A Study of Virtual Heritage Preservation on Rumah Uda Manap and Its Digital Transformation for Public Accessibility and Engagement.

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ABSTRACT

Heritage preservation is crucial to maintaining Malaysia's cultural identity, particularly with regard to traditional Malay homes, which are in risk due to environmental causes, modernization, and neglect. However, conservation and historical preservation are expensive and difficult tasks. In order to enhance public accessibility and participation for heritage conservation, this study aim to explores the possibility of digital transformation using 360-degree virtual tour of Rumah Uda Manap. The house was originally built on the banks of the Perak River in Kampong Ngior, Tanjong Blanja, now known as Parit in Perak, Northen Malaysia. The study creates a virtual environment by incorporating public feedback into the R2RD model (Read, Reflect, Display, Do). A survey questionnaire with 3000 participants revealed key design elements like interactivity and simplicity of navigation as part of digital conservation effort of traditional house. The results also demonstrate a strong interest in virtual heritage encounters, underscoring the potential of digital tools to close the gaps and advance travel. This study emphasizes the value of virtual heritage preservation as a cutting-edge strategy for conserving traditional Malay architecture and encouraging public participation.

INTRODUCTION

For all civilizations, culture and tradition serve as a sign of intellectual and spiritual wealth. Throughout the 20th century, the importance of culture in society has grown significantly. Culture had been practiced by people in their everyday lives in which may forms their character, behaviors, habits and daily practices. According to Liew (2005) culture provides connection between past, present and the future. Additionally, culture can be expressed in societal norms, values, and beliefs (Zuraidah Abd Manaf & Aliza Ismail, 2010). Towards these, cultural information enhances the understanding of a culture and can bring togetherness within communities. Thus, cultural diversity is an evident in the sports, dances, music, and other customs that have developed.

Malaysia is also renowned for its rich cultural legacy. For guaranteeing the sustainability of history and culture, heritage conservation and preservation are crucial. Traditional Malay homes, for instance. Although it is an important component of Malaysia's cultural legacy, the sustainability of traditional Malay homes is threatened by a number of factors, including ageing, unfavorable environmental conditions, and biological organism attacks (Salem et.al, 2019). Additionally, the modernization and growth have shaped Malaysian attitudes and lifestyles, which favors modern homes.

Additionally, the preservation of traditional Malay homes is important because cultural tourism can help local economies. In which, these houses draw tourists with an interest in history and architecture since they are cultural landmarks. Yasmin Nur Amirah, Rohaslinda, and Nor Rima (2021) claim that it is difficult to see the original materials and architectural design of a traditional Malay house. In addition, one of the challenges in preserving architectural heritage is the high expense of maintenance and the lack of knowledge. Consequently, Multimedia Super Corridor (MSC) has created Malaysia's digital transformation with implementation, both

imaginative and innovative to embark into preservation purpose.

According to this occurrence, the traditional Malay house dwelling activities are predicted to decline and suffer preservation challenges. Therefore, to overcomes the issue of disappearing of preservation, digital technology can be one of the solutions to maintain traditional Malay house. Through this solution the 360-degree virtual tour is utilized as an alternative way to preserve it in 3D environmental form. The virtual environment refers to the 360-degree virtual presentation which enables user to engage with their surrounding and allowing them to walk through in 3D area produced by the video.

Malaysia's Heritage Conservation Efforts Via Innovation and Digital Transformation

Monuments, collections of structures, and locations are recognized as heritage under the 1972 World Heritage Convention. However, archiving and recording issues continue to limit Malaysia's architectural heritage conservation efforts (N M Suaib, et. al 2020). Heritage moreover, according to UNESCO, can be divided into three categories: cultural, natural, and heritage in the context of armed conflict. Thus, to make sure that cultural heritage around the world is properly cared for and protected, the United Nations Educational, Scientific, and Cultural Organization (UNESCO) has set up working groups and manuals. However, Said, S. Y. (2013) asserts that conservation is only predicated on the upkeep and restoration of certain structures. The concept of conserving historic structures through preservation, adaptive reuse, restoration, or protection was not accorded the same priority as new construction for a long time (Cedeño Valdiviezo, A. 2023).

