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Serambi Maya: Development of a Virtual Application for Exploring Malaysian Traditional Village Games

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Abstract

The decline in popularity of Malaysian traditional village games among younger generations has raised concerns about cultural preservation in the digital age. This project, *Serambi Maya*, addresses this issue by developing a virtual reality (VR) application that offers an immersive and interactive exploration of traditional games such as *Guli*, *Galah Panjang*, *Baling Selipar*, and *Batu Seremban*. By leveraging the TRES-D methodology, the application integrates authentic cultural settings, gameplay mechanics, and educational content to engage users aged 13 to 30. The VR environment is designed to simulate hands-on experiences while providing historical context and gameplay tutorials in *Bahasa Melayu*, ensuring cultural relevance and accessibility. Usability and user acceptance were evaluated through functional testing and the System Usability Scale (SUS), with results 70.88%, indicating positive user engagement and satisfaction. This initiative not only revitalizes interest in traditional games but also contributes to the preservation of Malaysia's cultural heritage through innovative digital means.

1. Introduction

Traditional cultural practices are in danger of being forgotten in a society where digital entertainment and technology increasingly rule, especially among younger generations [1]. Traditional Malaysian games that represent the ideals, abilities, and customs of its multi-ethnic community include *Guli, Galah Panjang, Baling Selipar*, and *Batu Seremban*. These games are essential components of the nation's rich cultural legacy. These games not only offer entertainment but also impart valuable life values like patience, cooperation, and strategic thinking. However, based on recent research, these traditional games have been less and less popular in recent years, especially with younger Malaysians who are more likely to play contemporary digital games [2]. Therefore, it is crucial to protect these cultural assets and provide engaging, immersive access to them for the current generation of digital natives. With its ability to create a digital platform that connects the past and present, virtual reality (VR) presents a special chance to revive these classic games. recent studies indicate that younger generations, influenced by digital games and online entertainment, are increasingly unfamiliar with these traditional pastimes. This trend has raised concerns about the preservation of cultural heritage, as younger Malaysians are growing disconnected from traditional practices, contributing to a gradual cultural erosion [3].

Therefore, this project aims to design an immersive VR environment that authentically represents Malaysia's traditional games which is *Guli, Galah Panjang, Baling Selipar* and *Batu Seremban*, to develop an interactive VR gameplay that simulate hands on experience of playing Malaysian traditional games in a VR

environment and to evaluate the usability and user acceptance of the proposed application through testing and user feedback.

This project is designed for users between the ages of 13 to 30 years old, targeting a tech-savvy generation familiar with modern digital entertainment but perhaps less connected to traditional cultural practices. The content will be entirely in *Bahasa Melayu* (BM) to ensure that it resonates deeply with local users and provides a culturally authentic experience. Each of the application's four modules will deliver users a comprehensive, immersive learning experience by providing new knowledge on the history, rules for gameplay, and hands-on gameplay of the traditional games. The historical overview will be followed by a detailed explanation of each game's rules. Overall, the four modules of the application will offer users a thorough educational experience that enlightens them about the cultural settings, gameplay mechanics, and historical foundations of traditional Malaysian games in an engaging, immersive manner that makes learning pleasurable and unforgettable.

The rest of the paper will be arranged as follow section 2 that will covers study domain, technology used and the comparative analysis results. Section 3 explain about the methodology used which is TRES-D as well as the output of analysis and design phase of the project. Section 4 will be discussed about the results and discussion while Section 5 describe the conclusion.

2. Related Work

The project background study, technology used and comparative analysis will be discussed in this section.

2.1 Malaysian Traditional Games

Malaysian Traditional games such as *Guli, Galah Panjang*, *Batu Seremban and Baling Selipar* have long been an essential component of our country's cultural character. *Batu Seremban* is usually played indoor meanwhile *Guli* and *Baling Selipar* would be played outdoor at an open space. Apart from providing amusement, these games can serve as a platform for teaching important social skills including teamwork, strategic thinking, and cultural awareness [4]. If we go back into the history of traditional games, these games were played in village as a form of bonding among the children and adults alike. However, these traditional games are losing practice due to the rise of digital entertainment and shifting lifestyles, which has resulted in a significant decrease in their cultural relevance and presence in contemporary culture [5].

Moreover, the existing digital approaches also face challenges in making these games accessible to global audiences or individuals who lack physical resources to play. This leaves a gap that might be filled with the help of contemporary technology like virtual reality. By using VR, traditional games can be presented in an immersive, captivating, and instructive manner that appeals to younger generations. However, current VR applications that focus on cultural heritage tend to prioritize static visual tours or singular activities, with minimal emphasis on interactive gameplay or historical storytelling.

To solve the problem, a thorough and engaging applications is required that incorporates historical, cultural, and educational storylines into the experience in addition to simulating the gameplay of traditional Malaysian games. This project seeks to overcome these challenges by developing an interactive VR application that represent Malaysian traditional games, and providing both entertainment and also cultural and historical education in a format that resonates with modern audience.

2.2 Virtual Reality

As we know, Virtual Reality (VR) is a cutting-edge technology that immerses users in a virtual environment. Offer them a sense of presence and interactivity that mimics real life experiences. VR simulates a three-dimensional environment that users can explore and interact with using specialised technology, such as motion controllers and head-mounted displays (HMDs) [6]. There are three main categories of VR, each with varying levels of immersion. Firstly, non-immersive VR such as desktop applications which only allow users to interact with a virtual environment through a standard screen and the experience lacks the physical feeling of being inside the virtual world. Next, semi-immersive VR, which utilizes 3D displays or large screens, offers slightly more engagement but still lacks full interaction. Lastly is fully immersive VR, which this project adopts, is the most advanced type and integrates HMDs, motion tracking systems, and VR controllers.

Apart from that, despite its numerous benefits, VR also has it is own limitations. The price of VR gear, which includes controllers, HMDs, and powerful PCs, is a major hurdle. This may restrict its availability, particularly for under resourced communities. Another drawback is the potential physical side effects of extended VR system use, such as motion sickness or exhaustion, are another disadvantage. Nevertheless, numerous sectors have successfully adopted virtual reality technology. Virtual reality (VR) is utilised in education to create immersive learning experiences, such seeing historical locations, rehearsing medical procedures, or interacting with intricate scientific models. VR games like Beat Saber and Half-Life: Alyx demonstrate the potential for high levels of interaction and involvement in the entertainment and gaming sector [7]. Through the creation of secure and

adaptable virtual environments, virtual reality is used in the healthcare industry for therapy and rehabilitation. Another important area where VR is becoming popular is cultural preservation.

