Museum of Marche located at Ancona and the 3D reconstruction of the Roman Forum of Fanum Fortunae. Exploring the associations between information and objects in the context of both the virtual and real world is essential for the museum [27]. The work investigates the ICOM's perspective along with foundations about multimedia, the internet, and other technologies.

A detailed study of different types of virtual and digital museums gives a detailed insight into the usage of digital technologies [28]. A highlight of advantages and disadvantages with a comparison of traditional and contemporary technologies is also presented. This paper implements, investigates, and evaluates the results of the photogrammetric methods and 3D surveys that were used for the development of a virtual museum. The decisions, activities, methodology, and other elements for establishing digital and virtual museums must be analyzed [29]. The results of this would be fruitful for the future building of museums.

Yue Wu deployed a technology acceptance model that consists of quality and richness of information including system characteristics, research model, and users' behaviors towards the

construction of Digital Museums (DM) [30]. The results help to support the academic theories with practice and inspiration for all the stakeholders. There are three flavors in DM that coin communication, collaboration, and content [31]. This also discusses the semantics of the VM and its associated digital collections to know about the richness of ICH. The digital artifact permits intelligent navigation, concept-based discovery, and access.

The role of digital technologies in the main tasks such as collection, investigation, and mediating the object data is very important [32]. It is supported by the assumption that the objects in virtual space act as a medium to know the culture and heritage. The experience of the professionals working in museums should be analyzed to know the effectiveness of the technologies [33]. A comprehensive study on the experiences, practices, and perceptions about the implementation of VRT in museums with their potential advantages and limitations is done. The work contributes the perspectives of museum professionals across a number of countries with their views on the further development of DM.

Not all the elements can be digitalized. A proper understanding of what is to be converted to digital form from the cultural perspective and the strategic planning to accomplish this is very essential [34]. The work segments the present status quo into technology and strategy along with its transformation. Increasing innovations and VRT have created new forums for the establishment of these museums. The outcomes of co-creation pertaining to achieve the goals of designing futuristic DM are studied [35]. The research on the positioning of comprehensive virtual galleries and other digital collections plays an important role. The prototype unveils three design spaces of digital collections in DM namely individual or social, creation or consumption, and complementary or standalone.

DynaMus is a completely digital and innovative [36]. This connects multiple famous repositories, from Europeana and Google, to extract the content to establish a virtual exhibition. This also comes with a proper authoring interface, which is customizable. A study on content suggestions for establishing DM is done using reviews, surveys, case studies, in-depth interviews, and persona creation [37]. The responses were segregated into 'explorative persona' as well as 'entertaining persona' which shows potential future research direction to further improve the museums.

The establishment of VM of Spanish clothing dated from the 16th century in the digital format is done [38]. This work highlights the documentation, drawings, images, and pictures of clothing from the early days created by Marvelous Designer, a 3D modeling program. In addition to this, a complete 3D model of the exhibition hall was also created in the Unity videogame engine. The strategic governance of digital museums in cultural organizations, with more focus on social responsibility along with stakeholder engagement, is done [39]. Multiple case studies on the five digitalizations of Italian VM including documentary analysis with semi-structured interviews are done. Conduction of three virtual exhibitions based on the works Chronus, Woods, and Yu Minhong explored the visual discourse analysis that relies on semi-structured in-depth interviews [40].

Thus, the brief literature review on the establishment and methods of constructing the DM shows that VRT and 3D animations along with gaming studios play an important role. However, the survey indicates that there is a lack of concrete evidence and promising frameworks that will assist in further development of the DM. The existing works primarily focus on creating frameworks and architecture for VMs but not every work focuses on imparting security to the technologies used. As virtualization and digitization has led to uninterrupted access to all types of data, stringent security measure should be imposed which is not focused on the existing literature.

