UTILIZING HEDONIC-MOTIVATION SYSTEM ACCEPTANCE MODEL (HMASM) IN DEVELOPING A KERIS VIRTUAL REALITY GAME

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ABSTRACT

Virtual Reality (VR) games provide players with an immersive experience by mimicking a virtual world that seems authentic to them. However, designing and developing virtual reality games present a significant challenge in addressing issues related to prolonged use of head-mounted display (HDM) equipment, which can lead to digital vertigo or cybersickness. Accordingly, this study aims to create a VR game centred to address and alleviate issues related to digital vertigo, immersive settings, and interactive controls. This article reports on the findings from an investigation of initial requirements for designing and developing virtual reality games to enhance the immersive experience. For that, Hedonic-Motivation System Acceptance Model (HMSAM) was chosen as a part of the research conceptual framework which focuses on four factors (perceived usefulness, curiosity, enjoyment, and control). These factors are mapped to examine the acceptance factors of VR games, serving as a foundation to direct and elucidate research findings on cybersickness issue. A VR game called Keris was developed using Rapid Prototyping model. A focus group design was conducted with nine experts to measure the four factors. Their feedback were analysed using descriptive statistics. As a result of the study, all experts agreed that the four factors confirmed the robustness of the model. It revealed high mean score for various factors: Perceived Usefulness (Mean=4.52, SD=0.59), Curiosity (Mean=4.36, SD=0.61), Enjoyment (Mean=4.42, SD=0.62), and Control (Mean=4.40, SD=0.59). In conclusion, by using correct VR design and features, it is as reflected in the high overall immersive experience mean score for the prototype. The study implies that the four factors could be a guide for designers and developers of VR game application in increasing immersive experience despite cybersickness.

KEYWORDS

Virtual Reality games, immersive experience, Keris, cybersickness.

1. INTRODUCTION

Malaysia has made significant strides in addressing the Fourth Industrial Revolution (IR 4.0) across various sectors [1][2]. The government has taken proactive measures to advance digital transformation and innovation, fostering economic growth and enhancing global competitiveness. On October 31, 2018, Malaysia launched Industry4WRD: National Policy on Industry 4.0 as a response to the Fourth Industrial Revolution (4IR) [3]. This policy aims to facilitate manufacturing and related service sectors' digital transformation, putting an emphasis on the growth of digital infrastructure, encouraging research and innovation, reception of state of the art advancements like man-made consciousness, mechanical technology, and the Internet of Things

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(IoT), as well as enhancing workforce skills for a seamless digital age transition. Not only does incorporating IR 4.0 technologies increase productivity and competitiveness, but cultivates the making of novel plans of action and amazing open doors including metaverse enterprises [4].

In 1992, metaverse was first presented in the sci-fi novel Snow Crash [5]. The metaverse represents an innovative form of social media and Internet application that integrates various new technologies. Additionally, it refers to the idea of a virtual shared space created by a dynamic digital universe in which physical and virtual realities merge, frequently depicted as Avatars enable individuals to engage in three-dimensional interactions. The term metaverse combines the prefix "meta", extending beyond the concept of "universe", to define a virtual or parallel environment associated with the physical world [6]. Nevertheless, the definition of the metaverse can vary due to its status as an emerging and evolving domain. This idea transcends the conventional understanding of the internet to encompass an immersive 3D virtual realm that is collectively crafted and accessed by users in avatar form. The metaverse extends beyond a singular virtual realm to include numerous interconnected digital environments.

One of the technical components in the Metaverse includes Augmented Reality (AR), Virtual Reality (VR), and Mixed Reality (MR) as described in [5][7][8]. Extended Reality (XR) is a term that encompasses immersive technology. Augmented Reality (AR) overlays virtual information onto the detected object's position, displaying it on the device screen for real-time interaction. Virtual Reality (VR) offers an immersive experience, simulating a virtual environment that feels like the real world to users. Mixed Reality (MR) involves the real-time visual integration of physical and virtual environments, blending the real world with virtual elements.

A survey by Oppotus on technology trends revealed that awareness of virtual reality technology in Malaysia stood at 61% in the fourth quarter of 2022, down from 85% in 2021 [9]. It was reported [10] that a Milieu study of 1,000 Malaysian respondents found that 65% viewed the Metaverse as an enhancement to human social interaction, with 58% believing that social opportunities would improve due to Metaverse advancements. The VR headsets market in Malaysia generated €38.7m in revenue with a projected annual growth rate of 8.80% (CAGR 2024-2028). The rise in the technology-friendly community and the growing interest in immersive virtual reality experiences have led to a surge in demand for VR headsets in Malaysia [11]. It is also being forecast that by 2024, the global Metaverse market will reach US$800 billion, with the Metaverse equipment market reaching US$300 billion [12].

