

Virtualization of Digitalized Cultural Assets to Promote Sustainable Heritage Tourism in Malaysia

Hajiedah Fauzi¹, Harlina Md Sharif²), Rajabi Abdul Razak³)

^{1, 2) 3)} Department of Applied Arts and Design, Kulliyah of Architecture & Environmental Design, International Islamic University Malaysia, Gombak, Malaysia

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Corresponding author:
Hajiedah Fauzi
hajiedahfauzi@gmail.com



Abstract – A key policy goal for every nation is to ensure that their rich cultural treasures are preserved for future generations to enjoy and be inspired. In this regard, the virtualization of digitalized cultural assets has the potential to make heritage experienced in a new and unique way. However, as the guardian of the nation's cultural assets, the museum sector in Malaysia was caught unprepared when it experienced a 70 percent dip in the attendance of visitors during the pandemic due to its inability to capitalize on technology and reach out to local and international visitors. Thus, the study's primary objective is to assess the technology readiness level in Malaysian museums in adopting virtual heritage technologies. However, this paper explicitly discusses the challenges and methods of virtualization in museums by reviewing available literature and case studies of museums with interactive technology to understand the current technology state of museums in Malaysia. Consequently, working terminologies related to virtual heritage adoption by museums will be elaborated to define the scope and limitations of such studies. Most museums identified with Augmented Reality applications in Malaysia are still in an early stage of virtual technology adoption. Only Borneo Cultural Museum has embraced 30% interactive exhibition. Thus, this paper suggests that an in-depth study needs to be conducted to survey the technology readiness of museums in Malaysia.

Keywords: cultural assets, digitalized, tourism, virtualization.

I. INTRODUCTION

Malaysia's digital transformation began 26 years ago with the Multimedia Super Corridor (MSC) creation. The early implementation, both innovative and imaginative, enabled Malaysia to adopt Industry 4.0 initiatives by launching the Industry4WRD: National Policy on Industry 4.0 on 31 October 2018 (Amirul, 2021). The repercussions of the Covid 19 pandemic, however, witnessed the attempts of various institutions to restructure their operations in response to the new challenges faced by society. Ultimately, museums became more aware of the need to address changes in how cultural heritage assets are promoted by embracing digital culture. According to the poll conducted by the Museum Innovation Barometer 2021 (2021), COVID-19 was the primary catalyst for the digital transformation of museums and the adoption of innovative technologies like augmented reality (AR), virtual reality (VR), and mixed reality (MR).

In Malaysia, the National Museum Malaysia launched an augmented reality (AR) mobile application in March 2022 on 28 selected collections. This breakthrough can be linked to the sudden drop in the number of visitors to museums due to the pandemic. Compared to 2.782 million visitors in 2019 and 2.353 million in 2020, the National Museums Department reported only 241,909 visitors at

all 22 museums across the country from January to November 2021 (David, 2021). UNESCO report also found that 90% of museums globally were closed, with 10% of them perhaps never reopening (UNESCO, 2020).

However, it is also important to note that the urge to have immersive and innovative technology applications in museum exhibitions is not new. Even before the pandemic, the Metropolitan Exhibition Hall of Craftsmanship, the world-class historical center with the most notable exhibits, faced problems with its exhibition halls when people were more interested in online offerings (Shu, 2015). Increased internet usage has altered conventional visitor preferences, putting museums and heritage institutions under pressure to discover ways to accommodate new types of participation in museums. A preliminary study on selected museums in Klang Valley revealed that most visitors found that the museum display did not effectively use audio and video to hold their attention, and there was no computer-based audio with visual-based information. Overall, visitors provided an average of 60% of their attention to their museum experience, but less than 50% to interactivity and digital engagement in the museum (Rosli & Kamaruddin, 2020). According to Giannini and Bowen (2022), museums must be better equipped to adjust to unrelenting technological advancements. Thus, the change to virtual engagement is expected open the door for a new and diverse museum and heritage experience.

As the guardian of the nation's cultural assets, the museum sector in Malaysia was caught unprepared when it experienced a 70 percent dip in attendance of visitors during the pandemic due to its inability to capitalize on technology and reach out to local and international visitors, the issue that initiated this study. Thus, the study's primary objective is to assess the technology readiness level in Malaysian museums in adopting digital heritage technologies. However, this paper explicitly discusses the challenges in the adoption and methods of virtualization in museums by reviewing available literature and case studies of museums with interactive technology to understand the current technology state of museums in Malaysia. Consequently, working terminologies related to digital heritage adoption by museums will be elaborated in order to define the scope and limitations of such studies.