Additionally, the cultural heritage category includes the Rumah Uda Manap, which was selected to be a part of heritage protection efforts. N M Suaib et. al (2020) assert that cultural legacy is multifaceted and further separated into intangible and tangible forms. In general, tangible cultural heritage is referred to everything that can be seen, including moveable items like coins and paintings as well as immovable items like sites and monuments, both on land and underwater. Intangible cultural heritage, on the other hand, addresses highly individualized elements like customs, dances, and ceremonies.

Even though we live in a digital age, virtual conservation is an option that can be used while the structure is still standing. However, according to N M Suaib, et. al (2020) not much has been done to protect cultural heritage through the use of media technology and computer graphics. Among these were the digital conservation of Malay architectural heritage (such as the traditional Malay house in Kedah, Rumah Tok Su, the virtual reconstruction of famous heritage buildings, the 3D model of a traditional Malay house -Teratak Zaaba, the virtual preservation of panoramic Kota Kuala Kedah, and the 3D preservation of the A Famosa Fortress in Melaka.

Maintaining historical identity and traditions requires cultural heritage preservation, especially in light of environmental issues and modernization. According to Alsheikh Mahmoud et al. (2024), a number of reasons constitute a threat to traditional Malay houses, which are particularly important symbols of Malaysia's cultural legacy. Modernization is the fundamental source of these issues, as people desire more contemporary homes (Yasmin Nur Amirah et al., 2021). In addition, there is a lack of finance and significant maintenance expenses (Bahardin et al., 2022). Despite these difficulties, traditional Malay houses are incredibly valued as cultural icons due to their architectural characteristics, and heritage tourism can help local economies grow (Saedon, 2022).

The Multimedia Super Corridor (MSC), additionally as one initiative of the Malaysian government, aims to assist the preservation of cultural heritage by fostering innovation and digital transformation (Amirul, 2021). The preservation can be done in an immersive and economical way with virtual reality (VR) and these technologies have been shown to increase accessibility and engagement (De Fino et al., 2022). In particular, virtual tours have been successfully utilized to provide dynamic and captivating experiences in museums and educational platforms (Yow, 2022). Towards this initiative, the COVID-19 pandemic has been expanding the use of digital tools in cultural heritage (Klein & Todesco, 2021). However, although these technologies have been widely applied in museums and historic buildings, their application to traditional Malay houses is still under-discovered. Additionally, digital technologies may help preserve intangible cultural assets, ensuring the

preservation of not only for physical structures but also the customs, practices and traditions associated with them (Idris et al., 2016).

METHODOLOGY

This exploratory study adopted a survey questionnaire to collect information about public preferences, opinions and suggestions for the virtual heritage preservation of Rumah Uda Manap using 360-degree virtual environment. The survey indented to understand on the accessibility, engagement and design preferences of the public for the virtual tour. The survey was distributed to 3000 public respondents to providing a variety of perspectives that were used to inform the development of the 360-degree virtual heritage tour. A structured online survey was created as the main tool to collect the data. The survey included both open-ended questions that allowed participants to give specific recommendations, as well as closed-ended questions using Likert scales to measure user preferences.

R2RD Model Framework

This study used the R2RD model (Read, Reflect, Display, Do) to guide the design and development of the 360-degree virtual heritage tour. It also ensures that every stage of development, aligns with public needs and expectations. The application of the R2RD model was as following steps:

Read:

In this section, participants respond to a survey that asks about their preferences, expectations, and accessibility requirements for the virtual tour. Historical and cultural information about Rumah Uda Manap was also gathered from archival sources, current literature, and expert consultations to guarantee authenticity and correctness in the virtual portrayal.

