ARHYTHM: EXPLORING SABAH'S BAMBOO MUSIC HERITAGE THROUGH AR TECHNOLOGY

ELVYANNA EMMY FIONA HUTASOIT

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

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ELVYANNA EMMY FIONA HUTASOIT

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PERAKUAN KEASLIAN PENULISAN

Nama Pelajar:	Elvyanna Emmy Fiona Hutasoit
No. Pendaftaran:	D20211099620
Nama Ijazah:	Sarjana Muda Pendidikan (Teknologi Maklumat) dengan Kepujian
Bidang Pengkhususan:	Teknologi Maklumat
Tajuk Projek:	ARhythm: Exploring Sabah's Bamboo Music through AR Technology

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Tarikh

Prof. Madya Dr. Ramlah binti Mailok
Timbalan Dekan (Akademik dan Antarabangsa)
Fakulti Komputeran dan Meta-Teknologi
Universiti Pendidikan Sultan Idris
35900 Tanjong Malim, Perak

Tandatangan Penyelia

(Prof. Madya Dr. Ramlah binti Mailok)

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ABSTRACT

Traditional bamboo musical instruments such as Sompoton, Bungkau, Tagunggak, and Seruling are at risk of being forgotten by younger generations. To address this issue, this project explores the use of Augmented Reality (AR) technology as an interactive medium for preserving and promoting Sabah's bamboo music heritage. The AR-based application, ARhythm, provides users with a dynamic learning experience that integrates cultural education and digital innovation. The development of the application follows the ADDIE model (Analysis, Design, Development, Implementation, and Evaluation) to ensure a structured and effective design process. Various educational theories, including behaviorism, cognitivism, and constructivism, are applied to enhance user engagement and learning outcomes. The System Usability Scale (SUS) is employed as the primary evaluation method to assess the application's usability. SUS enables the collection of user feedback, which is instrumental in identifying areas for improvement and refining the application's interface and functionality. Findings from usability testing indicate that ARhythm effectively enhances user interaction with traditional musical instruments, making cultural education more accessible and engaging. This project contributes to digital heritage preservation efforts, ensuring that Sabah's bamboo music remains relevant for future generations through immersive AR experiences.

ABSTRAK

Alat muzik buluh tradisional seperti Sompoton, Bungkau, Tagunggak, dan Seruling berisiko dilupakan oleh generasi muda. Bagi menangani isu ini, projek ini meneroka penggunaan teknologi Realiti Terimbuh (AR) sebagai medium interaktif untuk memelihara dan mempromosikan warisan muzik buluh Sabah. Aplikasi berasaskan AR, ARhythm, menyediakan pengalaman pembelajaran yang dinamik dengan menggabungkan pendidikan budaya dan inovasi digital. Pembangunan aplikasi ini mengikuti model ADDIE (Analisis, Rekabentuk, Pembangunan, Pelaksanaan, dan Penilaian) bagi memastikan proses reka bentuk yang tersusun dan berkesan. Pelbagai teori pendidikan, termasuk behaviorisme, kognitivisme, dan konstruktivisme, diterapkan untuk meningkatkan penglibatan pengguna serta hasil pembelajaran. Skala Kebolehgunaan Sistem (SUS) digunakan sebagai kaedah penilaian utama untuk menilai kebolehgunaan aplikasi ini. SUS membolehkan pengumpulan maklum balas pengguna, yang berperanan penting dalam mengenal pasti aspek yang perlu diperbaiki serta menambah baik antara muka dan fungsi aplikasi. Hasil ujian kebolehgunaan menunjukkan bahawa ARhythm secara berkesan meningkatkan interaksi pengguna dengan alat muzik tradisional, menjadikan pendidikan budaya lebih mudah diakses dan menarik. Projek ini menyumbang kepada usaha pemeliharaan warisan digital, memastikan muzik buluh Sabah kekal relevan untuk generasi akan datang melalui pengalaman AR yang imersif.

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LIST OF ABBREVIATIONS

AR		*Augmented Reality*
ADDIE	-	*Analysis Design Development Implementation Evaluation*
3D	-	*Three Dimensional*
ISD	-	*Instructional Systems Design*
UI	-	*User Interface*
SDK	-	*Software Development Kit*
SUS	-	*System Usability Scale*

LIST OF ATTACHMENT

CHAPTER 1

INTRODUCTION

1.1 Introduction

In recent years, cultural institutions worldwide have witnessed a significant shift in their approach to engaging audiences. With a growing number of people immersed in digital experiences, these institutions have realized the importance of adopting new technologies to captivate visitors and remain relevant in a rapidly evolving landscape. Augmented Reality (AR) has emerged as one of the most promising and versatile technologies for this purpose. By merging the physical and virtual worlds, AR opens up exciting possibilities for transforming traditional cultural experiences.