II. ISSUES AND EFFORTS TOWARDS VIRTUALIZATION OF ARTEFACTS IN MALAYSIA

In recent years, museums have incorporated advanced digital technologies into various museum areas, such as collection management, research, curation, exhibition, and education. However, according to the Minister in the Prime Minister's Department (Economy) Datuk Seri Mustapa Mohamed, the low quality and coverage of broadband services, incomplete digital infrastructure, and the insufficient number of digitally skilled workers are challenges that need to be overcome to raise the country's digital proposition (Subramaniam, 2021). In addition, the Socio-Economic Research Centre has noted several significant barriers to the nation's future digital investments and transformation. A lack of resources, people, technical skills, a constrictive regulatory framework, cybersecurity threats, risk, and the need to find acceptable business models to realize the full potential of digital transformation are the five main difficulties that stand in the way of it (Guie, 2020).

A. Infrastructure: Connectivity

Ensuring that Malaysia's digital infrastructure provides consistent, dependable, and ultra-fast internet service is critical to realizing the digital economy's full potential. According to the MyDigital plan, Malaysia will have a 100 percent internet connection by 2025. However, with learning, economic activity, and social interactions increasingly taking place online, reliable, and effective internet access has become a necessary infrastructure (Mydin, 2021). According to Marc Woo, managing director of Google Malaysia, 81% of all internet users in Malaysia use digital services, and businesses are embracing technology more quickly than ever before after the pandemic to better serve their clients (*Malaysia's digital challenges* | Bangkok post, 2022, April 4). This applies to the museum sector as well. Thus, the Malaysian Government has taken the proactive step of engaging and hastening the implementation of the 5G network.

The JENDELA project, started by Malaysian Prime Minister Tan Sri Muhyiddin Yassin, intends to improve the country's digital sector's current connectivity. Through several public-private partnerships, the business sector will contribute resources and expertise to the development efforts (Subramaniam, 2021). This places Malaysia among Southeast Asia's early adopters of 5G internet and

cloud services (Amirul, 2021). Several efforts could also be seen in several strategies outlined by the Malaysian Government in recent years to speed up the internet with the 5G platform after the pandemic.

As part of the effort, Malaysia's national connectivity and digital infrastructure provider, Telekom Malaysia Berhad (TM), and worldwide leader in technology, Cisco International Limited, have announced a new strategic partnership focused mainly on helping the country develop its 5G innovation platform. This initiative is also a part of Cisco's Country Digital Acceleration program, a partnership with governments worldwide to speed up national digitalization agendas (TM One, 2022). This is crucial as higher performance and an efficient network will enable new user experiences and link new industries. Furthermore, by the end of 2022, MyDIGITAL is targeting 80% usage of cloud storage across the Government and incorporating cloud computing for businesses to procure services without having to own and maintain assets (Sagar & Ocampo, 2022). With the improvement in internet speed and accessibility of augmented reality on smartphones, utilizing augmented reality mobile applications at museums has become practical and popular (Ismail & Chan, 2019).

B. Human Resource & Expertise

It is crucial to stress that access to data, connectivity, and devices only will not offer economic potential. Skills must be at the forefront of any attempt to close the existing gaps throughout all demographics (Mydin, 2021). Employees are essential for any organization. As a company tries to realign its goals and secure its infrastructure with technology, the transformation must start with its employees. The faster staff adapt to these emerging technologies, the easier the path to digitalization. The full engagement of the workers is critical in this process (*What is Digital Readiness?*, 2021).

Isa (2012) stated that Malaysia's museums are lagging in developing cultural heritage tourism due to management inefficiencies. Improvements to the museum sector in Malaysia must undergo multiple hard and long phases and processes. She also stated that, because of budget constraints and a lack of imaginative authority, Malaysia's museum sector has lagged behind other affluent countries by nearly three decades (SER, 2020). Adopting digital technologies also requires equipping staff members with the necessary skill sets to keep up with emerging technologies in Malaysia's quest to adopt Industry 4.0 technology (TM One, 2020).

C. Hardware/ Software

Several museums continue to use the traditional display method, which can no longer attract and satisfy today's modern visitors, especially the digital native populations. This cause Malaysia's museum sector to face a difficult challenge in ensuring that museum growth continues to be relevant, competitive, and marketable (SER, 2020). Lack of audience engagement is a common problem in traditional museum and exhibition events. Immersive learning methods such as AR and VR can contribute to modernizing the educational process. For example, in a study of the Labuan Museum to examine the adoption of AR in enhancing the visitor experience by Ismail and Chan (2019), most of the respondents who engaged in the museum exhibition using AR agreed that the application could increase the visitor's learning outcome, meeting their expectations in the museum and enhance their overall experience.