2.3 Comparative Analysis

Comparative analysis between three similar existing application and proposed application were conducted. The applications that were compared are *Konda-kondi*: The legend [8], Google earth VR [9], and The lab VR [10]. The applications were compared with the proposed application based on four features of each application, the application strength and limitation in Table 1 below.

Table 1 *Comparative analysis*

Features/ Applications	Google Earth VR [9]	The Lab VR [10]	*Konda-Kondi*: The Legend [8]	*Serambi Maya*
Functional Requirement	Allows users to explore the globe in VR, zooming in on any location	Includes a variety of mini-games and experiments to showcase VR capabilities	Utilizes AR Technology to enhance gameplay experience	Teaches history and gameplay of Malaysian traditional games in a cultural context
User experience	Provides a cinematic, immersive experience for virtual travel	Physics-based puzzles, including archery and robotics mini-games	Includes multimedia elements like text, video, and images	Simulates traditional games like *Guli* and *Batu Seremban* in VR environments
Nonfunctional feature	Offers educational tools for geography and cultural landmarks	High-quality graphics and sound design for entertainment	Features detailed 3D characters and environment reflect the cultural and traditional aspects of the game	Includes educational modules on the cultural significance and history of each game
Functional feature	Focused on free exploration and discovery of global landmarks	Focused on showcasing VR capabilities	Includes real-time interactions such as swiping and flicking on screen to trigger the gameplay action	Interactive gameplay mechanic
Strength	Excellent tool for education and virtual tourism	Provides an engaging introduction to VR with various mini-games	Promotes creativity, social interaction, and collaboration	Combines cultural education with immersive gameplay to preserve heritage
Limitation	Limited interactivity beyond exploration	Lacks depth in cultural or educational aspects	Requires smartphones with AR capabilities, potentially limiting accessibility for some users.	Focused specifically on Malaysian games, which limits global applicability

Applied Information Technology and Computer Science Vol. 7 No. 1 (2026) p. 40-57

3. TRES-D Methodology

This section covers the methodology that will be used for the project development. The chosen methodology is TRES-D methodology as shown in Figure 1. The TRES-D, (Three dimensional user interface development) methodology was chosen due to its emphasis on iterative design and adaptability to immersive environments. The iterative design process phases in TRES-D ensures the incorporation of user feedback at each station, allowing for future improvement [11]. Moreover, the concept and design phase can allow the cultural heritage element to blend effectively with modern VR technology. The approach reduces a high risk and guarantees high quality results by breaking the development into discrete phases, which is in line with the project's aim.

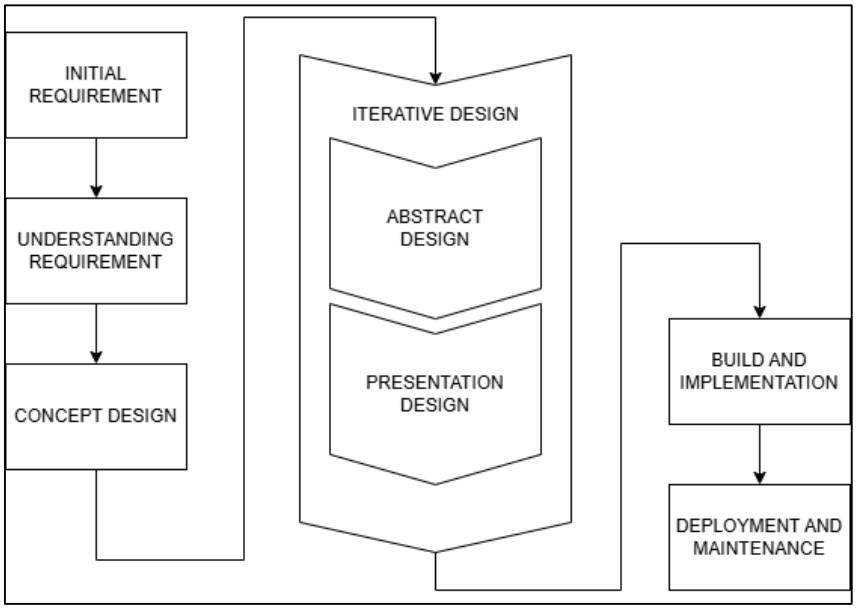


Fig. 1 *TRES-D Methodology* [11]

3.1 Initial Requirement Phase

During the Initial requirement phase, the foundation of the project was established and clearly define the purpose of the project which is objective of the project, scope and its target user. The first step in this process is deciding on the project title, which represents the main idea of the program. After that, the problem statement is presented to highlight the problems that the project seeks to solve. To ensure the application meets its objectives, an interview with a Subject Matter Expert was conducted to gather user requirements. This process helped identify the needs, preferences, and expectations of the target audience, resulting in the initial requirements checklist presented in Table 2.

Table 2 *Initial requirement checklist*

Item	Description
Type of application	• VR application
Objectives	• To design an immersive VR environment • To develop interactive VR gameplay mechanics • To evaluate the usability and user acceptance through user feedback and testing
Target platform	• PC based
Target Device	• Oculus Meta Quest 3/3s
Content	• Traditional games gameplay mechanic and their background history
Technology used	• Virtual Reality (VR)

3.2 Understanding Requirement Phase

In this phase**,** it is necessary to understand what is meant to be accomplished, task requirement for the project development. So, in this phase, the user persona will be created to reflect the different types of audience such as student and the younger generations. Cultural research were conducted to explore more about Malaysian traditional games such as *Guli, Galah Panjang, Batu Seremban,* and *Baling Selipar*, ensuring the content is accurate and authentic. Next, prioritizing the project requirement which to identify a must-have feature in the application such as interactive tutorials and gameplay and immersive historical content. Functional requirement of the application is shown in the Table 3 meanwhile a non-functional requirement such as smooth VR interactions were defined as in Table 4.