Reflect:

Following the collection of survey data, the results were examined to determine the most important insights. At this point, the public's needs and modifications to the intended virtual tour could be taken into account.

Display:

The virtual tour's layout was determined by the data acquired during the Read and Reflect stages. Audiovisual components and interactive features were added to boost user engagement and make the content more widely available.

Do:

The virtual tour was created and made available to users in the last stage. The survey results and user preferences from the previous phase served as a guide for the creation of the virtual tour. The finished design improved accessibility and featured interactive elements.

Data Collection

The Contextual Document Review

Reviews of the literature from books, journals, conferences, websites, unpublished theses, and journals were examined. This study acknowledges the architectural style of the Negeri Perak Traditional House as well as the Malay social environment exist in the Rumah Uda Manap. The document review determined the decoration of Rumah Uda Manap is unique even though the design's form and arrangement are typical of Perak. On carved wall panels and window shutters, flowers and birds are combined with Chinese themes, dragons, phoenixes, and calligraphic symbols. The brightly colored lime-based paint (kapor) that highlights the designs contributes to the carving's lightness, which is necessary because of how hard the wood is.
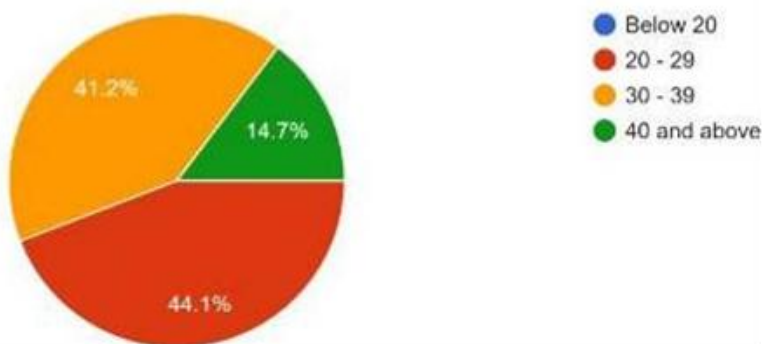
Fig. 1 The Architectural Design of Rumah Uda Manap (Source: https://rimbundahan.org/architecture/rumah-uda-manap/)
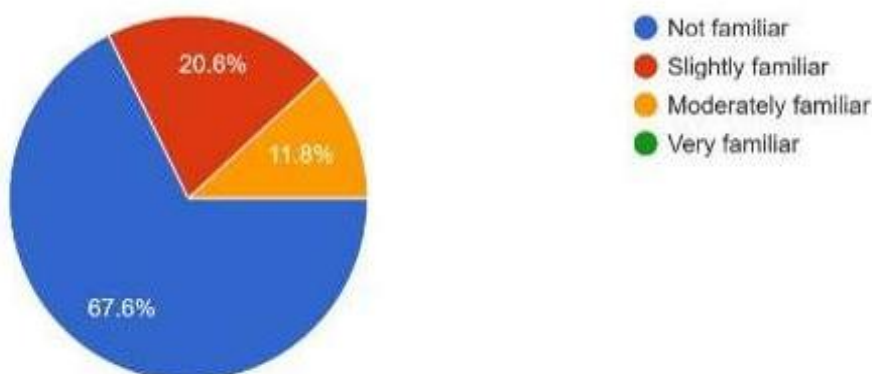
The Survey

The survey's findings are presented in this section with an emphasis on Rumah Uda Manap in order to influence design user preferences, interest, and views of virtual heritage preservation.

Demographics

Fig. 2 Participants' Demographic

Regarding their familiarity with Rumah Uda Manap, survey of respondents came from a variety of age groups. The two age groups with the largest percentage of responders were those aged 20–29 and 30–39 years old. Given that these groups comprised the majority of participants, it is likely that younger and middle-aged individuals made up a lesser percentage of the respondents than those aged 40 and above (Fig.2).