The transformations witnessed by the digital gaming sector due to the evolution of virtual reality offer a remarkable degree of engagement and interactivity for gamers. With technological progress, the development of VR games presents significant opportunities and challenges for game developers [13][14][15]. Key components for providing a captivating VR experience encompass crafting an immersive virtual environment, realistic visuals, and integrating user-friendly controls.

Designing and developing VR games present a significant challenge in addressing issues related to prolonged use of HMD equipment, which can lead to digital vertigo or cybersickness. Research also indicates that extended VR usage can result in motion-related difficulties [16], despite advancements in technology that mitigate these effects. Factors contributing to cybersickness include duration, field of view, equipment speed, user age, meeting user expectations, habits, and the susceptibility of VR equipment [17].

The task at hand involves the creation and implementation of an immersive VR game. A captivating and well-organized virtual setting has the potential to enhance users' spatial presence without compromising their visual-spatial skills and focus, even in the absence of extensive experience [18]. Immersive encounters play a crucial role in boosting motivation, as students may perceive their learning as ineffective when immersive experiences do not effectively engage their motivation [19].

The rest of the article is organized as follows. Section 2 describes the literature review which likewise addresses the information gained by contrasting existing and similar applications for VR games. The research design that was used in Section 3 this study involved the execution of four Rapid Prototyping Model steps. Section 4 discusses the outcomes of analyzing the data during the immersive experience testing.

2. LITERATURE REVIEW

This section presents an analysis of the literature in VR games and immersive experience. It begins with an overview of VR games and its evolution. Next, the following section focuses on the issues pertaining to VR application involving cybersickness. Further, a section on VR technology for cultural heritage preservation will be introduced. Finally, the discussion focusses on how a Hedonic-Motivation System Acceptance Model (HMSAM) and its four factors can help designers and developers in increasing immersive experience in VR games.

2.1. VR Games and its Evolution

VR has a rich and diverse history that extends over many years, encompassing advancements in hardware, software, and applications that propel its evolution. The beginning of VR has been around since 1950, its popularity peaked in the late 1980s and early 1990s [20]. In 1968, Ivan Sutherland and his students developed the inaugural VR/AR head-mounted display (HMD) named the "Sword of Damocles" [21]. It was suspended by a mechanical arm and an ultrasonic transducer to track head movements. This pioneering HMD offered users an initial experience of a computer-generated virtual world, enabling deeper interaction with the virtual environment. Researchers assert that Ivan Sutherland's HMD system serves as the foundation for immersive virtual reality applications [22].

One of the earliest interactive VR systems is the Krueger VIDEOPLACE, a project created by Myron Krueger in 1969 [23]. The VIDEOPLACE system, developed in 1975, utilizes computer graphics, projectors, video cameras, video displays, and sensor detection devices in a dimly lit room, allowing users to interact with a computer-generated silhouette that mirrors their movements. In 1993, Sega launched the Sega VR to accompany the Sega Genesis [24]. Nevertheless, the Sega VR project was terminated because the immersive gameplay posed a risk of injury to users who moved while using it. Additionally, the Stanford Research Institute cautioned about potential side effects such as headaches, dizziness, and illness, particularly among children and teenagers engaging with the Sega VR [25].

Significant progress in virtual reality technology has offered users with an immersive experience across different fields like gaming, education, and entertainment [26]. The way people interact with digital content is set to be transformed by technology, attracting significant interest from analysts and specialists the same. Numerous studies have concentrated on the impacts of immersion in VR experiences on different facets of user engagement, presence, and psychological health. For instance, a study was carried out by a group of researchers to examine the impact of immersive VR experiences on user presence and found that Feelings of presence and emotional engagement rise as immersion levels rise [27]. Additionally, this study demonstrates that VR applications can aid in memory and learning by creating an immersive multimedia environment with a variety of sensory elements.

2.2. VR Games and Cybersickness

The advancement of VR technology has resulted in the creation of sophisticated haptic feedback and motion detection systems that make it feel like you're actually there and in the virtual world environment. These technological advancements have created opportunities to explore the potential of using VR for therapeutic applications, including exposure therapy for anxiety disorders and phobias.