3. Methodology

Construction and establishment of VMs greatly rely on the internet cyberspace, computer technologies, and human-computer interaction. The proposed framework is a holistic collection of quintessential elements that operates in various layers namely the user layer, technologies layer, and Data storage and protection layer. This model or framework is primarily focused on the inheritance of the ICH with its protection for future generations by recording and recreating cultural artifacts through cutting-edge computer technologies. The VM design is a translation between virtual space and physical or concrete space. As the concrete space is unsustainable, culture transmission is done

through digital means by simulating and recreating the relics in ancient times, with imagination based on history, culture, history, anthropology, computer technologies, and geology. The digital ICH depends largely on the simulation technologies as well as on the image capturing and recording of the physical and cultural products to archive the digital characteristics. This digital development is embellished through the proper deployment of digital resources that focus on three main activities namely:

- Collecting, developing, acquiring, designing, and relevant souvenirs
- Developing the national and regional digital museum
- Creating and fostering a distinctive ethnic heritage and culture preserving sustainable ecological area

Great concern must be paid during the process of digitalization such that the right balance between technology and culture has been made. Neglection is easy culture, its inheritors and the owners will not serve the purpose of protection of ICH. Therefore, it is important to maintain a trade-off between culture and digitalization. As people always like to feel and participate, the display space must encompass all interactive elements like hearing, audio, vision, and feeling. VR, AR, and other technologies like computer images, super thin TV screens, big screen projection, touch screens, and robotized control technology, have helped the construction of DM with user satisfaction to experience the real situation.

The proposed framework strikes a proper balance between the protection and inheritance of ICH in a secure three-layered architecture as shown in Figure 6. The bottom layer includes a comprehensive collection of all the elements to be included in the ICH in its digital form augmented with security. The ICH elements are captured as images, recorded in video format, mixed with audio and some are even recreated to mimic the original ones. The comprehensive collection of elements includes digital collections pertaining to oral traditions, arts, traditional crafts, music celebration of festivals, artworks, dance, music, dress, agricultural tools, agricultural practices, fine arts, drawings, rituals, paintings, social practices, etc. These elements are actually depictions of traditional, contemporary living at or during the same period. In addition to this, these elements must be inclusive, representative, and community or region-based.

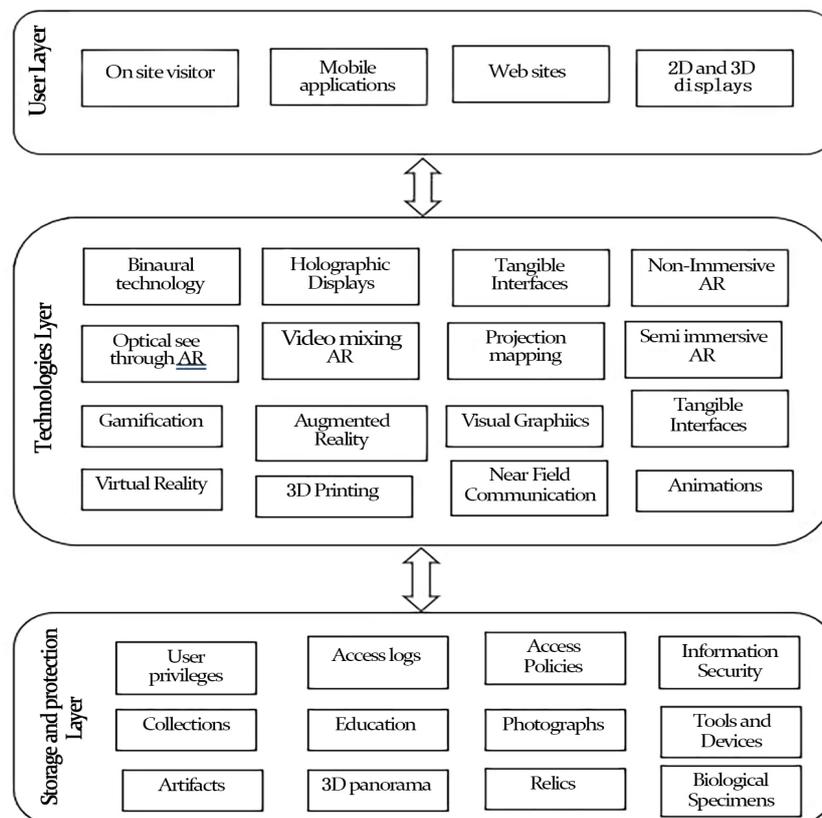


Figure 6. Collection Framework for Establishing Digital Museums for the Inheritance and Protection of ICH with Information Security

The data storage and protection layer also contain information security measures as ICH can easily be recreated, infringed, and copied from public display areas like VMs. So, it is important to consider every possibility to protect the transmission of ICH through access control policies and other information security elements [41]. It is quintessential to maintain the log of visitors and their access to different sections of the museums. The various information security measures that can be deployed are access control and configuring firewalls for adding various layers of security. Increasing the reliability of data and protecting them from infringement is done using redundant data storage. Alternatively, the sharing of data through communication channels can also be done using proper cryptographic tools and algorithms. The endpoint security also includes the physical protection of artifacts and other intangible resources of China. In case of any security breaches, China has a comprehensive IPR management system with copyright law, geographical indication system, trademark law, trade secret law, and patent law [42].

