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A Study on Components of Interactive Projection Mapping to Enhance Youth Engagement with Kuda Kepang in Malaysia

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ABSTRACT

Recognizing the declining interest among youth generations and the risk of cultural erosion, the research explored how immersive technologies can preserve intangible heritage. This study analysed the components of interactive projection mapping as a strategy to enhance youth engagement with Kuda Kepang in Malaysia. Kuda Kepang, a traditional Javanese dance with deep spiritual and cultural roots, has seen waning participation in modern times, particularly among youth audiences more attuned to digital forms of entertainment. Employing a qualitative content analysis approach, the study analysed six culturally themed interactive projection mapping works, focusing on four key components which are object, content, interaction, and environment. These elements were critically examined to understand how they influence user engagement, cultural resonance, and experiential impact. The findings revealed that dynamic visuals projected onto three-dimensional objects, combined with real-time audience interaction and carefully curated environments, significantly increase immersion, enjoyment, and emotional connection among youth. By transforming passive cultural presentations into participatory experiences, interactive projection mapping bridged the gap between tradition and contemporary digital expectations. The study concluded that integrating these components offers a promising pathway for sustaining and preserving Kuda Kepang, fostering deeper appreciation and ongoing preservation of Malaysia's cultural identity among future generations.
Keywords: Kuda Kepang, Interactive Projection Mapping, Immersive Experience

1 INTRODUCTION

Malaysia's rich cultural diversity is reflected in its many traditional arts, with the Kuda Kepang dance standing out as a unique heritage from the Javanese community, particularly in Johor. More than just a performance, Kuda Kepang carried deep symbolic meaning and historical value, representing both the spiritual and community life of the Javanese-Malay community.

According to Roslina Abu Bakar (2014), Kuda Kepang had strong cultural and aesthetic value, but it is slowly disappearing from public awareness. Datuk Ahmad Din (2022), President of Warisan Anak Seni Malaysia, warns that the Kuda Kepang dance could vanish within 20 years if not preserved. Losing such heritage can weaken national identity and is nearly impossible to recover once lost (Ibrahim, 2017).

To address this, finding new ways to make culture engaging for youth is important. Interactive projection mapping and immersive technology offered exciting possibilities to bring traditional dances like Kuda Kepang to life. By blending technology with heritage, we were able to educate, entertain, and help keep our cultural traditions alive for future generations.

The overall goal of this study was to contribute to the sustainable preservation and revitalization of Malaysia's intangible cultural heritage by exploring innovative approaches that make traditional arts like Kuda Kepang dances relevant and engaging for new generations, in line with UNESCO's recommendations for safeguarding intangible cultural heritage (UNESCO, 2003).

1.1   Research Objective

The objective of this study was to analyse the components of interactive projection mapping to enhance youth engagement with Kuda Kepang in Malaysia.

1.2   Problem Statement

One of the biggest challenges facing the Kuda Kepang dance is the declining interest among youth. Despite its long-standing role in Malaysia's cultural identity, many youths had limited knowledge about the dance, increasing the risk of the tradition being forgotten. Youth enthusiasm for preserving traditional arts is gradually fading, posing a threat to the dance's survival (Din, 2022).

Traditional presentations of Kuda Kepang, typically showcased during festivals or formal events, tended to be passive and did not effectively engage youth audiences. Many youths are unfamiliar with Kuda Kepang and often perceive it as outdated or irrelevant. Studies showed that interactive and innovative engagement methods, such as music therapy and multimedia approaches, can significantly increase youth appreciation and interest in Kuda Kepang dance (Ahmad & Bakar, 2021). However, a lack of accessible educational resources and modern platforms to teach the origins, meanings, and significance of Kuda Kepang remained, further widening the gap between tradition and contemporary youth culture (Sunarti & Fadeli, 2021).

By leveraging interactive technologies and multimedia approaches, this study aimed to revitalize Kuda Kepang for the youth generations. The goal was to bridge the gap between tradition and modernity, ensuring that the cultural, historical, and social values of Kuda Kepang continue to enrich Malaysian identity and community life for years to come. Losing such heritage could weaken national identity and is nearly impossible to recover once lost (Ibrahim, 2017). Moreover, maintaining authenticity through the use of original materials is one of the core challenges in heritage conservation, reinforcing the urgency of adopting sustainable and engaging preservation strategies (Zailani et al., 2024).