Another anticipated challenge is the loss of access to digital cultural materials due to changes in technology and software. Over time, the software versions would require upgrading, posing a threat to the loss of previous data as they become inaccessible due to technological disruption. A website called Virtual Museum Melaka was found with digital content from 13 museums around Melaka to document Melaka's historical and cultural treasures online. However, the videos on the website are outdated as Flash Player content can no longer operate because Adobe no longer supports Flash Player after 31 December 2020. Currently, the website contains a brief history of the Melaka museums and a few images that cannot be enlarged.

D. Budget

Museums' budgets have been reduced as authorities seek to minimize costs after the pandemic outburst. However, museums in financial distress are not uncommon in the museum industry worldwide. According to SER (2020), development projects, public-private partnerships, and social enterprise projects involving museum product development as well as museum tourism packages, are

strategic approaches that prospective contributors and Malaysian museum professionals should explore. The income base must be increased for financial stabilization.

III. METHODOLOGY

The main methodologies adopted in this study are the literature review on working terminologies and case studies. The literature is restricted mainly from 2000 to 2022 to acquire existing methods and data due to the significant advent of newer digitalization in this period. Google Scholar was chosen as one of the data providers since it is one of the largest repositories of research publications. Websites such as online newspaper articles and journals were reviewed to gather literature for this study. In addition, three case studies were selected based on museums with interactive technology to understand the current technology state of museums in Malaysia. The data for the case study were collected based on the information provided on the official museum website and visits to the selected museum. The selected museums are the National Museum Malaysia, the Digital Cultural Heritage Gallery of the Sultan Mahmud Islamic Center at UMT, and the Borneo Cultural Museum.

IV. LITERATURE REVIEW

A. Review of working terminologies

To define the scope of the study and identify limitations, this paper will review current literature that discusses the terminologies below:

1) Virtual Heritage

Technology improvements have grown more critical to visitor experiences worldwide in recent years. Most virtual heritage research in the older days focused on recreating and visualizing cultural artifacts to be displayed in virtual reality (Ibrahim et al., 2011). However, the usage of advanced technologies in virtual heritage has broadened to immersive technologies, which include Augmented Reality (AR), Virtual Reality (VR), and Mixed Reality (MR) technology which gives sensory experiences through diverse combinations of real and digital information (Bekele et al., 2018). In fact, according to (Rauschnabel et al., 2017), Extended Reality (XR), which is a combination of all 3 (Augmented, Virtual and Mixed) reality has transformed the way people interact and explore by connecting the real and virtual worlds (Chuah, 2018). By generating the illusion of being inside a virtual world, the attention is rapidly shifting to Immersive Virtual Museum, Heritage, and Tourism (IVMHT) (Esmaili et al., 2017). IVMHT experiences immersing a user in a 3D world, such as interacting with a single historical object or building a scene with numerous sorts of engagement. These approaches provide user-friendly display and digital access to cultural assets, especially where physical access is limited (Bekele et al., 2018). It gives users a sense of connection with the artifacts to emotionally engage and enhance their experience.

The meaning and usage of virtual heritage have widened in today's context. It is not merely a replication tool but a medium for engaging the content with the visitors. According to (Ibrahim et al., 2011), the definition suggested by Toast and Champion is the most comprehensive in describing what virtual heritage should be:

"...the use of computer-based interactive technologies to record, preserve, or recreate artifacts, sites, and actors of historic, artistic, religious, and cultural significance and to deliver the results openly to a global audience in such a way as to provide formative educational experiences through electronic manipulations of time and space" (p.2).

Arts presented in museums in the older days are assumed to be immobile in the form of a painting or a sculpture. However, according to (Stogner, 2009), the fast advancement of immersive and inexpensive technologies transformed the function of a museum beyond an object presenter to a place for adventure. Museums and informal educational institutions, which were previously reluctant to adopt digital technologies, are now considering using different types of virtual technologies for more intellectual development (Roussou, 2004). An exhibition called MeshMinds 2.0: ArtxTechforGood at the ArtScience Museum in Singapore by MeshMinds, focused on empowering

feasible improvement through creative technology. The exhibition allowed the audience to explore the potential of cities through the perspective of technology and gives exposure to environmental pollution (Ismail, 2019). It aids people in gaining knowledge of their living environments as well as sustainable urbanization from a technological standpoint. Rather than only drawing in more visitors and keeping them engaged, museums look into educational functions through technological advancement (see Fig. 1).