Fig. 3 Level of Participants'Familarity on Rumah Uda Manap

According to the survey, the majority of respondents said they had never heard of Rumah Uda Manap (Fig.3). Just a small percentage of those surveyed claimed to know something about the property and its cultural

significance.

Participants Preferences on Visual Quality

The respondents expressed a great deal of interest in exploring traditional Malay homes through virtual tours. The majority rated their level of interest at level 4 or level 5. Many respondents also rated visual quality as extremely significant, emphasizing how it enhances comprehension, realism, and immersion (Fig. 4). When asked what types of visual content would make them more interested in Rumah Uda Manap, participants ranked the following as their top priority (Fig.5).
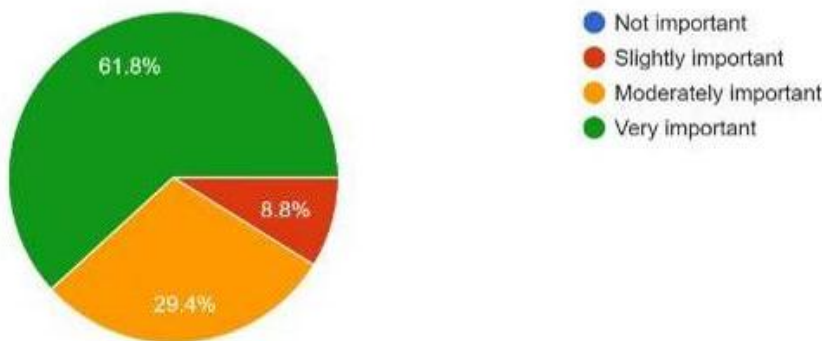
**Fig. 4** The significant of visual quality enhance realism and immersion
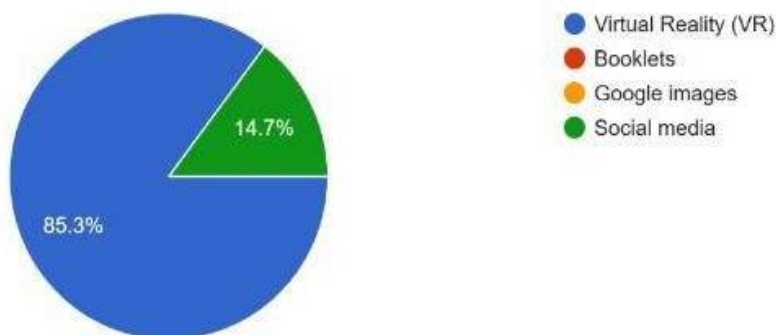
Fig. 5 The types of visual content

Features Preferred for User Engagement

In regards of the features should be in the virtual tour, 360-degree views were the most popular option since they allowed people to examine the complex elements of the house construction (Fig. 6). In order to comprehend the house's cultural and historical relevance, numerous respondents stressed the value of reading in-depth the media. In particular, a large percentage of participants concurred that 360-degree virtual information would significantly enhance their comprehension and admiration of Rumah Uda Manap's art and architecture. According to the respondents moreover, immersive visualization can improve accessibility for those unable to physically visit the site enable being physically present in the residence (Fig. 7). Additionally, gamified content, riddles, and quizzes were proposed as interactive components to enhance the experience.


Fig. 6 Elements can enhance experience in the virtual tour
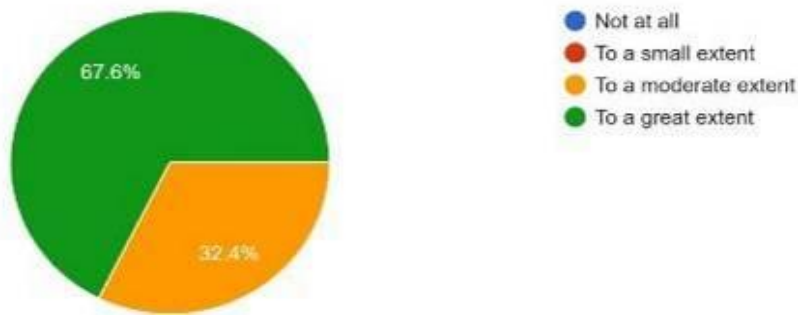
Fig. 7 Visual experience can help future generation appreciated traditional Malay homes preservation