Table 3 *Functional requirement*

Functional requirements	Module	Description
Autonomous system activities	Immersive activity module	• The user should be able to see the information details of the decoration items when they are pointed out
	Play module for traditional games	• User can select and play four traditional games such as *Guli, Galah Panjang, Batu Seremban and Baling Selipar* • Each game includes interactive VR gameplay mechanics that simulate the real-world experience
	Audio	• Background music should be playing while user start enters the VR environment and play the entire modules • Use traditional music mix with modern element
Provide learning content	Immersive activity module	• The application allows users to click on interactive elements within the application to learn more about the traditional games
	Tutorial module	• Interactive tutorials guide users on how to play each traditional game • Include step by step instruction and visual demonstrations
	History module	• Cultural history module provides information about the origins and significance of the traditional games
User interaction support	User navigation	• A user-friendly menu to allow smooth navigation between modules
	Immersive activity module	• Application should allow users to click start button to start the traditional games • Application should allow user to enter each house in the VR environment
	Learning module	• Application should allow users to click on the interactive element to learn about the history of each traditional games

Table 4 *Nonfunctional requirement*

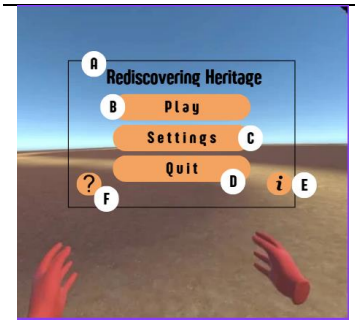
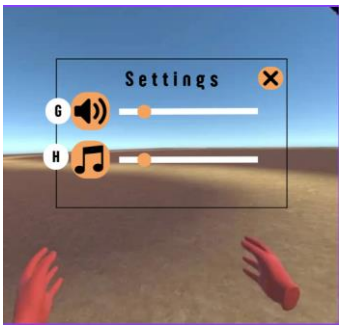
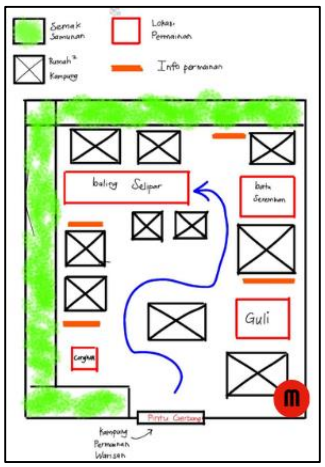
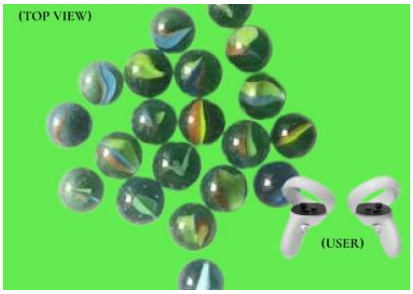
Nonfunctional Requirements	Description
Performance	• The application should not be lag and provide a smooth VR interaction • Loading times for modules and game should not exceed 5 seconds
Usability	• Tutorials and instructions should be simple and engaging • Clear indicators and simple controls
Accessibility	• Including customizable settings such as content language, sensitivity, and control types
Cultural authenticity	• It is important to ensure sensitivity and authenticity by appropriately reflecting Malaysian cultural element in the text, music and visuals
Compatibility	• Application must be compatible with standard VR hardware such as Meta Quest 3 and Meta Quest 3s

Applied Information Technology and Computer Science Vol. 7 No. 1 (2026) p. 40-57

3.3 Concept Design Phase

In this phase, all of the idea were transformed into a structured concept. The visual and structural blueprint of the application was developed to give a clear and better understanding of the project. Designing the application storyboard is one of the tasks in this phase. The user journey is visually expressed by the storyboard development, which charts out the sequence of displays and interactions. Table 5 below shows the selected interfaces from the storyboard of the *Serambi Maya* application.

Table 5 *Storyboard*

Item	Description
	• This is main menu interface • Consist play, settings, about, credit and quit button that can interact with user
	• This is setting interface • User can increase or decrease the sound and music during the gameplay
	• This is map blueprint idea • The settings of the environment are based on Malaysian traditional village • User can freely explore the village and play any traditional games module that they want
	• *Guli* gameplay example

3.4 Iterative Design Phase

During the Iterative Design phase for *Serambi Maya* application, the selected solution goes through a thorough design process at two levels which are abstract and presentation.

3.4.1 Abstract Design

The Virtual environment concept design were developed by specifying the precise locations of the virtual objects/elements and establishment of engaging routes. To give a clear explanation of how the system flows of the application will work, abstract design makes use of both flowcharts and navigation structure. The system flowchart illustrates the data, procedure, intraction and system flow inside the application.