A study was conducted on creating and assessing a VR game named "MedChemVR" with the goal of enhancing the instruction and comprehension of medicinal chemistry [28]. This game is crafted to aid students in grasping and retaining the intricate chemical composition of medications through an engaging and interactive setting. By integrating gamification techniques, the game enhances the educational experience, making it enjoyable and captivating for students.

A study examined the creation, advancement, and assessment of a serious VR game named FSCHOOL for fire preparedness training aimed at primary school educators [29]. FSCHOOL is crafted to enhance teachers' understanding and proficiency in fire prevention, extinguishment, and school evacuation. This research employs a mixed-method evaluation strategy involving 33 primary school teachers. The findings indicate that serious VR games are effective and captivating for instructional purposes, delivering challenges, enjoyment, and expertise. Participants provided favorable feedback on the game, emphasizing its realism, interactivity, and meaningful educational value. The study concludes by emphasizing the significant of virtual reality games that teach fundamental skills.

The research introduces a sophisticated VR game named Scrum VR [30]. Its objective is to educate on agile methodology within software engineering education, focusing on the Scrum approach. Users are immersed in a virtual Scrum team setting, enabling them to grasp Scrum principles through observing and engaging with virtual personas. Evaluation by educators and students indicates that the game is a promising educational tool that enhances motivation and aids in knowledge acquisition. These games overcome the constraints of conventional learning approaches, offering a captivating and interactive educational journey.

A study delivered on the creation and assessment of a VR game named RabbitRun for the rehabilitation of individuals suffering from low back pain (LBP) [31]. This game utilizes an immersive virtual reality setting to involve patients in a digital environment, diverting their attention from pain while carrying out LBP routines. Participants reported that the game was enjoyable, easy to grasp, and most expressed a willingness to continue playing it at home. In essence, this game demonstrates promise in enhancing the well-being of LBP patients by supporting their commitment to home exercises and diminishing pain levels.

A study discusses the creation and advancement of a software game named the "Claustrophobia Game", which utilizes VR technology for treating claustrophobia [32]. The game features two confined spaces, an elevator, and an Magnetic Resonance Imaging (MRI) machine, with the goal of systematically exposing patients to their phobias in a controlled setting. Assessment of the game involved a psychological survey and a playability evaluation, demonstrating encouraging results in decreasing anxiety levels and enhancing playability.

Currently, more research and VR technology/application project emerge due to extensive acceptance and usage among others in respective field to educate, to train and to promote respective agenda [33][34][35].

2.3. VR Technology for Cultural Heritage Preservation

VR technology has been explored for cultural heritage preservation since the late 1990s and early 2000s. However, it gained significant traction and more widespread application in the 2010s due to advancements in VR hardware, software, and digital imaging techniques. It was seen that during late 1990s and mid 2000s, introductory trials with computer generated reality and 3D modeling for cultural heritage, frequently constrained by the time period's technology [36]. However, in the mid-2000s, improved 3D scanning and digital reconstruction techniques allowed for more accurate and detailed virtual representations of artifacts and sites [37]. The distribution of consumer- grade virtual reality headsets in the early 2010s, including the attainable HTC Vive and Oculus Rift VR applications were made more accessible by advances in photogrammetry and laser scanning [38].

Significant projects and research initiatives began to emerge, focusing on VR for cultural heritage preservation and education. Currently, there are a continued development in VR technology, increased interest in preserving endangered sites, and collaborative efforts between technologists, historians, and cultural institutions have led to more sophisticated and widespread use of VR for cultural heritage [39][40].

A study delves into the creation of Javanese Cultural Applications utilizing AR to present the history of Javanese culture via a three-dimensional portrayal of customary residences, attire, and weaponry [41]. The research encompasses the process of application development, generating specific images associated with Javanese culture, transferring them to Vuforia for incorporation with augmented reality, crafting 3D visuals using Blender, and merging target images with 3D models using Unity engine. The study's conclusion is the educational value of providing cultural aspects for Indonesian-speaking students, demonstrating the fruitful advancement of an increased reality experience empowering clients to dig into traditional Javanese elements using a three-dimensional visualization.