2 LITERATURE REVIEW

This literature review examined key components of interactive projection mapping, such as object, content, interaction, and environment, and their potential to enhance youth interest in Kuda Kepang in Malaysia.

2.1   Kuda Kepang in Malaysia

Kuda Kepang is a traditional Javanese dance that was brought to Malaysia by Javanese migrants, particularly in Johor and Selangor. The dance features performers "riding" flat, woven horses made from rattan, accompanied by traditional music and rhythmic movements. It is often performed during cultural festivals, weddings, and community events, serving as a vibrant expression of Javanese-Malay heritage (Cher, 2014).

A distinctive feature of Kuda Kepang is the trance state entered by some dancers during performances, which is believed to invoke spiritual possession or protection. The trance phenomenon, as studied in Batu Pahat, Johor, highlights its cultural significance as a form of healing and spiritual connection within the community. Despite occasional religious concerns and restrictions, the trance element remains an integral part of the tradition, reflecting the syncretism of Islamic beliefs and local

folklore (Nasuruddin & Ishak, 2015).

Efforts to preserve and modernize Kuda Kepang had been growing, focusing on its cultural and artistic value rather than its mystical aspects. This has helped sustain the Kuda Kepang dances as a living heritage, promoting awareness among youth and wider audiences (Cher, 2014). Kuda Kepang represents an important cultural link between Malaysia and its Javanese roots, embodying a unique blend of history, spirituality, and community identity.

2.1.1 Visual Communication to Enhance Youth Engagement

Visual communication, especially through interactive projection mapping, was a powerful strategy for enhancing youth engagement with traditional dances like Kuda Kepang. By projecting dynamic visuals onto physical objects and allowing real-time audience interaction, this method transformed passive viewing into an immersive, participatory experience. The key components, object, content, interaction, and environment, work together to create a sense of presence, enjoyment, and realness, which are crucial for capturing and sustaining the interest of youth audiences (Hyora et al., 2013). This approach not only made cultural heritage more accessible and appealing but also bridged the gap between traditional practices and the digital expectations of today's youth and fostered deeper emotional connections and a renewed appreciation for cultural identity. Moreover, the integration of digital illustration further enhances immersive storytelling and visual engagement in augmented reality, enriching the overall user experience (Rizakri et al., 2024).

The Kuda Kepang dance itself was an experiential art form combining visual, auditory, spiritual, and community dimensions, and was well suited for innovative presentation methods like projection mapping to enhance its immersive qualities (Farid, 2023). Recent creative projects reinterpreted Kuda Kepang by integrating technology and modern design elements, aiming to present it to youth audiences in new contexts while respecting its cultural roots (Yahoo Southeast Asia, 2022). Moreover, maintaining cultural heritage through such interactive methods helped connect youth with ancestral traditions, strengthening community bonds and cultural identity (JKKN, 2023).

2.2 Interactive Projection Mapping Components

Interactive projection mapping consists of four key components: object, content, interaction, and environment. The "object" refers to the physical surfaces onto which visuals are projected, such as buildings, products, or other three-dimensional forms. "Content" encompasses not only the narrative and visual elements but also the expression of texture and materiality, blending real images with computer-generated graphics to enhance realism. "Interaction" involves the dynamic relationship between the audience and the projection, where the content responds to audience movements, sounds, or interface operations, making the experience participatory rather than passive. Finally, "environment" considers factors like lighting conditions, as projection mapping is highly sensitive to ambient light and is often most effective in darker settings. Together, these components work to increase immersion, interactivity, enjoyment, and a sense of realness for the audience, making interactive projection mapping a powerful tool for engaging viewers (Hyora et al., 2013)

2.2.1 Object

The "object" refers to the physical surface where projections are displayed. These surfaces can vary widely, from large building facades (media facade type) to smaller items like sneakers, cars, or miniature models (object type). The choice of surface is crucial, as three-dimensional and textured objects can heighten the sense of realism and spatial distortion, making the experience more immersive. Unlike flat screens, these objects allow for creative manipulation of space and perspective, drawing audiences into the virtual environment (Hyora et al., 2013). Recent advances in dynamic projection mapping have enabled projections onto moving and deformable non-rigid surfaces, such as clothing or paper, by using high-speed tracking and specialized markers to maintain alignment and immersion

(Ishikawa et al., 2016). These developments further expand the possibilities of projection mapping beyond static objects, enhancing interactive and immersive experiences.