Accessibility and Usability Consideration

The platforms that respondents favored for viewing the virtual tour were indicated. The most popular options were YouTube and websites since they were user-friendly and accessible. In addition, participants preferred virtual reality applications like EON-XR. Easy navigation and audio guidance were found to be essential components for enhancing the virtual experience's accessibility (Fig.8).
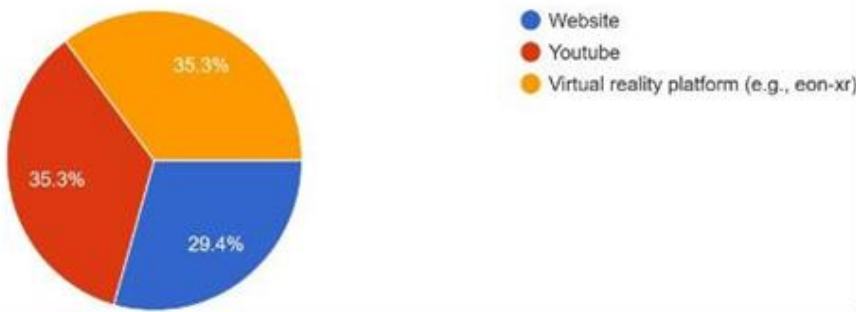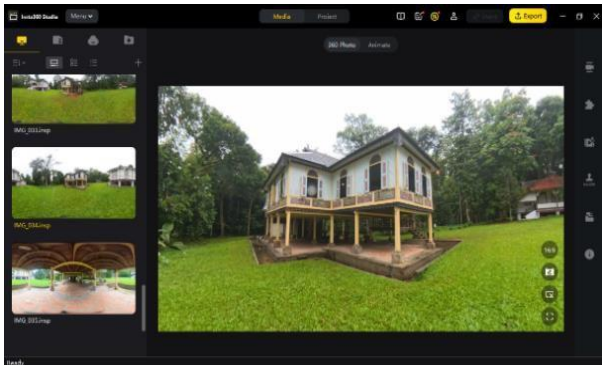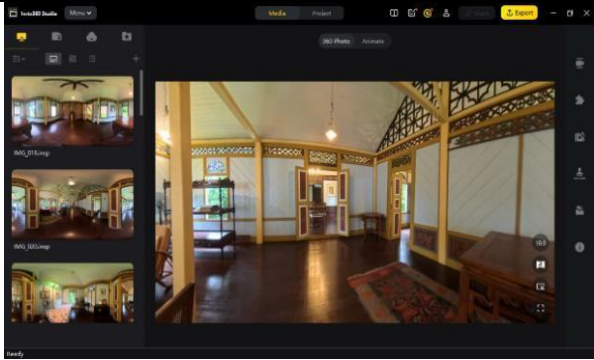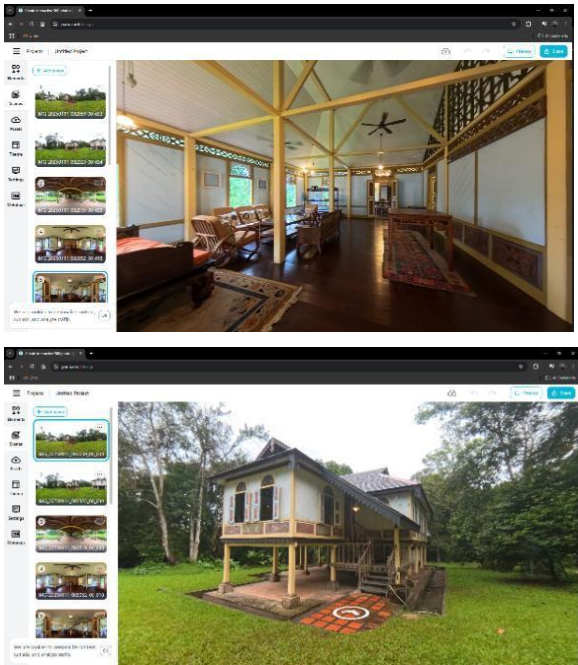

