

ROLE OF LITERATURE AND ARTS IN MAKING BHARAT A DEVELOPED NATION:

FROM LOCAL TO GLOBAL

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इस पुस्तक का सर्वाधिकार सुरक्षित है। प्रकाशक/लेखक की लिखित अनुमति के बिना इसके किसी भी अंश को, फोटोकॉपी एवं रिकार्डिंग सहित इलेक्ट्रॉनिक अथवा मशीनी, किसी भी माध्यम से, अथवा ज्ञान के संग्रहण एवं पुनःप्रयोग की प्रणाली द्वारा, किसी भी रूप में, पुनरुत्पादित अथवा संचारित-प्रसारित नहीं किया जा सकता।

IMMERSIVE DIGITAL ENVIRONMENT TO ENHANCE ACCESSIBILITY AND ENGAGEMENT WITH TRADITIONAL MUSIC

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Abstract

This study integrates an immersive digital environment to enhance accessibility and engagement with traditional music. Sri Lankan traditional music types such as bullock-cart songs, boatman songs, kamath gee, and watch hut songs were used as musical forms for this study. The proposed VR application provides an immersive educational experience for contemporary audiences. Given the intangible nature of these traditions and their declining practice, the application aimed to bridge the generational gap by leveraging VR technology to recreate these cultural expressions in their original context. The VR environment was designed using a structured design pipeline. Evaluation was conducted to assess the usability, cultural authenticity, and educational effectiveness of the developed VR application. The results demonstrate the potential of the application as an innovative tool for intangible cultural heritage preservation and transmission.

Key Words: Digital Environment, Enhance Accessibility and Engagement, Traditional Music, Virtual Reality

Introduction

According to Buragohain et al. (2024), technological interventions can significantly contribute to the preservation of cultural music by providing tools and methods for documentation, engagement, education, storage, conservation, and analysis. The dynamic intersection between technology and cultural heritage preservation has

redefined how societies safeguard and transmit their historical legacies to future generations to be preserved. According to Latta and Oberg (1994), Virtual Reality (VR) involves the creation and experience of an environment that is not normally or easily experienced by participants. Furthermore, they stated that the human-computer interface allows participants to interact with it. Moreover, Hao (2022) presented heritage education as an important strategy for teaching young people to understand their own culture from the past to the present. VR's interaction methods of VR and the user experience of VR play an important role in improving the quality of heritage education (Paolanti et al., 2023).

Traditional music is not just auditory; it's a multisensory experience that often involves specific cultural and environmental contexts. VR's immersive nature could be uniquely suited to replicating these aspects, allowing users not just to hear the music but to feel present in its original context. Y. Zhao et al. (2025) stated the potential of Virtual Reality (VR) for a range of cultural heritage preservation applications. This technology has the "ability to create three-dimensional representations of real or imagined locations, provides a compelling sense of realism, illustrating its potential for various applications in cultural heritage preservation, such as 3D historical reconstruction, enhanced tourism engagement, gamified learning, and pedagogical cultural heritage programs" (Y. Zhao et al., 2025, p. 1). VR's immersive capabilities surpass those of other digital technologies, such as 2D video or audio recordings, by providing a three-dimensional, interactive experience that more closely mimics attending a live performance. VR's interactivity differentiates it from other technologies in capturing the communal aspects of traditional music performances.

Traditional music often involves audience participation or a

communal setting that is difficult to replicate through passive viewing or listening. VR's interactive potential allows users to not only observe but participate in these performances, perhaps by playing an instrument or following the movements of a dance, thus more fully capturing the communal spirit of these traditions. VR can engage multiple senses simultaneously, a feature that is particularly relevant for traditional music performances. For example, beyond auditory and visual stimuli, VR could potentially incorporate tactile feedback (through haptic technology) to simulate the sensation of playing an instrument or the feeling of dancing. This multisensory engagement is something that other digital technologies, which might only engage sight and sound, cannot fully provide. VR environments can be designed to include educational elements, such as textual information about the history and significance of the music, interviews with musicians, or scenes depicting the music's role in community events. This aspect of VR could be highlighted as a unique affordance, as it allows for a more enriched learning experience compared to simply listening to music or watching a performance. Sri Lanka's traditional music forms, such as bullock-cart songs, boatman's songs, and watch hut songs, have historically been integral to the nation's cultural identity. These musical expressions were not merely artistic performances but were deeply embedded in daily life, agriculture, and community activities. However, with rapid modernization, urbanization, and shifts in occupational structures, these traditions have witnessed a significant decline. The environments and contexts that once nurtured these musical forms have transformed or vanished, making live performances increasingly rare and documentation challenging in the present day. In this sense, the younger generation has limited exposure to traditional musical experiences. The absence of firsthand encounters and the scarcity of accessible video recordings have created a cultural disconnect, posing a risk to the continuity of this