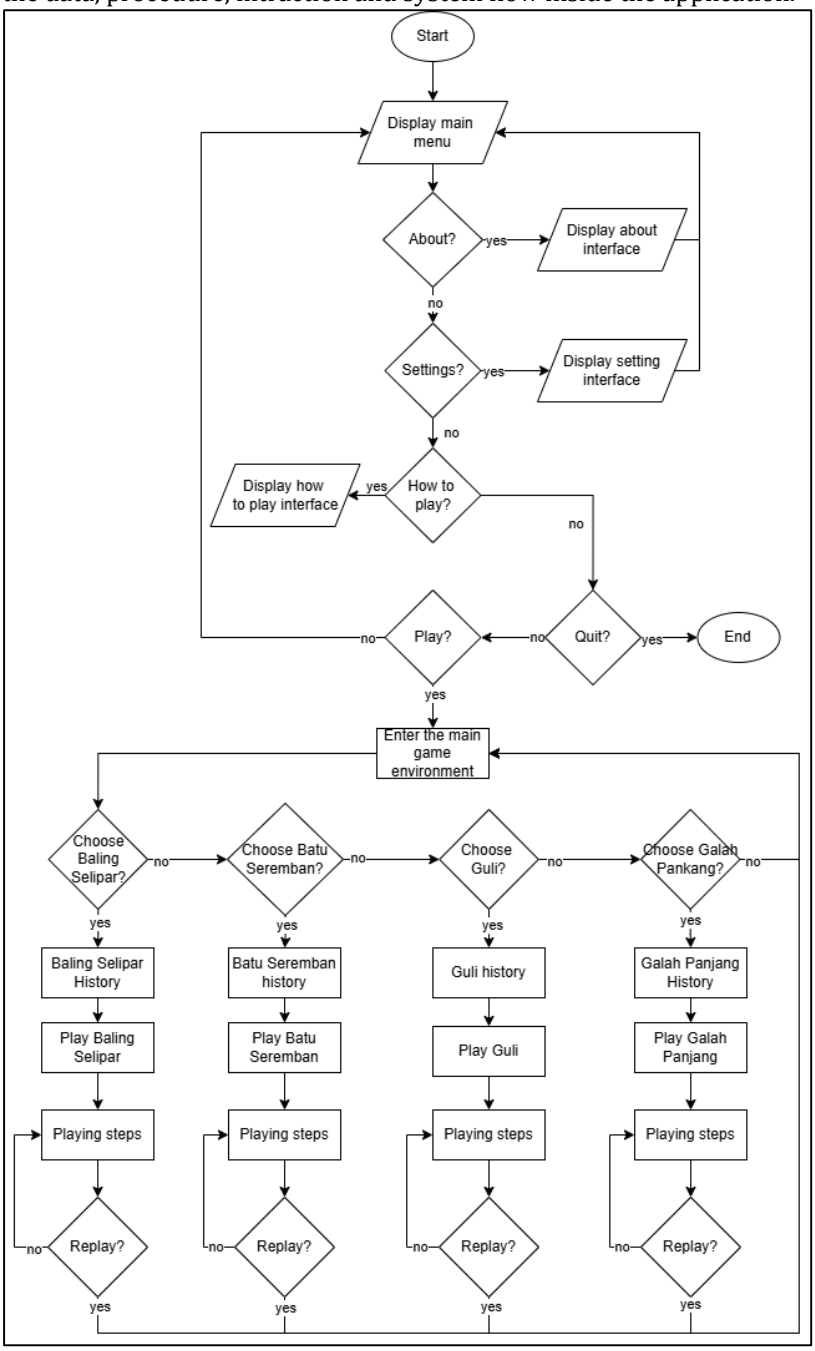


Fig. 2 *System flowchart*

Applied Information Technology and Computer Science Vol. 7 No. 1 (2026) p. 40-57

Figure 2 illustrates that the application is set within a 3D virtual environment, featuring a main menu with options such as Settings, About, How to Play, and Start Experience. Upon entering the main scene, users can freely explore the virtual village and choose any traditional game they wish to experience first. As users approach specific areas, they will encounter objects representing traditional games, accompanied by informational content. They can then decide whether to engage with a particular game by clicking the 'Play' button, which transports them to a dedicated scene designed specifically for that game.

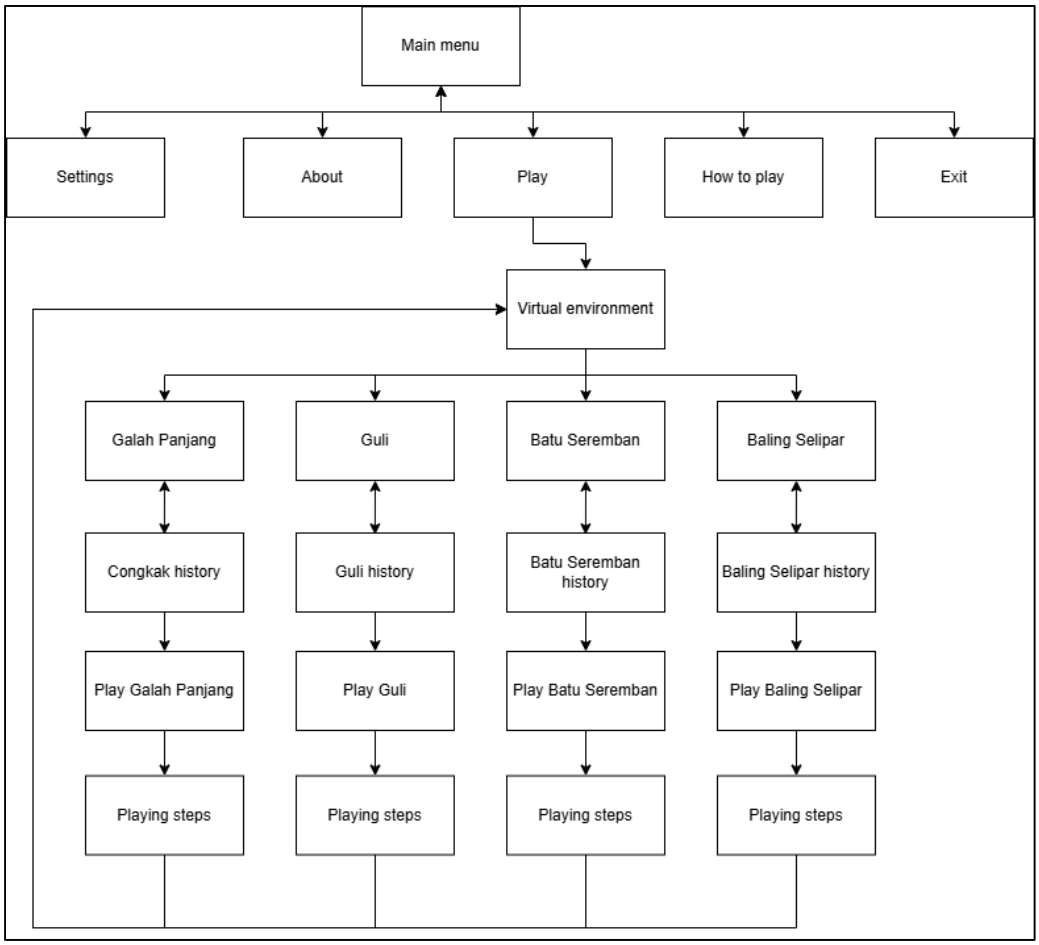


Fig. 3 *Navigational Structure*

Figure 3 shows users can access the main menu, including options such as Settings, About, How to Play, and a selection of traditional games such as *Guli*, *Baling Selipar*, *Batu Seremban*, and *Galah Panjang* and each are offering historical background and interactive gameplay features.

3.4.2 Presentation Design

The concept design process includes gathering reference material from real-world models, integrating the virtual environment into the application interface, and creating fundamental activities, low-level discourse, and interaction styles. Tables 6 and 7 outline the task details in the presentation design phase and the button design, respectively.