Fig 1. André Wee's Augmented Reality Experience, a Better Tomorrow
Source: Image courtesy of the MeshMinds Foundation

People are increasingly discovering and learning about historical locations, arts and monuments through digital media, such as virtual reconstructions, digital representations of art and artifacts, online recordings, etc. Thus, the use of digital technology for education will be highly beneficial. Learning should not only be done in schools. Museums are significant educational spaces that have a lot of learning potential.

2) Augmented Reality

According to earlier surveys, museum visitors do not want to spend much time reading (Yusoff et al., 2014). Children are particularly hard to attract to a museum as they tend to see it as a boring experience (Cirulis et al., 2015). Thus, immersive technologies assist museums in enhancing the educational experience. Augmented Reality (AR) is a part of a virtual heritage that creates virtual 3D representations of an actual environment. AR integrates actual and virtual objects in a real-world setting, interacts simultaneously, and aligns 3D and real objects (Azuma et al., 2001). In AR, a user's perception of a real-world situation is additionally superimposed with digital data (Chi et al., 2013). Many museums around the world are looking into this immersive technology. For instance, the impressive range of collections in the London Natural History Museum has long been a favorite among visitors to take a view of the exhibition in Augmented Reality (AR) and 360-degree virtual tour of the show from the comfort of their home with Google Arts and Culture (Wilson, 2020). Augmented Reality (AR) is an educational tool to create engaging experiences that can significantly enhance students' understanding. Besides that, the first art exhibition in The Pérez Art Museum, Miami, with augmented reality technology, is called "Invasive Species" (see Fig. 2).



Fig 2. Invasive Species With Interactive AR Experience
Source: Cuseum (2018)

Visitors are taken to a view of an invasive species-infested future version of the Perez Art Museum to show the vulnerability of our ecology and the danger posed by climate change (Coates, 2022). Technology implemented via exhibitions could be utilized to give awareness to society as well as to educate them.

There is potential to narrate the contents comprehensively with technologies such as VR headsets, immersive displays, projection domes, and holographic installations (Full dome Pro 2021). One of the examples of VR is *Mona Lisa: Beyond the Glass* developed by The Louvre in Paris as part of a 500th anniversary retrospective and remembrance of the artist's death. In this exhibition, visitors may interact with Da Vinci, see moving sights and sounds, and even ride on his flying machine in virtual reality (First & Petljak, 2022). Other than that, A project called "REVIVRE" ("To Live Again") was an initiative made by the Muséum National d'Histoire Naturelle in Paris (see Fig. 3). In this exhibition, animals that have gone extinct will come alive digitally and can be experienced by the visitors using Microsoft's HoloLens (Coates, 2021).



Fig 3. At Revivre, the French National Museum of Natural History and SAOLA Studio Are Breathing New Life Into Long-Extinct Species.
Source: SAOLA – Revivre (2021).

The digital world has dramatically altered how audiences in an art institution behave. Users increasingly anticipate being able to take part in and interact with art both offline and online. Augmented Reality is one of the methods that could provide an interactive experience in engaging content and visitors. Today, AR can be found in many different museums all around the world. AR is proving to be a new instrument for modernizing and transforming the art world for museums and galleries.

3) Digitalized Cultural Assets

Cultural heritage consists of two types which are tangible and intangible. Tangible Cultural Heritage refers to actual artifacts created, maintained, and passed down through generations in a civilization. It comprises creative creations, constructed heritage such as buildings and monuments, and other physical or tangible manifestations of human creativity that have cultural importance in a culture (see Fig. 4) (UNESCO, 2020). Definition of the categories of the world's tangible cultural heritage properties according to UNESCO-WHC:

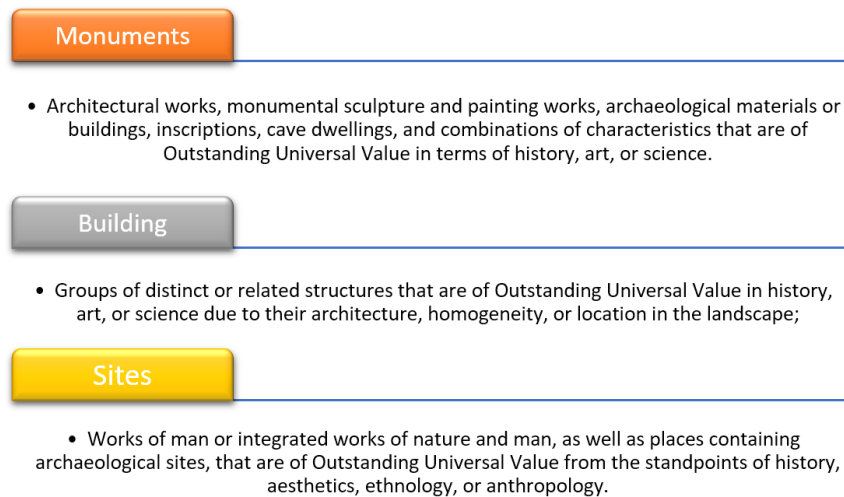


Fig 4. Elements of Tangible Cultural Heritage

Source: Rouhi (2017)

On the other hand, UNESCO defines intangible as “the practices, representations, expressions, as well as the knowledge and skills, that communities, groups and, in some cases, individuals recognize as part of their cultural heritage” (Intangible Heritage Convention). The following categories of intangible culture are specifically identified by UNESCO (Ruggles & Silverman, 2009):

- Oral traditions and expressions, including language
- Performing arts (such as traditional music, dance, and theatre)
- Social practices, rituals, and festive events
- Knowledge and practices concerning nature and the universe
- Traditional craftsmanship

According to the Intangible Heritage Convention, intangible culture is a way of life that is “transmitted from generation to generation” and “constantly recreated by communities and groups” in response to their surroundings (Ruggles & Silverman, 2009). The tangible cultural asset, whether a monument, a historic city, or a landscape, is simple to record, and its protection mostly comprises conservation and restoration efforts. Intangible property is made up of processes and practices. It requires a different protection approach and technique than tangible material.

While visible and intangible history is extremely distinct, they are two sides of the same coin in that they convey significance and humanity’s inherent memories. When comprehending the significance and relevance of each, tangible and intangible rely on each other (Munjeri, 2004). Both are cultural assets, including structures, sites, language, customs, and other historically significant elements in a region. It includes the entire setting representing prior endeavors and achievements that cannot be replaced.

Due to a lack of documentation, practitioners have become the only source of information for intangible heritage. The knowledge is gone upon their passing (Isa, 2019). This emphasizes how important it is to safeguard heritage in digital form for future generations. Digital Heritage consists of long-lasting computer-based materials that should be preserved for future generations (UNESCO, 2019). New technologies, such as computers and digital tools, have provided new opportunities in cultural asset conservation through digitalization. Digital technologies have the potential to significantly simplify and expedite documenting procedures (Hassani, 2015). Authorities

involved in heritage preservation can benefit from digital technologies by gaining accurate data in a short time.

Even though most museums across the world have been forced to close due to the current coronavirus epidemic, the museum continues to provide exhibition and education material to the community through online learning, digital, and social media (Abu Bakar et al., 2020). According to Brown (2020), even though museums were closed for a certain period, some museums provided free audio tours and digital technology applications such as the 'Shazam for art' app (Abu Bakar et al., 2020). These initiatives show us the potential of digital technologies that can be adapted in museums to be more inclusive and accessible regardless of a pandemic.

Jorgensen (2004) thought that interactive practices would allow museums to duplicate their object descriptions and collection annotations through the usage of virtual museums. This will be a turning point for the museum's efforts to expand and become more active in bringing new audiences to the organization through its website (Razak et al., 2018). For example, one of the best locations for art on the US west coast is J Paul Getty Museum in Los Angeles. A "museum view" is available on Google Arts and Culture to see the gallery interior (Wilson, 2020). Some Malaysian museums also provide such virtual exhibitions. For instance, the Islamic Arts Museum Malaysia, with more than 7,000 artifacts collections, provides a virtual gallery tour on its website, including a remarkable collection of books on Islamic art. Besides that, one of the first museums in Malaysia to digitize its exhibits and educational offerings is Bank Negara Malaysia Museum and Art Gallery. They have started nearly three new exhibitions, an art bazaar, several online programs, website virtual tours, and e-competitions in the first half of 2021. Technology in museums is fun as museums are coming up with creative ideas to draw in more visitors.