The technology layer houses all contemporary technologies pertaining to the field of computer science and communication technologies. A major part of the establishment and maintenance of DM relies on VRT that completely immerses and involves the visitors in a virtual environment with a very meager opportunity for physical interaction with the physical surroundings of the VM. Augmenting to this, the technology has great potential to simulate and recreate imaginary environments by hiding the real world and completely immersing the visitors into the virtual world through digital simulations.

Another technology that helps in constructing a more realistic VM is the Augmented Reality (AR) system that integrated virtual and real content, with interactive elements. It also supports the 3D views to improve visitor's perception of the presented physical environment by aggregating the digital content to the physical world, overlaying virtual features on real features with proper security measures like encryption and access control. In AR, the digital objects are overlaid in the physical or real-world environment without any control to manipulate the augmented objects. It renders the digital content into the real world.

Mixed Reality (MXR) is the next-generation technology that can be leveraged by DMs to blend the real environment with the virtual to a greater extent. From the perspective of ICH, this technology is seldom used, but it has greater potential to transform DMs. MR can recreate a virtual world where physical and virtual objects coexist.

Projection maps project the artifacts on ceilings, walls, floors, and other objects, which bring life into already existing surfaces with virtual content. The visitors can either visit them close by or view them from a far place in a magnified manner. Interactive Digital Art techniques can also be used to showcase or highlight the existing features within the historical monuments, buildings, and other structures related to ICH by illuminating appropriate structures. Entry to such arenas should be made possible only after leveraging the security mechanisms.

Binaural audio is another technology that is suitable to be deployed in VMs. It is a type of audio that is recorded in double channels to recreate and give impactful immersive sound. This technique attempts to replicate natural human hearing in a 3D effect [43]. Digital twin technology expands the horizons of object photography. This enables photogrammetry which is the process of capturing the photos as well as volumetric data simultaneously which facilitates the creation of a virtual model. This is greatly beneficial for the preservation of physical objects as they can be frozen in a moment to be included in a digital archive at the same time allow the visitors to manipulate the objects.

Hologram or hologram technology creates optical replication along with a demonstration of 3D images in the DMs. This is used for synthetic viewing of damaged or lost objects and other ICH. Another flavor of this is the holographic fan display that employs a rotating LED bar to render a floating effect to the object.

The last layer of the proposed framework is the user layer, which considers all possible usage scenarios of the VMs. The proposed model provisions not only the remote access of the museums but also explores the possibility of being viewed in person on site, through mobile applications, websites, etc. Augmenting to this, the objects and artifacts should be displayed in both 2D as well as 3D.

4. Results and Discussion

The development of Artificial Intelligence, Machine Learning, AR, VR, and other contemporary technologies has facilitated automation to aid humankind in almost all fields [44], [45]. Establishments of digital museums have also got benefitted by deploying the tools to leverage the effect of recreating ICH. Some of the popular tools are summarized in Table 1.

Table 1. Computing Tools used in Digital Museums

Tool/ Software	Description
PHP/ HTML/ XHTML	To create dynamic web pages with interactive elements
Unity	Game development platform to create a more interactive, digital environment
Omeka	Free and open-source web publishing tool for creating online digital ICH archives with both Web interfaces supported by back-end cataloging.
Panorama2Flash	Specialized panorama stitching software to incorporate the batch publish panoramic pictures into the Flash panoramas
AutoDesk 3ds Mask	3D rendering and modeling software
Aliyum	Cloud storage provider

Digital museums have indeed possessed several advantages like visitors' engagement with collections, attraction, better accessibility, education, intensive immersion, customized experiences, and technological advancements. Despite these advantages, the DMs also, face a few limitations and challenges. The major ones are listed here:

- Lack or minimal social interaction
- Proper training, education, awareness, and staffing
- Installation, staffing, and maintenance costs
- Accessibility issues
- Information security and privacy issues
- Glitches in technical elements
- Quality and resolution of imaging as the field is constantly evolving at very rapid rates
- Display and exhibition flow
- Acceptance of technology

The usage of AR and VR headsets creates insulation from the peer community hindering constructive discussions from the educational perspective. Also, communicative interference because of the overuse of technology must be considered. Trained staff with good knowledge about the technologies will boost the effect of the DMs, as they can handle the visitors and operational challenges in a professional way. The budgetary requirements of the DMs are very high. To combat this, many museums generally collaborate with third-party companies to sponsor the equipment. Hygiene issues in museums have increased after the pandemic. Proper sanitation and cleaning of the equipment has become an essential task due to the large number of users every day.

Overheating and Battery life for portable devices along with cable tethering is a major issue to be confronted in small and medium-sized museums [46]. In addition to this, the aesthetics and graphics quality is also a major concern in the case of rendering 3D photography, holography, and panoramic images. Most museums fail to incorporate access control methods, which may lead to improper and illegitimate use and recreation of ICH.

5. Conclusion and Future Work

The integration of technology in protecting and inheriting elements involving traditional legacy must be designed on par with the mission and strategies not to meet the design and business plans.

The constitution of digital museums with contemporary technologies is one such area, where the ICH is passed on between generations. The present work proposes a three-layered comprehensive collection framework specifically designed to establish digital museums with appropriate information security measures. The storage and protection layer provisions the maintenance of user logs along with access control policies. The technological layer encompasses a range of technologies that add aesthetic appeal to the museum without compromising the mission of ICH. These interactive and immersive technologies attract visitors and prevent the ICH from aging and fading away. The work also enumerated some of the widely adopted software tools and technologies in digital museums. The primary contribution of this framework is the inclusion of security aspects, which imparts comprehensive protection to the artifacts of virtual museums. A very brief discussion is made on limitations of the virtual museums, which will attract future researchers to make design changes in the technology. On the whole, the study focuses on the development of a digital framework for establishing virtual museums that should always adhere to:

- Integration and blending of the mission of the museum and the technologies.
- Deploy appropriate technology.
- The technologies should not disrupt the originality or the ambiance of the museum.
- Strike a balance between overuse and appropriate use.
- Consider the communication disruptions.

References

- [1] S. S.Zhang, and C. J.Wu, "Revitalizing endangered traditions: innovative approaches to safeguarding Yunnan's ethnic minority music as intangible cultural heritage," *Herança*, vol. 6, no. 1, pp.115-142, 2023.
- [2] F.Cominell, and X.Greffe, "Intangible cultural heritage: Safeguarding for creativity," *City, Culture and Society*, vol. 3, pp. 245-250, 2021.
- [3] R.Matthews, Q.H.Rasheed, M.Palmero Fernández, S.Fobbe, K.Nováček, R.Mohammed-Amin, S.Mühl, and A.Richardson, "Heritage and cultural healing: Iraq in a post-Daesh era," *International Journal of Heritage Studies*, vol. 26, no. 2, pp.120-141, 2020.
- [4] N.Y.Han, Z.Zhang, and S.M.Wang, "A prospective study on the mode of media applications of agricultural heritages communication," *Agricultural history of China*, vol. 3, pp.132-142, 2016.
- [5] Y.Cao and G.C.Zhou, "The protection challenges and inheritance strategy of the local culture in the process of urbanization plight inheritance strategy," *Modern Urban Research*, vol. 6, pp.31-34, 2013.
- [6] M.Li, and S.M.Wang, "Agro-cultural heritage: What is protected and how to protect," *Agricultural History of China*, vol. 2, pp.119-129, 2012.
- [7] Y.Zhou, D.Jiang, D.Ding, Y.Wu, J.Wei, L.Kong, T.Long, T.Fan, and S.Deng, "Ecological-health risks assessment and source apportionment of heavy metals in agricultural soils around a super-sized lead-zinc smelter with a long production history, in China," *Environmental Pollution*, vol. 307, p.119487, 2022.
- [8] P.J.Richerson and R.Boyd, "Cultural inheritance and evolutionary ecology," *In Evolutionary ecology and human behavior*, pp. 61-92, 2017.
- [9] K.Yan and S.Li, "Research on Digital Protection of Intangible Cultural Heritage Based on Digital Implantation," *In SHS Web of Conferences* , vol. 158, 2023.
- [10]A.B.Fromm, "Ethnographic museums and Intangible Cultural Heritage return to our roots," *Journal of Marine and Island Cultures*, vol. 5, no. 2, pp.89-94, 2016.
- [11]T.Ying and Y.Zhou, "Community, governments and external capitals in China's rural cultural tourism: A comparative study of two adjacent villages," *Tourism management*, vol 28, pp.96-107, 2007.
- [12]S.Zhang and S.Wu, "Evaluation of Digital Rural Development from the Perspective of Rural Revitalization—Take Zhejiang Province as an Example," *Strategic Planning for Energy and the Environment*, pp. 121-144, 2021.