heritage in the future. To fill this gap, innovative approaches are needed to preserve and revitalize these musical traditions. VR technology is an effective tool for achieving this purpose. VR can reconstruct the settings and environment in which traditional songs were originally performed by creating an immersive and interactive environment (Latta & Oberg, 1994). This technology facilitates the creation of interactive educational programs in which users can learn about the history, theory, and cultural significance of Sri Lankan traditional music through engaging simulations and virtual tutorials. Users can virtually experience the ambiance of a watch hut in the paddy fields or the rhythmic journey of a bullock cart, accompanied by authentic musical renditions. This immersive approach preserves auditory elements and contextualizes them within cultural and environmental settings (Paolanti et al., 2023). Moreover, VR facilitates experimental learning (Crogman et al., 2025) and allows users, especially young people, to engage with cultural content in a manner that is both educational and emotionally resonant.

According to Dandeniya's (2016) Temple Gateway and Transcultural Passage model, the VR environment functions as a virtual gateway through which users pass from their own cultural context into Sri Lanka's traditional music. When using a VR environment for traditional music in SL, if the user is unfamiliar with the music types, sounds, and environment, they may encounter a sense of disempowerment and disorientation. This is normal because they are in an unfamiliar cultural setting with unique practices. However, through the utilization of carefully constructed preorientation modules, interactive guides, and contextual narratives, the application fosters a progression that gradually enables users to transition from novice to informed observer and ultimately participate in the cultural performance (Dandeniya, 2016). The pre-orientation module

aligns with Multimedia Learning Theory's (Mayer, 2005). emphasis on providing prior knowledge to enhance learning from multimedia. It also addresses Technological Access Models (TAM)'s (Davis, 1989) focus on perceived usefulness by framing the experience's value. This theoretical lens underscores the importance of structuring VR experiences as a liminal journey that acknowledges the initial cultural distance but leads to meaningful engagement and empathy. Additionally, complementing this, the concept of proximal simulation learning (Nethsinghe, 2013) highlights that learning effectiveness increases when virtual environments closely mirror the real-world contexts they represent.

By pre-orienting the layout of watch huts, the rhythmic ways of bullock carts, the ambient sounds of the chena environment, and boat paddling, the VR application minimizes the psychological distance between the user and tradition. Interactive elements such as handling virtual elements or adjusting ambient conditions reinforce embodied cognition, allowing users to not only observe but also learn by doing within a high-fidelity simulation (Nethsinghe, 2013). This alignment with proximal simulation theory ensures that the VR tool not only captivates attention but also embeds lasting cultural knowledge through an immersive situated learning experience. Additionally, studies have highlighted the efficacy of VR in enhancing cultural education by providing multisensory experiences that foster deeper understanding and retention (Andonova et al., 2023; Crogman et al., 2025; Latta & Oberg, 1994; Paolanti et al., 2023). Integrating VR into cultural preservation strategies ensures that traditional musical forms are archived and revitalized, making them accessible and relevant to contemporary audiences. In conclusion, the use of VR technology offers a transformative approach to sustaining Sri Lanka's traditional musical heritage. It addresses the challenges posed by modernization and generational shifts, ensuring that these invaluable cultural expressions resonate

with and inspire future generations to come. This study integrates an immersive digital environment to enhance accessibility and engagement with traditional music.

Research Methodology

This study used purposive sampling to select the music forms. VR application development focuses on four specific musical forms: bullock-cart songs, boatman songs, Kamath gee, and watch hut songs. This study focused on traditional songs that are rarely performed in contemporary environments, with the objective of safeguarding endangered musical forms.