4) Sustainable Heritage Tourism

Sustainable tourism is defined by the UN Environment Program and UN World Tourism Organization as "tourism that takes full account of its current and future economic, social and environmental impacts, addressing the needs of visitors, the industry, the environment, and host communities" (UNWTO, n.d.). According to (Butler, 1999), sustainable tourism is a type of tourism that can remain viable in a given location for an indeterminate period. Sustainable tourism should assure the equitable distribution of long-term economic benefits, including social services as well as steady job and income earning opportunities. Uncontrolled tourism can significantly affect the environment, human consumption habits, pollution levels, and social institutions.

People visiting heritage sites, according to Markham et al. (2016), might cause a change in heritage ecosystems. Making the site less appealing and lowering their worth may lead to a decrease in tourist pleasure and the advantages others can obtain from heritage sites. How can tourists experience the irreplaceable resources of a country without damaging it? According to experts, augmented reality could preserve history for a very long time without damaging objects (Desai, 2018). Artifacts can also be displayed at museums in a constrained space with a lower risk of destruction with the current creative implementation of technologies. Therefore, immersive visitor engagement at the site might be considered a tool to achieve one of the goals of sustainability in heritage tourism. The different types of tourists with different levels of experience and motivation should also be considered carefully in studying and implementing sustainable management strategies at heritage sites (Alazaizeh, 2014).

The Historic Cities of the Malacca Straits, Melaka and Georgetown, are sustainable World Heritage tourism attractions in Malaysia. The original cultural significance and diverse legacy, tangible and intangible, strengthen the identity of local communities in both places. Proper management in tourism provides several benefits to travelers and the community, including improving environments for people to live in those regions, making it a sustainable tourism destination.

B. Case studies of the selected museums - Augmented Reality application in Malaysian Museums and Gallery

1) Muzium Negara | Augmented Reality Mobile Application

The traditional information display system utilized in Malaysia's national museum was said to lack interactivity and is unattractive to visitors, as reported by (Kim & Park, 2011). Recently, an app named Muzium Negara AR was launched as a solution. Using augmented reality (AR) in both 2D and 3D, Muzium Negara AR gives the general public access to data about 28 chosen collections held by

the National Museum. Visitors to the National Museum are the only ones who can take advantage of this AR experience (see Fig. 5).

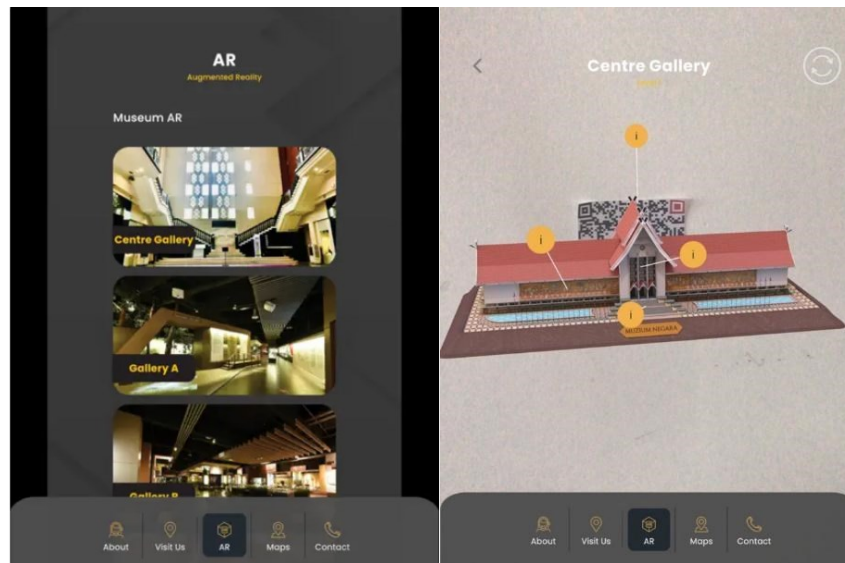


Fig 5. National Museum Augmented Reality App
Source: AppStore (2022)

According to a statement from the Tourism, Arts, and Culture Ministry, to experience this opportunity, visitors must download the app before or during their visit to the National Museum and scan the QR code that is made available (Bernama, 2022). Muzium Negara AR can be downloaded through Google Play, the App Store, and the Huawei AppGallery. (Department of Museums Malaysia, n.d.).

Apart from the augmented reality experience, this application serves as a platform for visitors to the National Museum to engage in a virtual experience and obtain general information about the National Museum (ticket prices, operating hours, guided tours, and more), the area plan and floor plan of the National Museum, the facilities and conveniences offered, details about each gallery (general information, segment, and location), news feeds, programs, and current activities, and trivia about the National Museum. The ancient items can be seen with much more clarity through AR. This virtualization effort serves the museum's objective of publishing the national historical heritage treasures and exhibiting and utilizing national historical heritage artifacts for community education towards identity building and nation development and making it one of the country's tourism products.