Table 6 *Task details in Presentation Design*

Tasks	Description
Selecting Interaction Styles	• Using input device when interacting with virtual objects to play the traditional games
Basic Interaction Tasks	• Users can interact with virtual objects by using device controllers to perform the activities
Concrete Interaction Techniques	• The application Makes use of device controllers to let user interact with the objects in the virtual environment
Design of World Structure	• The world structure in the *Serambi Maya* application is designed to create an immersive and culturally authentic environment that simulates the essence of traditional gameplay.
Geometry and Appearance	• Traditional House such as Minangkabau house and village environment, require detailed design of their geometry to render then in the application
Reference from Real World Models	• Reference model can be gathered from real world models, ensuring that the virtual version is as authentic as the actual traditional game such as *Baling Selipar*

Table 7 *Button design*

Button	Description
	• Start button • Allow user to enter the 3D virtual environment
	• Settings button • Allow user to navigate to settings interface
	• Exit application button • Allow user to exit the application after click the button
	• Controller settings button • It allows user to see each controller button action mapping for the application
	• About button • Allow user to see the details about the application
	• Close button • Allow user to close a pop-up window
	• Sound Volume icon • Let user knows that the volume they increased is sound volume
	• Music volume icon • Let user knows that the volume they increased is music volume

Applied Information Technology and Computer Science Vol. 7 No. 1 (2026) p. 40-57

3.5 Building and Implementation Phase

This phase involves the actual development of the application, where the core functionalities are implemented. The virtual reality (VR) environment is constructed to deliver immersive gameplay experiences with smooth transitions and interactions. Each game module is developed individually, beginning with interface design followed by the integration of functional components. C# scripting is used to enable interactivity, allowing users to engage with virtual objects, explore the village setting, and participate in traditional game activities. Various assets including images, videos, and 3D models representing traditional elements are incorporated to enhance the realism and cultural authenticity of the application. Table 8 describe all Application Asset Development

Table 8 *Application Asset development*

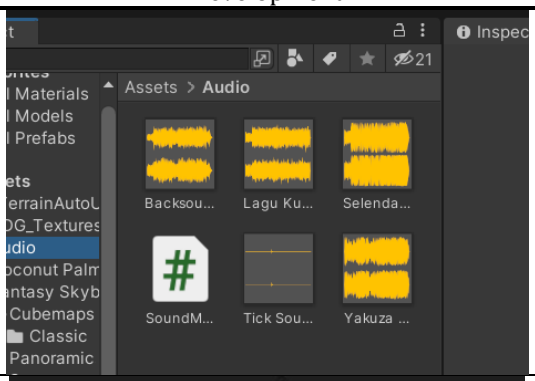
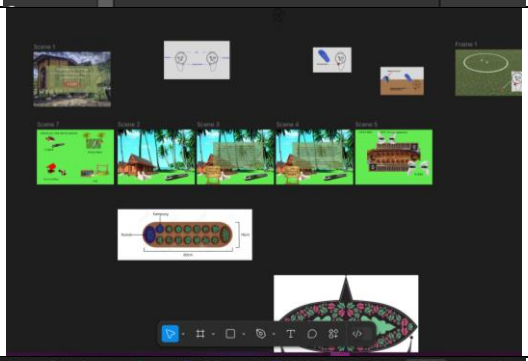
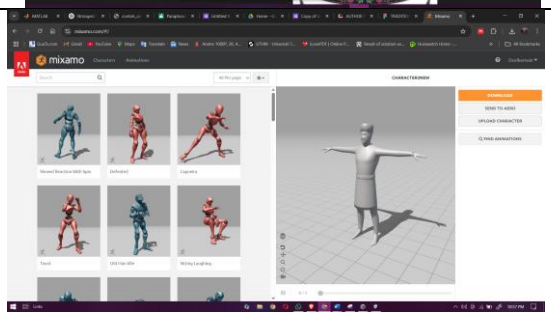
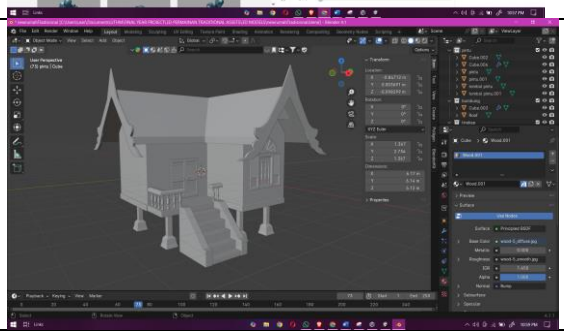
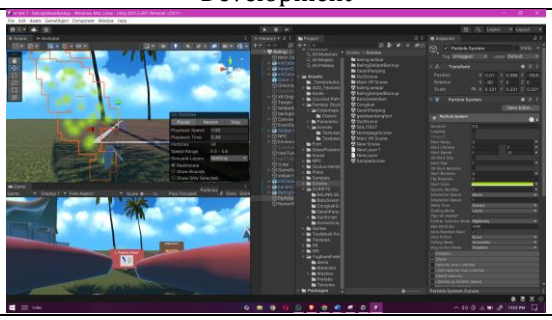
Assets	Development	Description
Audio		All of the audio is acquired from the free website and YouTube and will be stored in the Moving Picture Experts Group Layer-3 Audio (MP3) format.
Graphics		All graphics, application interface and storyboard were design by using Figma platform. The design then was downloaded from the Figma platform and the unnecessary background will be removed by using free background remover tools.
3D animation		This application only has animation for the NPC to make the environment feel more immersive and the simple animation were created by using free animation tools such as Maximo. Put the Character into the tools and Maximo will auto generate the rigging and apply the simple animation.
3D model		Most of the 3D models used in the application were created using Blender, a beginner-friendly and user-friendly modeling software. All models representing traditional games, village houses, and NPCs were designed and developed using this tool.

Table 8: *Application Asset development (cont.)*

Asset	Development	Description
Particle System		A simple particle effect was created in Unity 3D to apply more enjoyment for users. This effect only applied after the user hit the target stack of Slippers.

The creation of several assets for the VR application is described in Table 8, guaranteeing a deep and engaging user experience. These resources improve the application's interactive and visual aspects, giving users a realistic and captivating virtual reality experience. C# scripts are then created to make the application's primary features available. Functions, for instance, thrown object behaviour, manage and updating player score, manages end game state, and detect specific number of objects in the area.

Table 9 *Integration in Unity*

Function	C# Script	Description

This Unity C# script defines the behavior for a "thrown object" in a game, specifically how it reacts when it collides with a certain target.	`private void OnCollisionEnter(Collision collision)`
	`{`
	`if (collision.gameObject.CompareTag(targetTag))`
	`{`
	`ShowSuccessPanel();`
	`if (hitParticles != null)`
	`{`
	`// Move particles to the hit point`
	`hitParticles.transform.position = collision.contacts[0].point;`
	`hitParticles.Play();`
	`}`
	`}`
	`}`
	`private void ShowSuccessPanel()`
	`{`
	`if (successPanel != null)`
	`{`
	`successPanel.SetActive(true);`
	`}`
		This Script was used for *Baling Selipar* game which is designed to handle the behavior of a thrown object when it collides with a specific target. This script will be attached to a game object which is throwable slipper, it detects collisions using the `OnCollisionEnter` method. When the thrown object collides with another object tagged with a specific identifier, it triggers a visual and UI response. The UI response will show users a panel that they hit the target.