Fig. 8 Platform to access the virtual tour

The Development of the 360-degree Virtual Tour

Based on user feedback, the virtual heritage tour for Rumah Uda Manap was developed. To assure the establishment of an engaging cultural experience through virtual tours, the following table outlines the phases of development and the execution of the 360-degree virtual tour.

Table 1: The Development Phases of the 360-degree Virtual Heritage Tour for Rumah Uda Manap

NO.	PHASE	DETAILS
1.	Content Collection	This phase required a visit to Rumah Uda Manap at Kuang Selangor. The images were captured using a panoramic camera brand called Insta360 with high-resolution 360-degree photos. The shot was planned in a condition with good lighting to show the architectural details. The detailed historical and cultural information can also be gathered from the caretakers.

2.	Virtual Tour Tools	All the captured images were uploaded into the PanoCool platform which was chosen for its user-friendly interface and support for 360-degree images. This platform allowed web-based deployment, scene linking, and image stitching easily. Each panoramic view was connected to replicate in real-time movement between each room and sections of the house.
3.	Interactive Features	To increase the interest. The tour includes interactive hotspots. Navigation buttons were added to allow users to navigate the tour in a structured way.
4.	Accessibility Enhancements	To increase the usability and reach a larger audience, simple and easy-to-use navigation tools were implemented. It included zoom controls and a guided tour mode for first time users. It is also compatible with desktop and mobile devices. Text description and audio instructions were planned for future improvements for the enhancements.
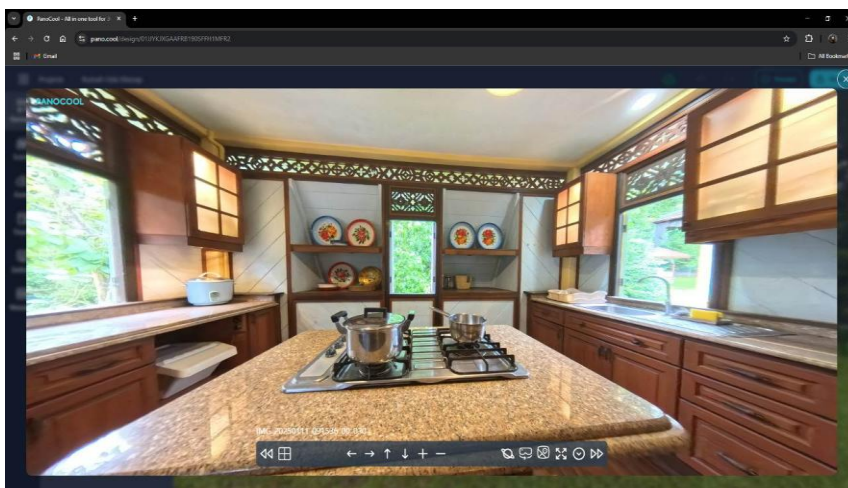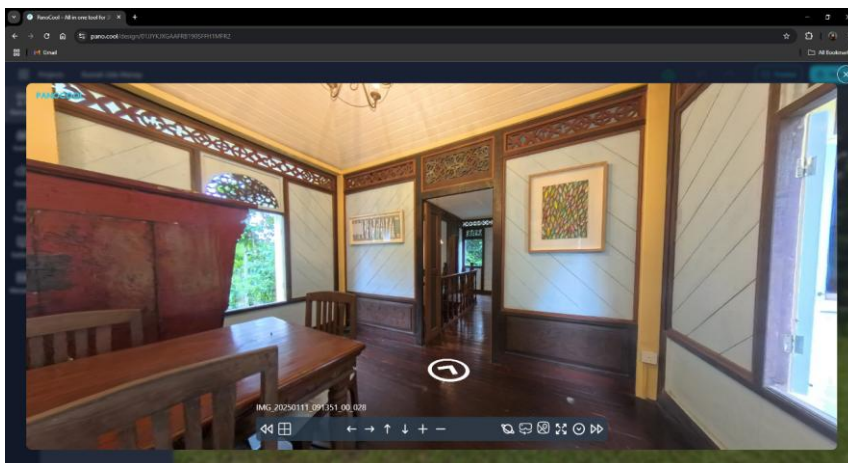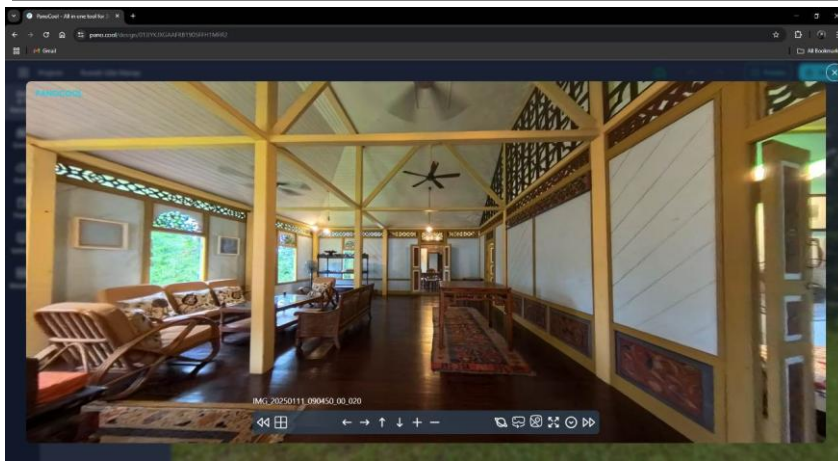
Fig. 9 Screenshots of the 360-degree virtual tour