- [13] C.Su, and Y.Liu, "A study on the Protection of Rural Characteristic Landscape in Northeast China—Taking Dagushan Town as an example," *2018 International Conference on Educational Research, Economics, Management and Social Sciences*, 2018.
- [14] E.Huhtamo, "On the origins of the virtual museum. In Museums in a digital age," *Museums in a Digital Age*, pp. 134-148. 2013.
- [15] S.Styliani, L.Fotis, K.Kostas, and P.Petros, "Virtual museums, a survey and some issues for consideration," *Journal of Cultural Heritage*, vol. 10, pp. 520-528, 2009.
- [16] J.M.Griffiths, W.K.Donald, "The IMLS National Study on the Use of Libraries, Museums and the Internet-Conclusions," 2008
- [17] J. Xie, "Innovative Design of Artificial Intelligence in Intangible Cultural Heritage," *Scientific Programming*, pp. 1-8, 2022.
- [18] V. C. Gungor et al., "Smart Grid Technologies: Communication Technologies and Standards," *IEEE Transactions on Industrial Informatics*, vol. 7, no. 4, pp. 529-539, Nov. 2011
- [19] A.Dolgireva, T.Balina, and A.Levitskaya, "Multimedia Brochure Taganrog—the Cultural Capital of the Don (Virtual Open-air Museum) as the Implementation of a Media Educational Project in Museum Pedagogy," *International Journal of Media and Information Literacy*, vol. 7, no. 1, pp.48-59, 2022.
- [20] His, "The Electronic Guidebook: A study of user experiences using mobile web content in a museum setting," *IEEE International Workshop on Wireless and Mobile Technologies in Education*, pp. 48-54, 2002.
- [21] T.Seligmann, "Learning museum: A meeting place for pre-service teachers and museums," *Journal of Museum Education*, vol. 39, no.1, pp.42-53, 2014.
- [22] D.A.L.Carvajal, M.M.Morita, and G.M.Bilmes, "Virtual museums. Captured reality and 3D modeling," *Journal of Cultural Heritage*, vol. 45, pp.234-239, 2020.
- [23] G.Margetis, K.C.Apostolakis, S.Ntoa, G.Papagiannakis, and C.Stephanidis, "X-reality museums: unifying the virtual and real world towards realistic virtual museums," *Applied Sciences*, vol. 11, no. 1, pp. 338, 2020.
- [24] Y.Chen, and X.Luo, "Design of digital campus somatosensory interactive system based on unity3D and VR technology," *In Journal of Physics: Conference Series* , vol. 1345, no. 6, p. 062015, 2019. IOP Publishing.
- [25] V.Arribas, and J.A.Alfaro, "3D technology in fashion: from concept to consumer," *Journal of Fashion Marketing and Management: An International Journal*, vol. 22, no. 2, pp.240-251, 2018.
- [26] P.Clini, L.Ruggeri, R.Angeloni, and M.Sasso, "Interactive immersive virtualmuseum: Digital documentation for virtual interaction," *The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences*, vol. 42, pp.251-257, 2018.
- [27] W.Schweibenz, "The virtual museum: an overview of its origins, concepts, and terminology," *The Museum Review*, vol. 4, no. 1, pp.1-29, 2019.
- [28] S.Styliani, L.Fotis, K.Kostas, and P.Petros, "Virtual museums, a survey and some issues for consideration," *Journal of cultural Heritage*, vol. 10, no. 4, pp.520-528, 2009.
- [29] M.Skamantzari, "3D Visualization for virtual museum development," *The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences*, vol 41, pp. 961-968, 2016
- [30] Y.Wu, Q.Jiang, H.E.Liang, and S.Ni, "What drives users to adopt a digital museum? A case of virtual exhibition hall of National Costume Museum," *SAGE Open*, vol. 12, no. 1, p.21582440221082105, 2022.
- [31] G.Geser and F.Niccolucci, "Virtual museums, digital reference collections and e-science environments," *Uncommon culture*, pp.12-37, 2012.
- [32] W.Schweibenz, "The "Virtual Museum": New Perspectives For Museums to Present Objects and Information Using the Internet as a Knowledge Base and Communication System," *Isi*, vol. 34, pp.185-200, 1998.
- [33] M.Shehade, and T.Stylianou-Lambert, "Virtual reality in museums: Exploring the experiences of museum professionals," *Applied sciences*, vol. 10, no. 11, p.4031, 2020.