Table 9: *Integration in Unity (cont.)*

Function	C# SCript	Description

This script is responsible for managing and updating the player's score based on interaction with specific game object	`private void Start()`
	`{`
	`UpdateScoreText();`
	`}`
	
	`private void OnCollisionEnter(Collision collision)`
	`{`
	`if (collision.gameObject.CompareTag(targetTag))`
	`{`
	`IncreaseScore(1);`
	`}`
	`}`
	
	`// Use this if you're using trigger colliders instead`
	`private void OnTriggerEnter(Collider other)`
	`{`
	`if (other.CompareTag(targetTag))`
	`{`
	`IncreaseScore(1);`
	`}`
	`}`
	
	`void IncreaseScore(int amount)`
	`{`
	`score += amount;`
	`UpdateScoreText();`
	`}`
	
	`void UpdateScoreText()`
	`{`
	`if (scoreText != null)`
	`{`
	`scoreText.text = "Score: " + score;`
	`}`
	`}`
		This script is used for managing scoring for *Guli* gameplay. The script should be attached to a It should be attached to a `GameObject` that either collides with or triggers against other objects that are meant to increase the score. The script uses a public integer variable score to keep track of the current score, and it displays this score using a UI Text component, which must be assigned through the Unity Inspector. The objects that contribute to the score are identified using a specific tag (defaulted to "`ScoreObject`").

This Unity C# script manages the end-game state of the *Galah Panjang* game	`private void Awake()`
	`{`
	`Instance = this;`
	`}`
	
	`public void WinGame()`
	`{`
	`//Time.timeScale = 0f;`
	`winUI.SetActive(true);`
	`Debug.Log("You Win!");`
	`}`
	
	`public void LoseGame()`
	`{`
	`//Time.timeScale = 0f;`
	`loseUI.SetActive(true);`
	`Debug.Log("You Lose!");`
	`}`
		This `GameManager` script can be used to manage the win and lose conditions for a *Galah Panjang* gameplay in *Serambi Maya* application. In the game, attackers aim to cross multiple zones without being tagged by defenders. This script helps manage what happens when either the attackers succeed or fail. It includes two public `GameObjects`, `winUI` and `loseUI`, which are UI panels displayed to the player depending on the outcome.

Table 9: *Integration in Unity (cont.)*

Function	C# Script	Description

This Unity C# script is designed to detect when a specific number of objects are placed within a designated area	`private void Start()`
	`{`
	`if (winPanel != null)`
	`winPanel.SetActive(false);`
	`}`
	`private void OnTriggerEnter(Collider other)`
	`{`
	`// You can tag your objects as "Placeable" in Unity`
	`if (other.CompareTag("Grabbable"))`
	`{`
	`currentObjectsInArea++;`
	`if (currentObjectsInArea == totalObjectsToPlace)`
	`{`
	`ShowWinPanel();`
	`}`
	`}`
	`}`
	`private void OnTriggerExit(Collider other)`
	`{`
	`if (other.CompareTag("Grabbable"))`
	`{`
	`currentObjectsInArea--;`
	`}`
	`}`
	`void ShowWinPanel()`
	`{`
	`if (winPanel != null)`
	`winPanel.SetActive(true);`
	`Debug.Log("You Win!");`
		This Script is used for *Batu Seremban* gameplay. To guarantee that the `winPanel` (if assigned) stays hidden until the player completes the mission, the script turns it off at the beginning of the game. The `OnTriggerEnter` and `OnTriggerExit` methods, which are automatically invoked when an object with a collider (and designated as a trigger) enters or leaves the designated region, include the essential functionality.

3.6 Deploy and Maintenance Phase

The final phase, deployment and maintenance, involves ongoing refinement to ensure optimal performance and user satisfaction. The TRES-D methodology supports flexibility in updating and maintaining the application's quality. During this phase, comprehensive functionality testing is conducted on all buttons and features to identify any issues or areas for improvement. Any bugs discovered are promptly addressed, and the application is updated accordingly. Once the application runs smoothly, it is released for testing by the target users to gather feedback and validate its effectiveness. Two types of testing are carried out in this phase: functional testing and user acceptance testing. The testing was conducted by giving the target user to try the application and collect all valuable response data that can be used for apps improvement and also the acceptance of application. Table 10 presents functional testing results of the application. All the problems are recorded and counter measures have been noted to ensure the smooth performance and enhance user experience in the VR environment. Results of user acceptance testing will be discussed in the following section.

Table 10 *System Functionality Testing*

Test	Expected Result	Actual Result	Action needed
Start Button	Begin exploring the *Serambi Maya* virtual world	Works Well as expected	None
Settings Button Info Button	Show settings UI panel Show Info UI panel		
Next Button	Navigate to next information panel for history section		
XR Grab Interaction	Object can be grabbed in the scene without any glitches		

Table 10: *System Functionality Testing (cont.)*

Test	Expected Result	Actual Result	Action needed
XR Release Interaction	Object can be released smoothly and fall naturally with gravity	Works Well as expected	None
Audio	Audio be played without any issue		
Ensure the box collider prevents object from falling	User cannot move through object with box collider		
Player movement	Player can move smoothly in the virtual environment without any problem		
Instruction Panel	Instruction panel transition smoothly	Half of the module's instruction need improvement	Finalize instruction panel and make it work smoothly
NPC animation	Animation transition play smoothly when in Galah Panjang game module	Animation still not smooth	Fix the script for animator controller
Respawn point after exit scene	Player should be at the location where they first enter the game scene after leave the scene	Player respawns at initial point where they spawn in the virtual environment	Make a script for player to stay at point where they enter the scene

4. Results and Discussion

To ensure the application performs as intended, user acceptance testing was conducted. Each module's functionality was thoroughly evaluated. The overall usability of the application was assessed using the System Usability Scale (SUS), a standardized ten-item Likert scale designed to provide a comprehensive measure of users' subjective experience and satisfaction.