CONCLUSION

Traditional homes are the most valuable part of a society's cultural legacy and are one of the most significant housing typologies. Traditional Malay house in Malaysia represent the country's identity and are a reflection of traditional Malay values, traditions, and beliefs. It also carries with it economic, cultural, historical, and social values that are advantageous to the nation. The Malay house moreover is subject to possible hazards in the surrounding area that could endanger their survival and lead to decay. Thus, preserving the Traditional Malay house is important for the benefit of future generations.

According to the literature, the majority of conservation and preservation initiatives on the Traditional Malay house focused on physical cultural assets, particularly digital media technologies. Besides, most actions on Traditional Malay house preservation are performed by architects or conservators. Digital media platforms additionally have a lot to offer and open up countless opportunities for cultural conservation initiatives. It can be applied either to site visualization, building reconstruction, and also documentation. Furthermore, the 2030 Sustainable Development Goals that emphasize heritage structure conservation, along with the risks imposed on traditional Malay houses and their significance, support the need to preserve them. Within these, this study suggests a course of action for the better, more efficient preservation of traditional Malay house through 360-degree approach. Researchers, technologists, and conservators also can learn more about the state of practices and difficulties in maintaining Malay house from this study. This will assist preservationists of all backgrounds in effectively organizing their preservation activities to produce the intended outcomes.

In an effort to preserve the Malay cultural heritage, this study also established the potential for virtual heritage preservation of traditional Malay house. The survey's results also demonstrated a high degree of interest in virtual tour experiences, which underscoring the importance of accessibility and engagement of the public towards traditional Malay house. Following the study finding, below are the potential topics that call for more research in the preservation of traditional Malay house:

1. Assessing the efficiency of digital media in maintaining traditional Malay house preservation activities.
2. Creating a mutualistic connection between traditional Malay house preservation and heritage tourism.
3. Examining how digital media relates to the preservation of traditional Malay house and how it affects the planning and design of preservation initiatives for these houses.