2.2.2 Content

"Content" includes the narrative, visual imagery, and the expressive qualities of the projection. Expressive content leverages texture, materiality, and the seamless blending of real images with computer-generated graphics to create a vivid sense of realism. This can make the projected object appear as if it has truly transformed, enhancing the audience's sense of presence. Non-expressive content, by contrast, lacks these qualities and may not evoke the same level of engagement or immersion. The richness and realism of the content are key factors in sustaining the audience's interest and emotional response (Hyora et al., 2013). Projection mapping technology enables the transformation of physical surfaces by visually altering their material appearance, such as turning a plaster statue into metallic or furry textures, thereby enriching the immersive experience (D. Iwai, 2024). The ability to adapt content dynamically to the geometry and color of the projection surface further enhances realism and audience engagement (Jones, 2015). Moreover, the integration of real-time input and interactive elements allows projection mapping to create responsive environments that sustain viewer interest and emotional connection (Nishanka, 2021).

2.2.3 Interaction

"Interaction" sets interactive projection mapping apart from conventional projection through various interface types. Contact interfaces require physical input like pressing buttons or touch surfaces, while non-contact interfaces use sensors for motion, facial recognition, or audio input, enabling touchless engagement. Interaction patterns include reaction, where the system responds predictably to input (triggering animations), and interactivity, where audience actions alter the narrative, enabling a more dynamic, participatory experience. This control and feedback enhance presence, agency, and immersion (Hyora et al., 2013).

Technologies such as motion-sensitive zones and gesture recognition allow users to influence visuals in real time, as demonstrated in immersive museum exhibits like "The Edge of Government" exhibition in Dubai, where visuals react dynamically to audience movement (Hafza, 2024). Tangible interfaces that combine physical models with projection have been used effectively in cultural heritage museums to create interactive storytelling experiences, such as the Mastic Museum installation in Greece, which connects tangible and intangible heritage through projection on 3D-printed models (Nikolakopoulou et al., 2022). Furthermore, body-based interactions using hand and head movements in immersive virtual environments have been found to increase user engagement and presence compared to traditional device controls (Intuiface, 2022). These developments illustrated the growing potential of interactive projection mapping to create immersive, participatory experiences across museums, exhibitions, and cultural events.

2.2.4 Environment

The "environment", especially lighting conditions, plays a crucial role in the effectiveness of projection mapping. Since projectors are sensitive to ambient light, interactive projection mapping works best in dark or dimly lit spaces where the projected images remain vivid and clear, allowing the visuals to fully transform the perception of the object or space and maximize immersion (Hyora et al., 2013).

3 METHODOLOGY

3.1 Research Design

This study used a qualitative content analysis approach to examine interactive projection mapping components that enhance youth engagement with Kuda Kepang in Malaysia, focusing on elements such as object, content, interaction, and environment (Hyora et al., 2013). According to Krippendorff (2013), Content analysis is a systematic method for making valid inferences from texts within their context, emphasizing clear research questions and contextual understanding. This approach enables the identification of themes and patterns in qualitative data, helping to organize complex information and clarify how projection mapping components relate to audience engagement (Bengtsson, 2016). A sample of six interactive projection mapping videos related to the culture & heritage theme was selected for data analysis. The videos were selected based on projection mapping works that include interactive elements.