2) *Digital Cultural Heritage Gallery of the Sultan Mahmud Islamic Center at UMT | Terengganu Quran manuscript in digital form*

Delicate and detailed carvings in the Quran manuscripts from Terengganu, which are thought to be between 100 and 200 years old, are among the most beautiful in Southeast Asia. Visitors are not permitted to touch the manuscripts displayed at the Terengganu State Museum out of concern for their condition. However, utilizing 'Augmented Reality (AR) technology, the Sultan Mahmud Islamic Centre of University Malaysia Terengganu has taken the initiative to digitize the six Quran manuscripts with the aid of Ericsson, a Swedish telecommunications corporation (see Fig. 6).

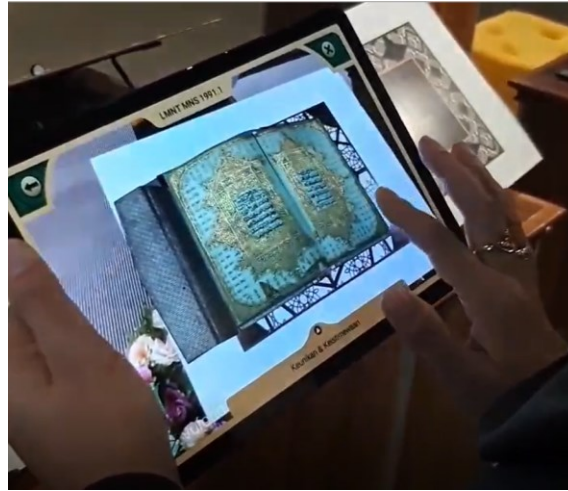


Fig 6. AR Quran manuscript at Cultural Heritage Digital Gallery, Sultan Mahmud Islamic Centre of University Malaysia Terengganu
Source: Authors (2022)

The exhibition allows visitors within the gallery space to explore the Quran manuscripts in detail through a device provided, and extra information on manuscripts is hung on the walls of the galleries. It is an attempt to educate people about priceless assets. The digitization process using AR technology makes it possible to see every aspect of the al-Quran clearly, including the colors and ornate patterns as well as the verses' excellent calligraphy. In addition to the various decorations that are delicately and exquisitely painted on the pages, the use of pure gold sprinkled on the decorations in the manuscript also contributes to the distinctiveness of the holy book. The use of pure gold also proves that the Sultanate of Terengganu appreciates the Quran so much that they decorate it with luxurious materials. This virtualization effort attracts more visitors to value the manuscript, which was also said to be one of Southeast Asia's most beautiful al-Quran writings. However, currently, only six AR collections are made to be on display.

3) *Borneo Cultural Museum | Massive Projecting Display, Augmented Reality, Audio Visual Technology*



Fig 7. Borneo Cultures Museum
Source: Sarawak Museum Department (2021)

The Borneo Cultures Museum and the Annex Office Building make up the New Sarawak Museum, a brand-new landmark in Kuching (see Fig. 7). The Borneo Cultures Museum is a contemporary, five-story structure with an eye-catching architectural style that honors Sarawak's rich cultural heritage and distinctive traditional crafts. More than 1,000 artifacts representing the rich culture and tradition of the indigenous peoples of Borneo and Sarawak are housed in this museum with a 30% interactive exhibition. The museum has five levels, the first housing a gallery for temporary exhibitions and the second housing a children's gallery, a Love our Rivers part, and an Arts and Crafts

area. The permanent thematic galleries “In Harmony with Nature” (which features sights from Borneo’s coasts, jungles, and highlands), “Time Changes” (which highlights cave discoveries and the creation of Sarawak), and “Objects of Desire” (which houses relics on trade and craftsmanship, along with spiritual designs of the cultures) are located on levels 3, 4, and 5 (see Fig. 8) (Rashid et al., 2022).



Fig 8. Interior Exhibition Space in Borneo Cultures Museum
Source: Borneo Cultures Museum (n.d.)

The Children’s Gallery and the Arts and Crafts Gallery are located on the second level (see Fig. 9). The preservation and conservation efforts made to maintain the rivers clean are the main subject of these galleries. The gallery’s “Love Our Rivers” theme uses interactive learning and games to capture young people’s interest and increase their level of awareness. There is a lounge space and a playground for parents and children to unwind.