Purposive sampling was chosen for the selection of music forms due to its effectiveness in identifying and selecting information-rich cases that are particularly knowledgeable about or experienced with a phenomenon of interest. In the context of this study, the phenomenon of interest is the endangered traditional musical forms of Sri Lanka. The criteria for selection were primarily based on,

- the historical significance of the music forms within Sri Lankan culture,
- their current level of practice and performance within traditional settings, and
- the availability of practitioners or knowledge holders.

These criteria were operationalized by consulting with ethnomusicologists, reviewing archival records at the National Archives of Sri Lanka, and preliminary field interviews with cultural practitioners in rural areas. This approach ensured that the selected music forms represented a broad spectrum of Sri Lanka's musical heritage, while also prioritizing those at greatest risk of fading from cultural memory.

The scarcity of live performances necessitated the use of multifaceted data collection strategies. The following data

collection methods were used to collect data related to the development of the tool.

Archival Research – Examined existing audio recordings, manuscripts, and ethnographic studies from national archives and institutions.

Field Interviews – Conducted interviews with elder community members, academics, experts, and cultural practitioners to gather oral histories and contextual information.

Song Recordings – Traditional songs related to the development of tools were recorded in the Department of Ethnomusicology studios.

Results and Discussion

Initial focus groups discussions were conducted with potential users, including students and ethnomusicologists, to gather requirements and preferences for the VR application. Their feedback influenced the selection of traditional music forms and the design of interactive elements. Prototype testing sessions were later held to refine user interfaces based on direct observations and user-reported experiences. The Agile development methodology was selected for its flexibility and iterative approach, allowing for continuous user feedback and rapid incorporation of changes into the VR application. This approach was deemed necessary due to the exploratory nature of developing an educational VR experience, where user feedback could lead to significant adjustments in content presentation and interaction design.

Unity was chosen as the primary development environment due to its strong VR support across multiple platforms, including Oculus Quest and HTC Vive, and its extensive asset store, which provided access to high-quality 3D models and environmental textures. Blender was used for custom 3D models due to its powerful modeling tools and

compatibility with Unity. The application underwent multiple testing phases to ensure its functionality, usability, and cultural accuracy of the content. Technical tests were conducted to assess the performance metrics. User testing was conducted to gather feedback from target users and evaluate the educational effectiveness and user experience of the application.