Components of Interactive Projection Mapping, adapted from Hyora et al., 2013, which included object, content, interaction, and environment
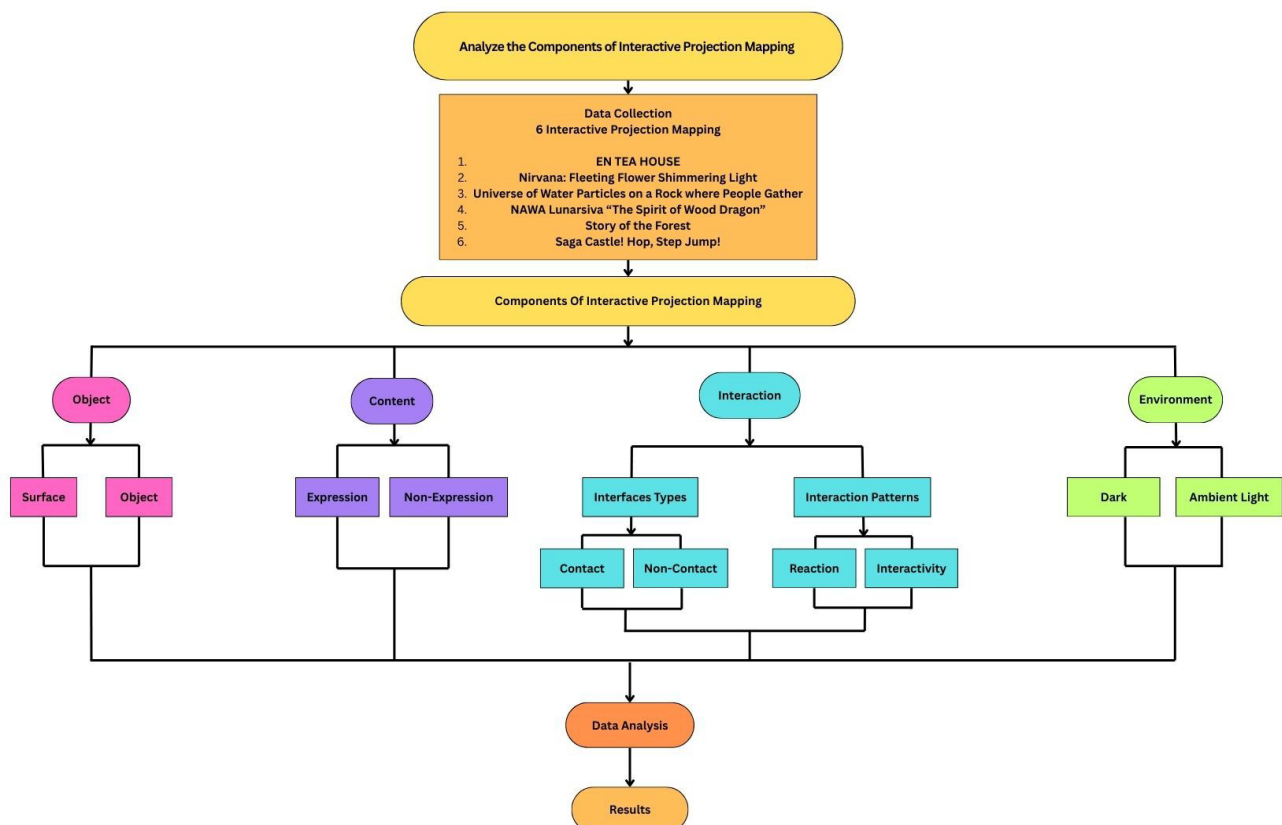
Figure 1 Framework of Study (Source: Hyora et al., 2013)

4 SAMPLE OF INTERACTIVE PROJECTION MAPPING

These interactive projection mapping works were selected for their availability on YouTube and for their cultural and heritage themes from various regions across Asia. They showcased how projection mapping incorporates interactive elements to attract and engage visitors. The selection specifically focused on culturally themed works, ranging from as early as 2013 to the most recent in 2025.