Table 11 *System Usability Scale Output (Odd Number)*

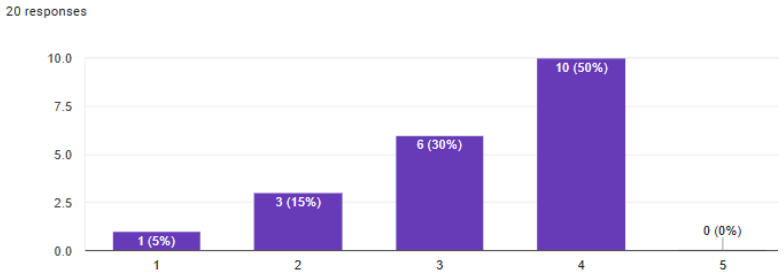
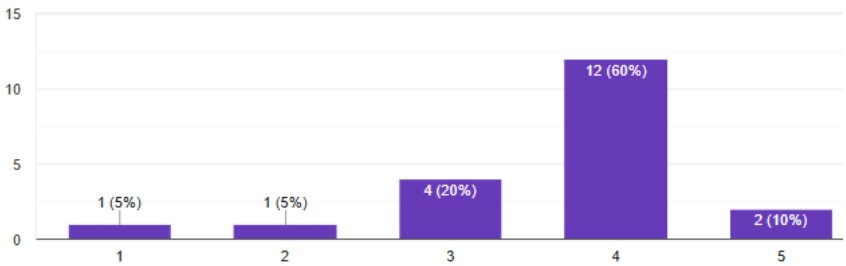
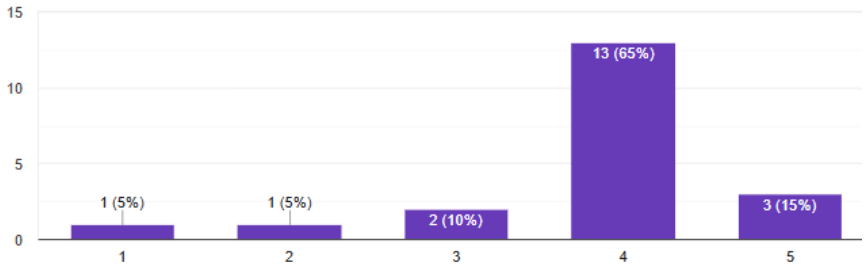
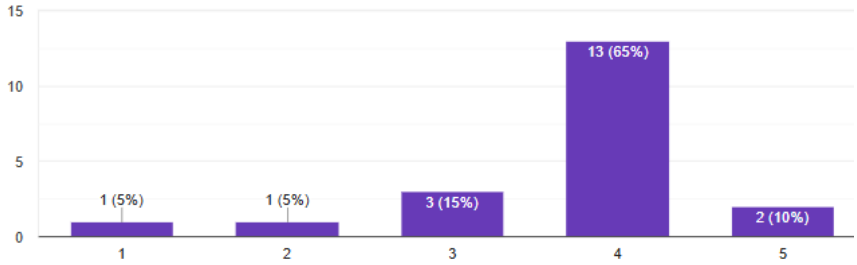
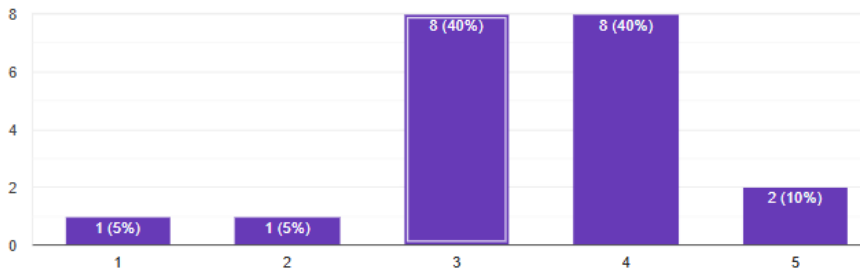
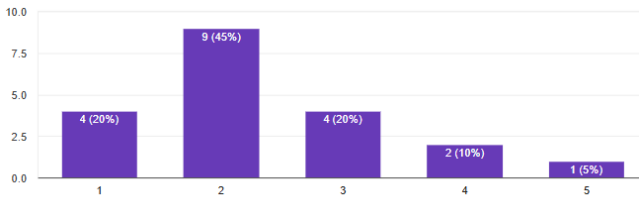
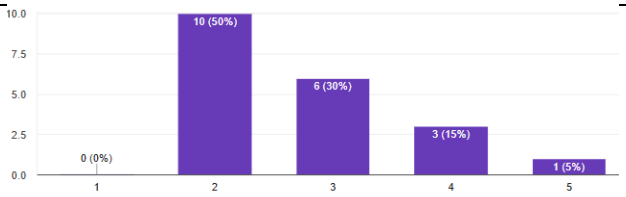
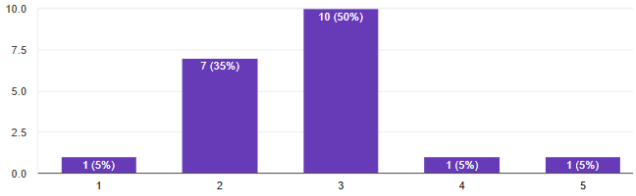
Questions	Output
1. I think that I would like to use this VR application frequently.	
3. I though the application was easy to use	

Table 11: *System Usability Scale Output (Odd Number) (cont.)*

Questions	Output
5. I found the various functions in this application were well integrated	
7. I would imagine that most people would learn to use this application very quickly	
9. I felt very confident using the application	

Based on Table 11 above, most of respondent chose 4 and 3 for positive statements, showing that they agree for the satisfaction and usability of the application. The results overall show a user satisfaction and acceptance in the usage of the application.