A study in 2019 presented a game titled "Mystical Weapon of Nusantara," which introduces Indonesian traditional weapons [42]. The game, developed using the MDA framework, targets users, particularly the youth, with the goal of sparking interest in Indonesian culture and history through interactive gameplay. Evaluation utilizing the game flow test and test play revealed a favorable response from players towards various game elements, including challenge, player focus, control, ultimate objective, skills, game feedback, and immersion. The researchers also assessed players' knowledge before and after gameplay, demonstrating an enhancement in players' knowledge following their engagement with the game.

A study examines the advancement of augmented reality applications for educating individuals about traditional weaponry utilized in eastern Indonesia [43]. The study underscores the significance of safeguarding cultural heritage amidst globalization, particularly for the younger populace. While acknowledging the cultural value of traditional weapons post-assessment, many participants express a preference for more engaging educational approaches and exhibit limited familiarity with traditional armaments. User feedback analysis reveals predominantly favorable responses, indicating the effectiveness of augmented reality in enhancing users' understanding and enthusiasm for traditional weaponry.

The meaning of this study lies in improving interest in the social tradition of conventional Malay weaponry, especially the keris, among youngsters and the more extensive local area. Ensuing exploration is planned to evaluate the adequacy and appropriateness of the game and its issue of cybersickness in settings that preserve cultural heritage. This study makes a significant contribution to the field of VR game development by providing empirical evidence on the effectiveness of HMSAM in enhancing immersive experiences and addressing cybersickness.

2.4. Hedonic-Motivation System Acceptance Model (HMSAM)

This section reviews the Hedonic-Motivation System Acceptance Model (HMSAM) and its four factors that can help designers and developers in increasing immersive experience in VR games. The HMSAM is a prominent framework in the field of consumer behavior and technology adoption. It underscores the significance of hedonic motivation in influencing an individual's decision to embrace a specific technology, prioritizing the enjoyment derived from its use over functional or utilitarian factors.

The HMSAM model was introduced as an expansion of van der Heijden's (2004) hedonic-motivational model [44]. This model acknowledges that individuals are motivated not only by practical requirements but also by emotional and psychological gratification obtained from utilizing technology [45]. Additionally, it acknowledges the social and cultural elements on hedonic motivation, highlighting the significance of subjective norms and social influence in shaping individual perspectives on technology-related pleasure and enjoyment.

The HMSAM offers a comprehensive view of the factors influencing technology adoption [46]. It enhances comprehension of user behavior in the digital age by providing valuable insights into the intricate interplay of hedonic motivation, social influence, and technology use. It was developed to comprehend the utilization and sustained use of hedonic systems, which are information systems primarily utilized for entertainment, pleasure, or enjoyment rather than utilitarian purposes [47].

In this study, to measure the immersive experience in playing a Keris VR game, four factors in HMSAM are used, i.e. perceived usefulness, curiosity, enjoyment, and control. Table 1 shows the HMSAM four factors used in this study each with its constructs.

Table 1. HMSAM Four Factors and Its Constructs

MODEL	FACTOR	CONSTRUCT	DESCRIPTION
Hedonic-Motivation System Acceptance Model (HMSAM)	Perceived Usefulness	a) Educational Value	• provide detailed, interactive, and context-rich experiences • tool for education and understanding of cultural heritage
		b) Preservation and Documentation	• accurate digital preservation of sites and artifacts
		c) Accessibility and Outreach	• share with audience
	Curiosity	a) Exploration and Discovery:	• explore cultural heritage sites from different angles and perspectives
		b) Engaging Storytelling	• engaging narratives, historical reenactments, and interactive storytelling
		c) Interactive Learning	• encourage users to engage actively with the content
	Enjoyment	a) Immersive Environments	• places users in realistic and engaging settings, stimulating their desire to explore and

MODEL	FACTOR	CONSTRUCT	DESCRIPTION
		b) Interactive Elements	discover new details • puzzles, quests, and exploratory tasks
	Control	a) Intuitive Navigation b) Customization Options	• user-friendly and intuitive controls • simple gestures or buttons for movement, interaction, and exploration • customize and personalize settings

2.4.1. Perceived Usefulness

The perceived usefulness of VR technology for cultural heritage preservation can be understood through the adoption and use of technology based on hedonic (pleasure-related) motivation. This study is not looking at the utilitarian motivation (functionality-related). Three constructs related with perceived usefulness in this study are:

a) *Educational Value*: VR can provide detailed, interactive, and context-rich experiences, making it a powerful tool for education and understanding of cultural heritage.
b) *Preservation and Documentation*: VR technology allows for the accurate digital preservation of sites and artifacts, which can be invaluable for research, restoration, and protection against damage or loss.
c) *Accessibility and Outreach*: VR makes it possible to share cultural heritage with a global audience, including people who may not be able to visit physical sites.