Table 1 Selection Sample of Interactive Projection Mapping Based on Culture and Heritage Themed that available on the YouTube Platform.
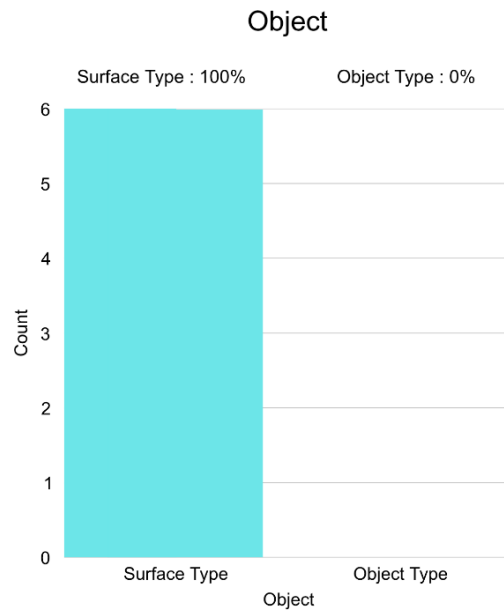
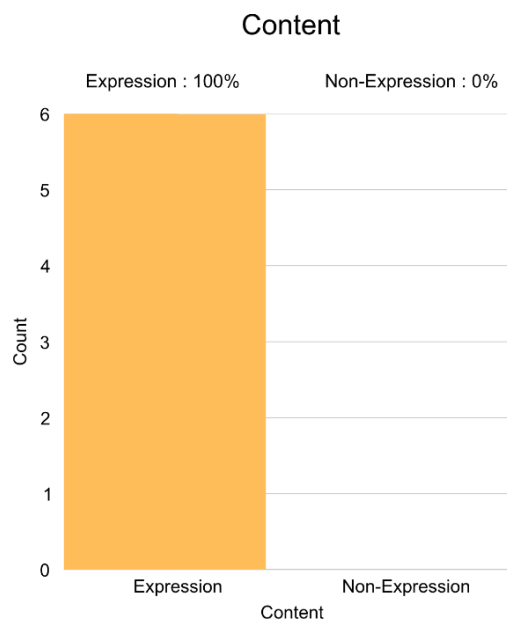| No	Code	Interactive Projection Mapping	Production	Year & Places	Theme	Platform
1	IPM 1	EN TEA HOUSE	teamLab	(2018-present) teamLab Borderless, Azabudai Hills, Minato City, Tokyo, Japan	Culture & Heritage	YouTube
2	IPM 2	Nirvana: Fleeting Flower Shimmering Light	teamLab	(2020-present) teamLab Borderless, Azabudai Hills, Minato City, Tokyo, Japan	Culture & Heritage	YouTube
3	IPM 3	Universe of Water Particles on a Rock where People Gather	teamLab	(2018-present) teamLab Borderless, Azabudai Hills, Minato City, Tokyo, Japan	Culture & Heritage	YouTube
4	IPM 4	NAWA Lunarsiva "The Spirit Of Wood Dragon"	Lzy Visual	(3 Feb – 10 March2024) Pakuwon City Mall, Surabaya,Indonesia	Culture & Heritage	YouTube
5	IPM 5	Story of the Forest	teamLab	(2016-2024) National Museum of Singapore, Glass Rotunda	Culture & Heritage	YouTube
6	IPM 6	Saga Castle! Hop, Step Jump!	teamLab	(2013) Saga Castle History Museum, Saga, Japan	Culture & Heritage	YouTube

5 DATA ANALYSIS

Table 2 Analysis of Components of Interactive Projection Mapping

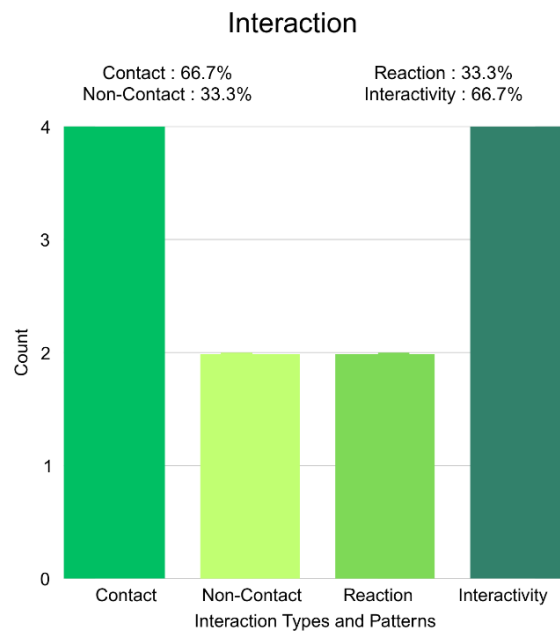| Code	Components Of Interactive Projection Mapping (adapted from Hyora et al., 2013, which includes object, content, interaction, and environment)									
	Object		Content		Interaction				Environment	
	Surface Type	Object Type	Expression	Non-Expression	Interfaces Types Contact	Non-Contact	Interaction Reaction	Patterns Interactivity	Dark	Ambient Lights
IPM 1	(/) Tabletop, Teacup		(/) Digital visuals of tea, flowers bloom in cups		(/) Touch (Physical interaction when picking up or placing the teacup).			(/) Visuals (Respond dynamically to user actions, like blooming flowers)	(/)	
IPM 2	(/) Wall		(/) Animated flowers, Animals, & immersive light patterns		(/) Touch (Flowers scatter upon physical contact)			(/) Visual (Responds in real-time to user actions, like flowers scattering)	(/)	
IPM 3	(/) Wall		(/) Simulated water flow, changing visuals			(/) Body sensor (Water flow changes to avoid people without contact)		(/) Visual (Continuously adapts to people's movement in real-time)	(/)	
IPM 4	(/) Wall, floor		(/) Animated dragon, cultural expression		(/) QR codes (Physical action with a device)		(/) Animated Lantern (Plays in response to QR code scan to trigger effect)		(/)	
IPM 5	(/) Wall, Ceiling		(/) Animated forest, animals move with the visitor			(/) Motion/Body Sensor (Animals react to nearby movement or presence)		(/) Visual (Animals respond to visitor movement in real-time)	(/)	
IPM 6	(/) Castle Wall		(/) Castle transforms, animated effects		(/) Jumping (Physical jump on trampoline to trigger effects)		(/) Jumping (Triggers one-time cannon fire and video projection)		(/)	