Fig 9. Using River Waste to Create a Band
Source: Borneo Cultures Museum (n.d.)

Borneo Museum also offers interactive educational programs and activities, allowing visitors to appreciate different tribes in Sarawak. The third level’s theme, “In Harmony with Nature,” highlights the Borneo people’s bond with nature and is the museum’s largest exhibition. Here, you can observe how the inhabitants formerly lived, learn about their traditions and customs, and explore the exhibition’s immersive and multisensory activities.

V. RESULTS AND DISCUSSION

Recently, it has been identified that engaging visitors in the strategic plan is a critical component of achieving sustainability; thus, global trends in tourism destinations are now focusing on

a more tourist-oriented approach that focuses on consumer preferences and the quality of individual experiences (Alazaizeh, 2014). In Malaysia, several museums and galleries identified to have started digitizing and virtualizing their contents to improve the quality of visitor experience, as listed below (see Table 1):

Table 1. List of Museums in Malaysia That Are Digitizing and Virtualizing Their Contents

Museums & Gallery	Virtualization of Digital Cultural Heritage
National Museum Malaysia	Augmented Reality Mobile App, Virtual Tour on the website
Digital Cultural Heritage Gallery, UMT	Augmented Reality Terengganu Quran manuscript
Borneo Cultural Museum	Massive Projecting Display, Augmented Reality, Audio Visual technology
Islamic Arts Museum Malaysia	Virtual Tour on the museum website
Bank Negara Malaysia Museum and Art Gallery	Virtual Tour and Exhibition on the museum website

Source: Authors (2022)

Most museums identified with the application of Augmented Reality in Malaysia are still in an early stage of virtual technology adoption. Only Borneo Cultural Museum has embraced 30% interactive exhibition. Some museums have started providing virtual tours on their website. However, based on the literature, a website called Virtual Museum Melaka (n.d.) was found with outdated content as Flash Player can no longer operate.

The issues related to the virtualization of digital heritage should not be overlooked. Malaysian Government's effort toward improving and developing digital technologies can be seen in the projects and policies targeted to improve connectivity. However, IT infrastructure and software updates should also be considered before creating a virtual display. This is because product updates are standard in the digital age, where companies will update their apps frequently to maintain consumer satisfaction and engagement. Thus, the virtual software and hardware used in museums must be able to respond quickly to future advances. Users must be represented with the content in an understandable format whenever they are required in the future to utilize the modern, up-to-date access methods available.

Besides that, a limited budget, especially for the Government and small individual organizations, is always an uprising issue. These organizations could be carried away by the latest technological trends and believe customers want spectacular immersion. However, sometimes within a museum's budget, interactive apps such as AR or VR experiences might not be feasible. When planning the project, it is better to consider these costs and consult a multimedia developer to maintain the budget.

In addition, other difficulties are the lack of resources, people, and technical skills, a constrictive regulatory framework, cybersecurity threats and risk, and the need to find acceptable business models to realize the full potential of digital transformation, a barrier to digital transformation. Thus, a good solution must be resolved to overcome all these challenges by reviewing guidelines from international and local museums to obtain best practices in virtualizing digital content.

VI. CONCLUSION

The dip in the attendance of visitors due to its inability to capitalize on technology caused a decline in tourism revenue and urges museums to have immersive and innovative technology applications in museum exhibitions. Thus, the study's primary objective was to assess the technology readiness level in Malaysian museums in adopting digital heritage technologies. However, this paper specifically discussed the challenges in the adoption and methods of virtualization in cultural institutions in Malaysia by reviewing available literature and case studies of museums with interactive technology to understand the current technology state of museums in Malaysia. Based on the challenges in adopting the various virtualization methods, Malaysia's museum industry and tourism administration have improved several aspects to make museums a vital part of the country's cultural heritage tourism. Undeniably, the virtualization of digitized information could benefit the public by providing a new experience and engagement in the museum environment as well as cultural and historical sites by improving the accessibility on-site or offsite. Thus, the creative involvement of technologies in preserving and presenting cultural assets could assist in putting the country on a path

toward sustainable tourism development. The growing technologies should be utilized wisely to ripe more benefits for the continuity and relevance of the museum sector and other future industries. Thus, this paper suggests that an in-depth study needs to be carried out to survey the digital readiness of museums in Malaysia. This is because digitalization started long ago, as mentioned earlier, so it is crucial to understand further the barriers and challenges faced by our museums.

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