2.4.2. Curiosity

The adoption of VR technology can be specifically applied to understand how these technology for cultural heritage preservation stimulates user curiosity. Three constructs related with curiosity in this study are:

a) *Exploration and Discovery*: VR allows users to explore cultural heritage sites from different angles and perspectives, uncovering details they might not notice in traditional settings.
b) *Engaging Storytelling*: VR can present cultural heritage through engaging narratives, historical reenactments, and interactive storytelling, making users curious about the broader historical context.
c) *Interactive Learning*: Features like quizzes, interactive timelines, and artifact manipulations encourage users to engage actively with the content, fostering curiosity.

2.4.3. Enjoyment

VR technology significantly enhances the enjoyment of cultural heritage preservation by providing immersive, interactive, and emotionally engaging experiences. Two constructs related with curiosity in this study are:

a) *Immersive Environments*: The immersive nature of VR places users in realistic and engaging settings, stimulating their desire to explore and discover new details.
b) *Interactive Elements*: Interactive features such as puzzles, quests, and exploratory tasks in VR experiences can enhance enjoyment and drive users to uncover more information about cultural heritage.

2.4.4. Control

Control in this context refers to the degree to which users feel they can navigate, interact with, and personalize their VR experiences. Two constructs related with curiosity in this study are:

a) *Intuitive Navigation*: User-friendly and intuitive controls ensure that users can easily navigate virtual environments. Simple gestures or buttons for movement, interaction, and exploration increase user confidence and control.

b) *Customization Options*: Allowing users to customize and personalize settings such as movement speed, interaction sensitivity, display preferences gives them a sense of control over their experience, let users personalize their avatars, choose their paths, and select the information they want to explore enhance their control and engagement.

3. RESEARCH DESIGN

The study employed a focus group design which involves nine experts in the field of education and VR application/technology. It involves seven steps to gather valuable quantitative data on immersive experience, preferences, and challenges in using Keris VR games. Table 2 shows a simplified guide on conducting the focus group session:

Table 2. Focus Group Session Guide.

Step	Activity	Event
1. Define Objectives (determine the purpose)	• Identify the specific goal • Define the key questions and topics to explore	• immersive experience testing • the ten constructs of HMSAM
2. Plan and Design the Focus Group (select participants, materials, and a moderator)	• Identify the target audience • Recruit a representative sample • Prepare materials • Appoint moderator • Prototype for participants to interact with	• experts in education and VR • nine • questions and discussion prompts • one moderator • the Keris VR game
3. Logistics and Setup (venue and equipment)	• Comfortable and neutral location • Arrange seating for open discussion • Audio/video recording equipment • Informed consent • Related hardware and tools	• a cozy meeting room • round table discussion • video recording equipment • a consent form • VR equipment •
4. Conducting the Focus Group (ice-breaking and discussion)	• Welcoming • Introductory session • Interacting with the prototype	• icebreaker and explaining the purpose • obtain consent form and confidential • playing for an hour, observation
5. Conclude (reflection and	• Instrument (questionnaire) • Discussion	• questionnaire • open-ended questions on

Step	Activity	Event
appreciation)	• Summarize key points	immersive experience, preferences, and challenges • participants final thoughts
6. Post-Session (transcript, analysis, and reporting)	• Transcribe the recording • Analyze data • Qualitative analysis method • Report	• Video playback and detailed notes • Identify common themes, insights, and patterns • Coding and interpret data • Detailed report summarizing the findings • Direct quotes to illustrate key points • Recommendation • Use the insights to inform design decisions, improve usability, and address user needs.

3.1. Rapid Prototype Model for Prototype Development

A VR game called Keris was developed using Rapid Prototyping model. It is an iterative approach and was selected due to several reasons. First, the prototype can be developed quickly using tools and techniques that support rapid iteration such as wireframes, mock-ups, and low-code/no code platforms. Second, by refining the prototype through rapid iterations and feedback, development can proceed more smoothly and cost saving. Third, rapid prototyping allows for the creation of a working model of the game early in the development process.
There are four steps in Rapid Prototype Model introduced for the Keris VR game development, as simplified in Table 3:

Table 3. Rapid Prototype Model: The Four Steps

Step	Activity
1. Information Gathering	Detailed requirement collected through brainstorming session and document analysis.
2. Design	A storyboard design, user interface design, immersive design.
3. Development	Unity Engine for developing the prototype, i.e. the Keris VR game.
4. Evaluate	A focus group session for immersive experience testing.