- [34] V.Kamariotou, M.Kamariotou, and F.Kitsios, "Strategic planning for virtual exhibitions and visitors' experience: A multidisciplinary approach for museums in the digital age," *Digital Applications in Archaeology and Cultural Heritage*, vol. 21, p.e00183, 2021.
- [35] C.Morse, C.Lallemand, L.Wieneke, and V.Koenig, "Virtual masterpieces: Innovation through public co-creation for digital museum collections," *International Journal of the Inclusive Museum*, vol. 15, no. 1, pp.65-83, 2021.
- [36] C.Kiourt, A.Koutsoudis, and G.Pavlidis, "DynaMus: A fully dynamic 3D virtual museum framework," *Journal of Cultural Heritage*, vol. 22, pp.984-991, 2016.
- [37] H.K.Lee, S.Park, and Y.Lee, "A proposal of virtual museum metaverse content for the MZ generation," *Digital creativity*, vol. 33, no. 2, pp.79-95, 2022.
- [38] C.Meier, I.S.Berriel, and F.P.Nava, "Creation of a virtual museum for the dissemination of 3D models of historical clothing," *Sustainability*, vol. 13, no. 22, p.12581, 2021.
- [39] P.Esposito, A.Braga, A.Sancino, and P.Ricci, "The strategic governance of the digital accounting environment: insights from virtual museums," *Meditari Accountancy Research*, vol. 31, no. 2, pp.366-380, 2021.
- [40] J.Snels, "Virtual connectedness in times of crisis: Chinese online art exhibitions during the COVID-19 pandemic," *World Art*, vol. 12, no. 1, pp.95-118, 2022.
- [41] D.Vekariya, M.J.Kannan, S.Gupta, P.Muthusamy, R.Mahajan, and A.K.Pandey, "Analysis of Computer Network Security Storage System Based on Cloud Computing Environment," *International Journal of Communication Networks and Information Security*, vol. 14, no. 2, pp.33-52, 2022.
- [42] Q.Lin and Z.Lian, "On protection of intangible cultural heritage in China from the intellectual property rights perspective," *Sustainability*, vol 10, no. 2, pp.4369, 2018
- [43] X.Xu, H.Zhou, Z.Liu, B.Dai, X.Wang and D.Lin, "Visually informed binaural audio generation without binaural audios," *In Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition*, pp. 15485-15494, 2021.
- [44] S.Sharanya, Revathi Venkataraman and G.Murali, "Estimation of remaining useful life of bearings using reduced affinity propagated clustering," *Journal of Engineering Science and Technology*, vol. 16, no. 5, pp.3737-3756, 2021.
- [45] J.L.M.Carhuancho, J.J.Vertiz-Osores, M.A.Cueva-Rios, D.Fuster-Guillen, Y.Ocaña-Fernández, and Z.M.C.Inga, "Machine Learning Algorithms for High Performance Modelling in Health Monitoring System Based on 5G Networks," *International Journal of Communication Networks and Information Security*, vol. 14, no. 3, pp.330-341, 2022.
- [46] N.Gupta, S.Janani, R.Dilip, R.Hosur, A.Chaturvedi, and A.Gupta, "Wearable Sensors for Evaluation Over Smart Home Using Sequential Minimization Optimization-based Random Forest," *International Journal of Communication Networks and Information Security*, vol. 14, no. 2, pp.179-188, 2022.