PAPER CONTRIBUTION TO RELATED FIELD OF STUDY

This paper makes several contributions whereby the findings help to provide a better understanding of how conservation of cultural heritage can be achieved through digital media platforms.

REFERENCES

1. Alsheikh Mahmoud, S., Bin Hashim, H., Shamsudin, M. F., & Alsheikh Mahmoud, H. (2024). Effective Preservation of Traditional Malay Houses: A Review of Current Practices and Challenges. Sustainability, 16(11), 4773. https://doi.org/10.3390/su16114773
2. Amirul. (2021, July 26). Malaysia's journey in the Digital age. MIDA. Retrieved April 19, 2025, from https://www.mida.gov.my/malaysias-journey-in-the-digital-age/
3. Bahardin, N., Baharuddin, M., Azman, M., Bakhari, M., & Rashid, M. (2022). Assessing a condition of timber defect for perak traditional malay's architecture: an initial step to creating entity relationship (er) model in databased management system (dbms).
4. Malaysia. https://doi.org/10.21837/pm.v20i22.1135.
5. bin Saedon, M. A. M. (2022). Tourists' Perception on Virtual Reality Application of Traditional Malay House. International Journal of Creative Multimedia, 3(1), 57–67. https://doi.org/10.33093/ijcm.2022.3.1.4
6. Cedeño Valdiviezo, A. (2023). Adaptive reuse: Its potential role in sustainable architecture and its relationship with restoration and rehabilitation. Revista de Arquitectura (Bogotá), 25(1), 173 186.

https://doi.org/10.14718/RevArq.2023.25.4520

7. De Fino, M., Bruno, S., & Fatiguso, F. (2022). Dissemination, assessment and management of historic buildings by thematic virtual tours and 3D models. Virtual Archaeology Review. https://doi.org/10.4995/VAR.2022.15426.

8. Hamzah, Nur & Mat So'Od, Noor Fatehah Binti & Aziz, Zirwatul & Hinchman, Mark. (2022). Digitalisation Heritage Conservation Documents of Rumah Uda Manap. Environment-Behaviour Proceedings Journal. 7. 313-321. 10.21834/ebpj.v7i21.3757.

9. Idris, Muhammad Z., et al. "Preservation of Intangible Cultural Heritage Using Advance Digital Technology: Issues and Challenges." Harmonia Journal of Arts Research and Education, vol. 16, no. 1, Jun. 2016, pp. 1-13. https://dx.doi.org/10.15294/harmonia.v16i1.6353

10. Klein, V. B., & Todesco, J. L. (2021). COVID-19 crisis and SMEs responses: The role of digital transformation. Knowledge and Process Management, 28(2), 117-133.

11. Liew, C. L. (2005). Online cultural heritage exhibitions: A survey of information retrieval features. Electronic Library and Information System, 39(1), 4-24.

12. N M Suaib, N A F Ismail, S Sadimon and Z Mohd Yunos, (2020). Cultural heritage preservation efforts in Malaysia: A survey, IOP Conference Series: Materials Science and Engineering, 979(1):012008. https://doi.org/10.1088/1757-899X/979/1/012008

13. Said, S. Y., Aksah, H., & Ismail, E. D. (2013). Heritage conservation and regeneration of historic areas in Malaysia. Procedia-Social and Behavioral Sciences, 105, 418-428.

14. Yasmin Nur Amirah, T., Rohaslinda, R. & Nor Rima, M. A. (2021). Modernization of Traditional Malay House in Heritage Village of Malacca. Built Environment Journal, 18 (1), 23-40.

15. Yow, H. (2022). A Case Study of Virtual Anatomy Museum: Facilitating Student Engagement and Self- paced Learning through an Interactive Platform.International Journal of Information and Education Technology. https://doi.org/10.18178/ijiet.2022.12.12.1758