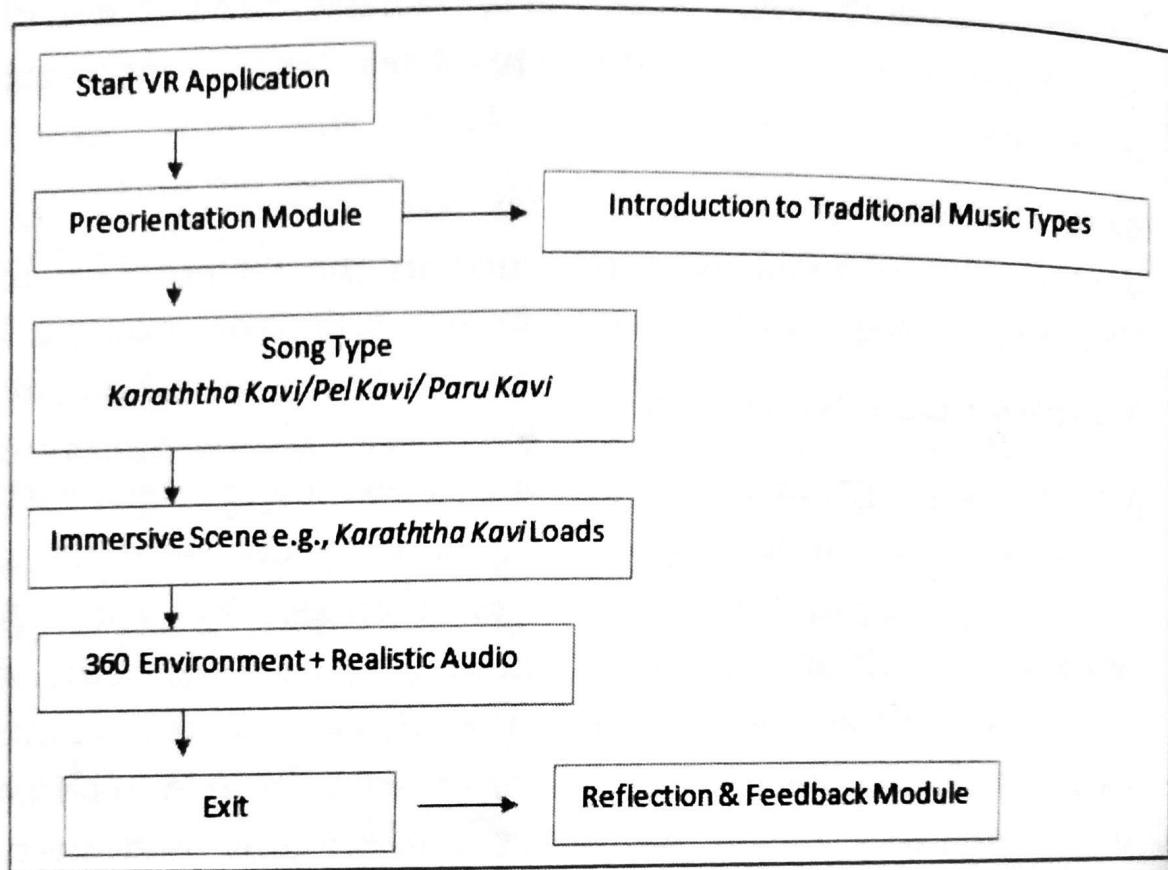


Figure 3: User Experience Flow

The UX flow diagram in Figure 1 outlines the structured navigation within the VR application. The training begins with a preorientation module. The application provides cultural grounding for users before they enter immersive environments that represent specific traditional music types, such as Karaththa Kavi. Each environment was designed with a combination of interactive and observational elements that aligned with the pedagogical goals of engagement and cultural immersion. This flow ensures both usability and educational depth, in line with user-centered design principles and the conceptual framework of Proximal Simulation (Nethsinghe, 2013).

A key challenge identified during the design process was the cultural unfamiliarity of many users, particularly youth, with traditional Sri Lankan music forms. Recognizing that users may lack familiarity with Sri Lankan traditional music forms, a preorientation module was developed and integrated into the VR application. By treating each VR scene as a Temple Gateway described by Dandeniya, (2016), we acknowledge the user's initial cultural disorientation and then gradually facilitate transcultural passage via preorientation and interactive guidance. The preorientation module introduces users to the historical and cultural contexts of the musical practices they are about to encounter, thereby enhancing their understanding and emotional engagement. In parallel, that study incorporated the Proximal Simulation principles introduced by Nethsinghe (2013). Simultaneously, employing Proximal Simulation (Nethsinghe, 2013) ensures that our virtual watch huts, bullock carts, and ambient sounds of real-world sensory and motor cues optimize both immersion and educational impact. This preorientation aims to provide users with foundational knowledge and enhance their cultural understanding and appreciation of immersive experiences. The application was developed using the Unity game engine to ensure cross-platform compatibility with widely available VR hardware, including headsets such as the Oculus Quest and HTC Vive. This scalability enables future expansion into diverse educational and cultural dissemination platforms such as YouTube.

Three-stage evaluation of the application was conducted to assess the usability, cultural authenticity, and educational effectiveness of the developed VR application. The results demonstrate the potential of the application as an innovative tool for intangible cultural heritage preservation and transmission.

Technical Testing Results:

Technical testing conducted throughout the development cycle confirmed the stability, real-time responsiveness, and cross-device compatibility (e.g., Oculus Quest and HTC Vive). The frame rate performance remained consistently above 72 FPS, minimizing motion sickness and ensuring a smooth immersive experience. The latency was maintained within acceptable thresholds, and asset loading times were optimized using Unity's asynchronous loading and asset-bundling strategies. These outcomes validate the technical soundness and readiness of this application.