4. RESULTS

As mentioned, the data analysed in the immersive experience testing were analysed using descriptive analysis method. Their feedbacks were analysed using descriptive statistics. Next section revealed the result of the study. It revealed high mean score for various factors: Perceived Usefulness (Mean=4.528, SD=0.595), Curiosity (Mean=4.363, SD=0.624), Enjoyment (Mean=4.385, SD=0.616), and Control (Mean=4.40, SD=0.59). Table 4 simplifies the results based on the constructs and overall HMSAM Four Factors:

Table 4. Results for HMSAM Four Factors

FACTOR	CONSTRUCT	RESULT
Perceived Usefulness Mean=4.528; SD=0.595	a) Educational Value b) Preservation and Documentation c) Accessibility and Outreach	Mean=4.530, SD=0.682 Mean=4.530, SD=0.628 Mean=4.520, SD=0.642
Curiosity Mean=4.363; SD=0.624	a) Exploration and Discovery: b) Engaging Storytelling c) Interactive Learning	Mean=4.330, SD=0.700 Mean=4.300, SD=0.693 Mean=4.460, SD=0.682
Enjoyment Mean=4.385; SD=0.616	a) Immersive Environments b) Interactive Elements	Mean=4.420, SD=0.678 Mean=4.350, SD=0.693
Control Mean=4.401; SD=0.598	a) Intuitive Navigation b) Customization Options	Mean=4.280, SD=0.713 Mean=4.490, SD=0.656

Based on Table 4, the expert participants have a strong believes that the four factors can reduce cybersickness and increase immersive experiences in playing Keris VR game application in understanding cultural heritage preservation. Table 5 shows feedback received from focus group discussion during the post-session:

Table 5. Focus Group Feedback Based on the HMSAM Four Factors

FACTOR	RESULT
Perceived Usefulness	1. The VR game decreases my stress. 2. The VR game help me better pass time. 3. The VR game provide a useful escape. 4. The VR game help me think more clearly. 5. The VR game help me feel rejuvenated.
Curiosity	1. The VR game experience excites my curiosity. 2. The VR game experience makes me curious. 3. The VR game experience arouses my imagination
Enjoyment	1. I find playing the VR game to be enjoyable. 2. I have fun using the VR game. 3. Using the VR game is not that boring. 4. The VR game sometimes really annoy me. 5. The VR game experience is pleasurable. 6. The VR game leave me satisfied.
Control	1. I have a lot of control when playing the VR game. 2. I can choose freely what I want to see or do when playing the VR game. 3. I have little control over what I can do when playing the VR game. 4. I am in control when playing the VR game. 5. I have control over my interaction when playing the VR game. 6. I am allowed to control my interaction when playing the VR game.

The study provides valuable insights into the development of VR games using HMSAM. In addition, here are some suggestions on future research that could benefit from different aspects:

a) Expanding the sample size and diversity of experts to enhance the generalizability of the findings.

b) Investigating additional factors that may impact user acceptance and immersive experience in VR games.
c) Conducting longitudinal studies to assess the long-term effects of VR game design on user experience and cybersickness.

5. SUMMARY

VR technology for cultural heritage preservation can be perceived as highly useful, leading to greater adoption and positive impacts on education, preservation, and public engagement. It is believed that VR technology can offer cost-effective solutions for exhibitions, education, and preservation. It also provides a platform for researchers to study and to analyze cultural heritage in new ways. Together, these components enable VR technology for cultural heritage preservation to deeply pique users' curiosity and encourage them to explore and learn more about history and culture, all while making learning more pleasurable and engaging.

This article discuss findings from a study on utilizing HMSAM in developing a Keris VR Game to measure the immersive experiences despite cybersickness issues due to prolonged use of HDM equipment. Four factors have been analyzed and revealed that the Keris VR game significantly enhances the enjoyment of cultural heritage preservation by providing immersive, interactive, and emotionally engaging experiences. Virtual reality (VR) invites users to explore, understand, and appreciate history and culture in a way that traditional techniques cannot equal by making cultural heritage accessible, engaging, and pleasurable. This combination of educational value, emotional engagement, and innovative technology makes VR a powerful tool for enhancing the enjoyment of cultural heritage preservation.

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