This research is about an Augmented Reality (AR) technology for bamboo music in Sabah, Malaysia. The aim of this research is to create an application by using

The application educates users on the construction, playing techniques, and acoustic properties of bamboo musical instruments, emphasizing their unique sound characteristics. This product can be used by a tourist, locals, children, teachers and students.

This research contains six sections, where chapter one relates to the introduction of the research, problem statement, research objective, research questions, and scope of the study. Chapter two explains the literature review that explains concerning the product to be developed which is the ARhythm. While chapter three is the methodology or methods used in product development. Chapter four will describe the design and development. While chapter five describes the collection of information and analysis of research findings. Finally, chapter six will describe the discussion on the achievement of objectives, the advantages and disadvantages of the product produced, produt recommendations and improvements of the product for the future as well as the conclusions drawn through the research that has been conducted.

1.2 Background

Sabah, a Malaysian state on the island of Borneo, is home to a diverse array of ethnic groups, each with its own unique cultural practices. Among these, bamboo music stands out as a significant traditional art form. This music, created using bamboo instruments, plays a crucial role in various ceremonies and cultural events. However, with

modernization, there is a risk of these traditions fading away. Hence, there is an urgent need to document and revitalize this cultural heritage.

The Sabah Bamboo Music Heritage Project is dedicated to preserving and showcasing the rich musical traditions of Sabah, Malaysia. Traditional exhibits often struggle to captivate and retain visitors' attention, particularly in an era marked by digital distractions. Digital technologies have been shown to receive high acceptance from visitors and have a positive impact on their exploration and learning about cultural heritage (Liu, 2020). AR technology offers a potential as an educational tool for the Sabah Bamboo Music Heritage Project. By integrating AR applications, the project can become an extension of the formal education system. Teachers, students also tourists can utilize quizzes, and educational info to enhance the learning experience using this product where I will make it like a gallery AR. Augmented Reality is a digital technology that overlays virtual content onto the real-world environment, creating interactive and immersive experiences for users. Augmented reality is one of the newest technologies, which offers new ways to educate effectively and attractively (Kysela & Štorková, 2015). This approach not only reinforces classroom teachings but also introduces students to a more experiential and engaging form of learning.

The Sabah Bamboo Music Heritage Project plays a crucial role in promoting Malaysia's cultural heritage. With AR technology, the project can enhance the storytelling aspect of its exhibits. By immersing visitors in interactive historical narratives, AR fosters a deeper understanding and emotional connection to the country's musical heritage. Visitors can explore historical events, famous musicians, and

landmark moments in Sabah's musical journey, creating a dynamic and memorable experience.

Jeffrey Kim et al. (2020) says that the use of augmented reality allows one to view the real world with the addition of external information intended to provide a new understanding of what is being seen. As technology continues to evolve rapidly, cultural heritage projects must adapt to stay relevant and appealing to modern audiences. The implementation of AR technology at the Sabah Bamboo Music Heritage Project demonstrates the institution's commitment to embracing innovation and remaining at the forefront of educational and cultural engagement. By actively exploring new technological advancements, the project showcases its dedication to preserving Sabah's musical heritage while providing a forward-looking and exciting experience for visitors.

1.3 Problem Statement

Generation Z is a generation born in a world full of challenges (Halim et al., 2018). This generation grew up in an environment that uses digital technologies such as the internet and social media networks, and widespread electronic gadgets. This generation is guided and encouraged by parents to use technology from the beginning since they have not been able to speak (Siti Mahani & Nazlinda, 2015).

Sabah’s traditional bamboo music faces the risk of cultural erosion due to insufficient documentation and the absence of contemporary platforms for its preservation and dissemination. (Antunes, 2017). There is a need for innovative

solutions to preserve and promote this cultural heritage to younger generations and a global audience such as Augmented Reality technology.

Current educational materials on Sabah's bamboo music heritage are insufficient and do not engage students effectively. Traditional teaching methods may fail to capture the interest of the younger generation, leading to a decline in the knowledge and appreciation of this cultural heritage. Access to authentic bamboo musical instruments and performances is limited, especially for people living outside Sabah or in remote areas. There is a need for a solution that can make this cultural heritage accessible to a broader audience through easily available technology (Sylaiou, 2010). Traditional methods of learning about and experiencing Sabah's bamboo music heritage lack interactive and engaging elements. There is a need for an interactive platform that allows users to experience and learn about bamboo music in an immersive way (Chatzidimitris, 2020).

1.4 Research Objectives

This study is conducted based on some objectives as follows:

1. To identify key aspects of Sabah's bamboo music heritage into the AR experience.

2. To design and develop an interactive AR application that immerses users in Sabah's bamboo music culture.
3. To conduct user testing of AR in exploring Sabah's bamboo music heritage.