Table 12 *System Usability Scale Output (Even Number)*

Questions	Output
2. I found the application unnecessarily complex	
4. I think that I would need the support of a technical person to be able to use this application	
6. I thought there was too much inconsistency in this application	

Applied Information Technology and Computer Science Vol. 7 No. 1 (2026) p. 40-57

Table 11: *System Usability Scale Output (Odd Number) (Cont.)*

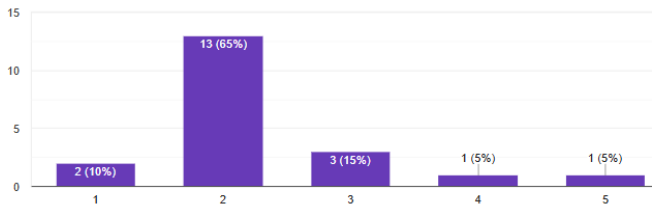
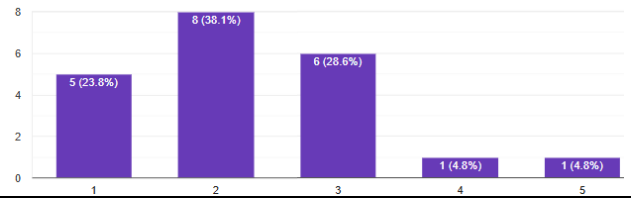
Questions	Output
8. I found the application very cumbersome to use	
10. I needed to learn a lot of things before I could get going with this application	

Table 11 above shows the results for negative statement in the questionnaire. It shows that most of the respondent chose 1, 2 and 3 and majority chose 2 which is disagree. This shows that users do not have any problem when play the application. Some of them chose another answer because of maybe they do not have any exposure to the VR technology. Overall, this shows that users find this application is user friendly and easy to use.

Table 12 *System Usability Scale Score*

Respondent	Item Score										Odd Score	Even Score	Total Score
	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10			
R01	4	2	4	2	4	3	4	2	4	2	15	14	72.5
R02	4	4	4	4	5	2	4	2	4	3	16	10	65
R03	4	3	4	3	4	3	4	2	3	3	14	11	62.5
R04	4	2	5	2	4	3	4	2	5	2	17	14	77.5
R05	2	2	4	3	4	3	4	2	3	3	12	12	60
R06	2	2	3	2	3	2	4	2	4	2	11	15	65
R07	4	2	3	3	4	3	3	2	3	2	12	13	62.5
R08	3	2	3	2	4	3	4	3	4	2	13	13	65
R09	3	3	3	2	4	2	3	2	3	2	11	14	62.5
R10	2	1	4	2	4	2	4	1	5	1	14	18	80
R11	4	1	4	2	4	2	4	2	4	4	15	14	72.5
R12	2	2	2	2	2	2	2	2	2	2	5	15	50
R13	3	2	4	3	4	1	4	2	4	1	14	16	75
R14	3	1	4	2	4	3	4	1	3	1	13	17	75
R15	5	1	5	1	5	1	5	1	5	1	20	20	100
R16	3	2	4	2	4	2	4	2	4	2	14	15	72.5
R17	4	3	4	3	4	3	4	3	4	3	15	10	62.5
R18	4	1	5	2	5	3	5	2	3	1	17	16	82.5
R19	4	2	4	2	5	2	5	2	4	2	17	15	80
R20	4	1	4	1	4	2	4	2	3	3	14	16	75
												Average Score	70.88

The testing phase of the VR application was conducted by involving students from Universiti Tun Hussein Onn Malaysia (UTHM) as participants. These students were invited to try out the developed VR application in a controlled environment to evaluate application functionality, usability, and overall user experience. After

experiencing the application, they were asked to complete the System Usability Scale (SUS) form, which served as a standardized method to gather feedback on the application's usability. The collected responses provided valuable insights and helped identify areas that could be improved to enhance the effectiveness and user satisfaction of the VR application. The analysis of respondents' Google Form Questionnaire scores is displayed in Table 12 above.

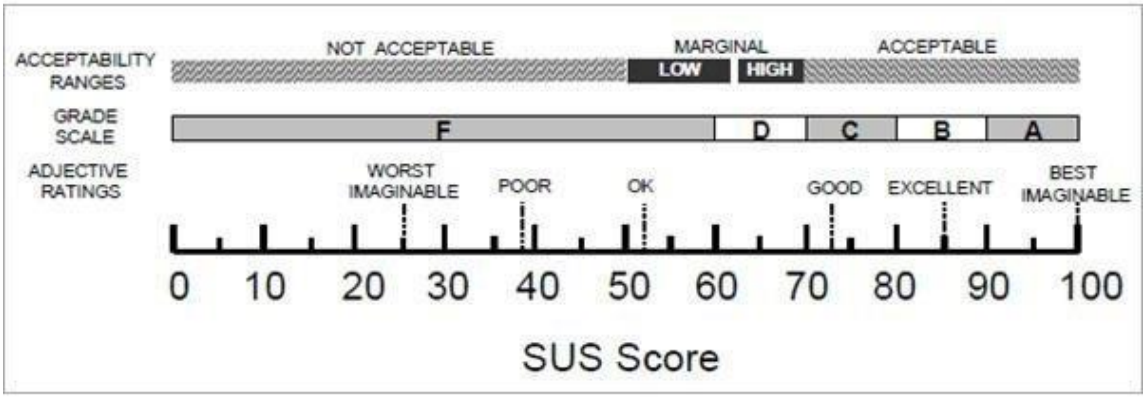


Fig. 4 *System Usability Scale (SUS)*

By using a technique based on the System Usability Scale (SUS), the total scores for every question from the user testing were calculated. The average score of 70.88 which is gain from calculation in Table 12 above falls in the range of acceptable according to the SUS scale shown in Fig 4. Good is the adjective rating meanwhile grade scale falls into C grade scale. Overall, the application has successfully met the user requirement of the target user.

5. Conclusion

The development of the *Serambi Maya* application successfully achieved its primary objectives: designing an immersive virtual reality (VR) environment, developing interactive gameplay for traditional Malaysian village games, and conducting comprehensive functionality and user acceptance testing. The application effectively targets users aged 13 to 30, offering an engaging and educational platform that revives interest in traditional games such as *Guli, Galah Panjang, Baling Selipar*, and *Batu Seremban*. The results from usability testing, particularly the System Usability Scale (SUS), indicate that users found the application intuitive, enjoyable, and culturally enriching. The use of the TRES-D methodology contributed significantly to the structured and iterative development process, ensuring that user feedback was integrated at every stage. Despite some limitations such as the need for VR hardware and the absence of tactile feedback the application demonstrates strong potential for preserving cultural heritage through modern technology. Moving forward, future enhancements may include expanding the range of traditional games and further refining the user experience to increase accessibility and engagement.

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Author Contribution

The authors confirm contribution to the paper as follows: ***study conception and design:*** *Dzulkarnain Jamaluddin, Rahayu A Hamid;* ***data collection:*** *Dzulkarnain Jamaluddin;* ***analysis and interpretation of results:*** *Dzulkarnain Jamaluddin, Rahayu A Hamid;* ***draft manuscript preparation:*** *Dzulkarnain Jamaluddin, Rahayu A Hamid. All authors reviewed the results and approved the final version of the manuscript.*

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