User Testing Results

Semi-structured interview data were coded to identify major themes, as described by Creswell (2009). Thematic analysis was applied to interview transcripts and that allows for the identification of recurrent themes related to user experience and cultural engagement. Table 1 summarizes the identified codes and their corresponding thematic categories.

Table 4: Identified codes and themes

Codes	Themes
Improved cultural context	Enhanced cultural understanding
Learned about the origins of the songs	
Increased the historical background of the songs	
Recognized the different rhythms	
Saw how music was part of daily life	
Realized the value of these songs	
Understood the value of the preservation of these songs	
Felt closer to tradition	

Felt present in the scene	Increased engagement
Like to learn more	
Enjoyed fully	
Felt a connection with it	
Interact with the environment	
Like to continue	Suggestions to improve interactivity
Need to interact with the surroundings	
Like more control over the music	
Apply to other songs	

Three major themes were identified from the categorized codes.

- **Enhanced Cultural Understanding:-** Users reported a heightened appreciation for traditional music forms, particularly in relation to their cultural and historical contexts. This underscores the effectiveness of the preorientation module and the contextual scaffolding of the application.
- **Increased Engagement:-** The interactive and immersive qualities of the VR environment promote user interest and enjoyment. Many users expressed a desire to explore additional musical traditions through similar applications.
- **Suggestions for Improved Interactivity:-** Participants recommended more opportunities for control and manipulation within the environment, such as the ability to choose songs, adjust audio layers, or interact with more contextual elements.

Expert Review Results

Six expert reviewers from the field of ethnomusicology, educational technology, and VR development evaluated the application. Expert reviewers highlighted the application's

potential as a supplementary teaching tool for traditional work-related songs. Moreover, they confirmed the cultural accuracy of musical representations. They suggested including a border range of musical forms and minor improvements to the interfaces.

Conclusion

The evaluation results indicated that the VR application can be used as a tool to bridge the gap between traditional music and the younger generations. The results revealed that the application was technically accurate. Users stated that the application was relatively easy to use. The positive feedback from the participants stated that VR is a powerful medium for enhancing the cultural education experience. The enhanced cultural understanding theme identified in this study showed that the preorientation module and the contextual information provided within the application were effective in addressing potential user disorientation and knowledge gaps. User suggestions for more interactivity align with both theories - supporting generative processing (Multimedia Learning) and enhancing perceived usefulness and ease of use (TAM). The evaluation results suggest users found the VR application useful for enhancing cultural understanding. This aligns with TAM's emphasis on perceived usefulness driving technology adoption. User feedback indicated the application was relatively easy to use, which TAM (Davis, 1989) identifies as another key factor in technology acceptance. While Multimedia Learning Theory emphasizes the benefits of combining visual and auditory stimuli for enhanced learning, the Technology Acceptance Model focuses on factors influencing user adoption of new technologies. However, both theories converge on the importance of active processing and user engagement in achieving positive outcomes in educational technology applications. The success of the preorientation module aligns with the principles of the Temple Gateway Model

(Dandeniya, 2016) that emphasizes the importance of guiding users through a transcultural passage to facilitate understanding and appreciation. The application's ability to create a sense of presence and connection aligns with the principles of Proximal Simulation (Nethsinghe, 2013). The application effectively conveyed the essence of the musical forms by recreating the key elements of the performance settings and incorporating realistic sensory cues. However, the evaluation of the application revealed areas for future development. The expert review suggested that while the application provides a good foundation, there is room for expansion in terms of the depth and breadth of cultural knowledge offered. Future development efforts should focus on enhancing interactivity and expanding the range of contextual information. Future research can be done to assess the long-term impact of the application on user's cultural knowledge and attitudes. Further development should aim to enrich user agency by allowing more control over musical and environmental variables. Future versions may include multi-language support, user-driven exploration paths, and adaptive learning features. Future studies could investigate the sustained impact of VR engagement on users' cultural knowledge, memory retention, and attitudes towards heritage preservation. In summary, this pilot deployment confirms the value of immersive technology in supporting the education, revitalization, and safeguarding of intangible cultural heritage. The results advocate for the integration of such VR tools into both formal curricula and informal learning environments to cultivate a deeper, more participatory appreciation of traditional Sri Lankan music.

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