1.5 Research Questions

This study was conducted based on several objectives as follows:

1. How can AR technology be used to effectively preserve and promote Sabah's bamboo music heritage?
2. What are the key features needed in an AR application to engage users in learning about traditional bamboo music?

1.6 Research Scope

The application comprises multiple modules, including a main interface, AR visualization, content management, and interactive learning components. The application offers a user-friendly interface, enabling seamless navigation, interactive AR content integration, and engagement in educational activities such as quizzes. This comprehensive approach aims to revolutionize the cultural heritage experience, blending digital and physical elements seamlessly, and offering a dynamic and

immersive journey for visitors to connect with Sabah's musical heritage and its stories. The application will provide content about Sabah's bamboo music and augmented information such as text, graphics, photos, audios and videos. It also enables interactive encounters with the bamboo music, allowing users to interact with them.

The target users for the application are all visitors to the Sabah Bamboo Music Heritage Project, young generation and teachers.

1.7 Significance of Research

The significance of this study is to encourage tourist, students and locals for promotion of Tourism. The utilization of innovative AR technology may draw more visitors to the Sabah Bamboo Music Heritage Project.

Other than that, community engagement where ARhythm strengthens the project's relationship with the local community. The project becomes more inclusive and accessible to various audiences by providing an innovative and participatory experience, fostering a sense of pride and ownership among community members.

It is also a sustainable development. The implementation of AR technology aligns with sustainable development goals, such as promoting cultural heritage, supporting inclusive education, and utilizing technology for positive social impact.

ARhythm showcases how technology can be harnessed for cultural preservation and educational enrichment.

1.8 Operational Definition

Some of the terms that are considered important and widely used in this study are clearly stated in this section. The following are the terms defined according to the scope of this research:

1.8.1 Bamboo Music

Traditional music played using instruments made of bamboo, prevalent in Sabah's cultural practices. This includes a variety of musical forms and instruments, each with unique cultural and historical significance.

1.8.1.1 Sompoton

A traditional musical instrument made from bamboo and gourd, the Sompoton is a mouth organ that produces sound through the vibration of bamboo reeds. It is commonly used by the Kadazan-Dusun people of Sabah and is known for its soothing and melodious tones.

1.8.1.2 Bungkau

Also known as the bamboo jaw harp, the Bungkau is a simple but expressive instrument made from a single piece of bamboo. It is played by plucking the bamboo strip with a finger while holding the instrument between the teeth. The sound produced is modulated by changing the shape of the mouth and breath.

1.8.1.3 Tagunggak

These are bamboo idiophones used by the indigenous peoples of Sabah, particularly the Kadazan-Dusun. The Tagunggak ensemble consists of multiple bamboo tubes of different lengths, which are struck with sticks to produce rhythmic patterns. This instrument is often played during traditional ceremonies and festivals.

1.8.1.4 Seruling (Bamboo Flute) / Suling

A traditional bamboo flute, the Seruling is used in various musical compositions in Sabah. It is known for its rich, melodic sound and is often used in traditional dance performances and rituals. Suling, a side-blown mouth flute with six holes and made from sebiling bamboo (Photo 2), can be played solo by either men or womenfolk. Among the Lundayeh, it is also known as lun suling and usually played in a pipe band known as Rurum Lun Suling (Pugh-Kitingan 2004: 32).

These instruments and dance forms collectively represent the rich bamboo music heritage of Sabah, each contributing uniquely to the region's musical tapestry and cultural expression.

1.8.2 Augmented Reality

Augmented Reality (AR) is an interactive, reality-based display environment that takes the capabilities of computer generated display, sound, text and effect to enhance the user's real-world experience. From Demi Adidrana (2013), it is said that AR is a term that combine between the real world and virtual world. Augmented Reality (AR) is refers to technology that is give ability to users sense the real world while interacting with the virtual and physical object. According to Azuma (1997), Augmented Reality (AR) is a technology that allows computer-generated virtual imagery information to be overlaid onto a live direct or indirect real-world environment or real time. According to Johnson (2010), AR can be applied either in marker-based or marker less based.

1.8.3 Cultural Heritage Preservation

Efforts to maintain and protect cultural expressions, traditions, and artifacts for future generations. This includes documenting and digitizing cultural artifacts,

creating educational programs, and using modern technology like AR to create interactive and engaging experiences. Ensuring the usability and functionality of these digital tools through testing and feedback is crucial to making cultural heritage accessible and engaging for the public.

1.9 Conclusion

This first chapter provides an introduction to the research project and the proposed ARhythm app for exploring Sabah's bamboo music heritage through AR technology. The research background of the implementation of AR technologies in cultural heritage settings, as well as the problems faced in these settings, are covered in this chapter. The research objectives and research questions to be answered at the conclusion of the research study have also been clearly specified. This chapter also discusses the scope of the proposed app and the significance of the research study.