6 RESULTS

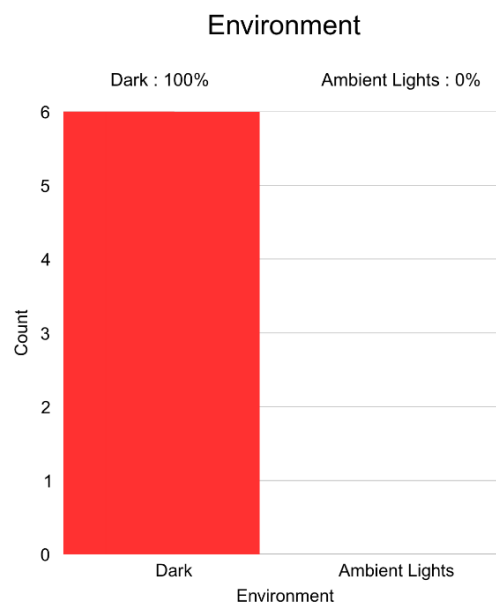**Figure 2** Results of Object in Interactive Projection Mapping

Figure 3 Results of Content in Interactive Projection Mapping

Interaction

Contact : 66.7%
Non-Contact : 33.3%

Reaction : 33.3%
Interactivity : 66.7%

Figure 4 Results of Interaction in Interactive Projection Mapping

Environment

Dark : 100%

Ambient Lights : 0%

Figure 5 Results of Environment in Interactive Projection Mapping

7 FINDINGS

The findings indicate that all six interactive projection mapping samples incorporate three-dimensional physical objects such as walls, tables, and ceilings as projection surfaces. These tangible forms enhance spatial realism and immersion, as visuals can interact naturally with their shape and texture, drawing users deeper into the experience.

Additionally, all installations utilise expressive digital visuals, including animated graphics and responsive imagery that adapt in real time to audience presence. The consistent absence of static or non-

expressive content underscores the importance of dynamic storytelling in maintaining youth engagement and emotional connection.

Regarding interaction, both contact-based (touch, physical triggers, QR scanning) and non-contact-based (motion sensors, gesture recognition) interfaces are applied. Notably, approximately 66.7% of the samples favour contact-based methods, which foster a more tangible and immediate sense of participation. These interactive features foster a stronger sense of agency by encouraging active user involvement, aligning with the preferences and behaviours of digitally native audiences.

Finally, all installations take place in controlled, dark environments without ambient lighting. This condition ensures maximum clarity and vividness of the projections while minimizing visual distractions. Taken together, the findings suggest that effective projection mapping requires a thoughtful combination of engaging objects, rich content, responsive interactivity, and immersive environments. Moreover, the integration of service design strategies enhances user experience and supports the long-term sustainability of cultural spaces (Bakar & Idris, 2024).

8 CONCLUSIONS

In conclusion, this study demonstrates that interactive projection mapping is an effective approach to enhance youth engagement with cultural heritage, particularly the Kuda Kepang tradition in Malaysia. Installations that integrate expressive digital content, immersive environments, and both contact and non-contact interactivity prove to be more successful in capturing and sustaining youth interest. Among the key components, expressive visuals and real-time audience interaction stand out as critical in creating memorable, participatory experiences. Furthermore, the consistent use of dark or controlled lighting environments significantly enhances the impact and clarity of the projections. Ultimately, combining projection mapping with meaningful cultural narratives presents a compelling strategy for revitalizing traditional arts. This approach not only makes heritage more accessible and relevant to younger generations but also supports broader efforts to preserve Malaysia's intangible cultural legacy.

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AUTHOR CONTRIBUTIONS

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CONFLICT OF INTEREST

There is no conflict of interest.

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