

TADON : THE DEVELOPMENT OF AR BOARD GAME IN LEARNING CULTURAL HERITAGE HISTORY

DELL OXFORD VALENTINE

**FAKULTI SENI, KOMPUTERAN & INDUSTRI KREATIF
UNIVERSITI PENDIDIKAN SULTAN IDRIS**

2023

TADON : THE DEVELOPMENT OF AR BOARD GAME IN LEARNING
CULTURAL HERITAGE HISTORY

DELL OXFORD VALENTINE

FINAL YEAR PROJECT REPORT SUBMITTED TO MEET THE
REQUIREMENTS FOR ACQUISITION OF BACHELOR DEGREE
(SOFTWARE ENGINEERING (EDUCATIONAL SOFTWARE)) WITH HONOR

FACULTY OF ARTS, COMPUTING AND CREATIVE INDUSTRY
SULTAN IDRIS EDUCATION UNIVERSITY

2023



**FAKULTI SENI, KOMPUTERAN DAN
INDUSTRI KREATIF**

PERAKUAN KEASLIAN PENULISAN

Nama Pelajar: Dell Oxford Valentine

No. Pendaftaran: D20191087058

Nama Ijazah: Ijazah Sarjana Muda (Kejuruteraan Perisian (Perisian Pendidikan))
dengan Kepujian

Bidang Pengkhususan: Software

Tajuk Projek: Tadon: The Development of AR Board Game in Learning Cultural
Heritage History

Saya sahkan bahawa segala bahan yang terkandung dalam laporan projek tahun akhir ini adalah hasil usaha saya sendiri. Sekiranya terdapat hasil kerja orang lain atau pihak lain sama ada diterbitkan atau tidak (seperti buku, artikel, kertas kerja, atau bahan dalam bentuk yang lain seperti rakaman audio dan video, penerbitan elektronik atau Internet) yang telah digunakan, saya telah pun merakamkan pengiktirafan terhadap sumbangan mereka melalui konvensyen akademik yang bersesuaian. Saya juga mengakui bahawa bahan yang terkandung dalam laporan projek tahun akhir ini belum lagi diterbitkan atau diserahkan untuk program atau diploma/ijazah lain di mana-mana universiti.

21.02.2023

Tarikh

Tandatangan Pelajar

Perakuan Penyelia:

Saya akui bahawa saya telah membaca karya ini dan pada pandangan saya karya ini adalah memadai dari segi skop dan kualiti untuk tujuan penganugerahan Ijazah Sarjana Muda (Kejuruteraan Perisian (Perisian Pendidikan)) dengan Kepujian.

23.02.2023

Tarikh

Tandatangan Penyelia

(Ahmad Nurzid bin Rosli)



ACKNOWLEDGEMENT

First and foremost, I would like to express my sincere gratitude to my supervisor Mr Ahmad Nurzid bin Rosli. Without his guidance, it would be impossible for me to complete this Final Year Project, which is the requirement for Degree in Software Engineering (Educational Software) within the specified duration. I would like to thank for his patient, motivation, and the vast knowledge that been thought to me for the entirety of the project completion. I could not imagined having a better supervisors.

I am also grateful for Mrs Asma Hanee binti Arifin who is the coordinator for the MSR3982 Final Year Project 1 who is also under the same department as Mr Nurzid. The classes and webinar has help me in preparation for doing this project and the proposal report for the FYP1.

I would also mention my friends, Tan Kang Yong, Adib Zickry, Noel Chrisly, and Syahmi Fahim as their support and help has contributed to my knowledge and attitude toward finishing the objective of the project. Without their motivation and help, I would not have been able to finish the thesis writing on specified time.

Last but not least, I would express and share my gratitude to my parents, Valentine Maragun and Rozita Sami who were there to help in the research process of early phases in this project where they help me gather and answered a lot of questions that I faced on the cultural heritage topics. I am grateful for the sacrifices they have made in order to support my academic pursuits and for providing me with the resources and tools I needed to complete my thesis. My parents unwavering support has been a tremendous source of motivation and has pushed me to achieve my best.



ABSTRAK

Laporan ini membincangkan topik kajian yang dipilih, pendidikan sejarah warisan budaya yang menggunakan pendekatan berasaskan permainan dengan *Augmented Reality* sebagai cara penyampaian maklumat. Mempelajari sejarah warisan budaya boleh menjadi cabaran untuk dipelajari oleh generasi muda. Nunuk Ragang misalnya merupakan monumen bersejarah budaya Kadazandusun dan juga tapak warisan yang sering terlepas pandang di Sabah, Malaysia. Tambahan pula, ia terletak di tapak yang kurang didedahkan oleh pelancong kerana monumen itu berada jauh dari bandar menjadikannya kurang mudah diakses. Oleh itu, kami mencadangkan aplikasi yang dikenali sebagai Papan Permainan Realiti Diperkukuh "Tadon" (Asal). Tadon dibangunkan untuk membolehkan pelancong dan pelawat dapat mengakses monumen Nunuk Ragang menggunakan teknologi AR. Ia juga akan membolehkan mereka meneroka maklumat yang berkaitan dengan monumen dengan lebih mudah menggunakan papan permainan yang menyediakan cara interaktif dan menyeronokkan untuk belajar yang memberi tumpuan terutamanya untuk menarik pengunjung dan anak-anak muda..

TADON : THE DEVELOPMENT OF AR BOARD GAME IN LEARNING CULTURAL HERITAGE HISTORY

ABSTRACT

Learning cultural heritage history can be challenging for the younger generation to learn. Nunuk Ragang for example is a historical monument for Kadazandusun culture and also a heritage site that often gets overlooked in Sabah, Malaysia. Furthermore, it is located at a site with less exposure by tourists due to the monument being further from the city making it less accessible. Hence, we proposed an application known as “Tadon” (Origin) Augmented Reality Game Board. Tadon is developed to allow tourists and visitors able to access the Nunuk Ragang monument using AR technology. It is also will allow them to explore the information related to the monument easier using the game board which provides an interactive and fun way to learn that mainly focus to attract visitor and youngsters.

CONTENT**Muka Surat**

PERAKUAN KEASLIAN PENULISAN	i
ACKNOWLEDGEMENT	ii
ABSTRAK	iii
ABSTRACT	iv
CONTENTS	v
TABLE LIST	viii
FIGURE LIST	ix
ABBREVIATION LIST	x
APPENDIX	67

CHAPTER 1 INTRODUCTION

1.1 Introduction	1
1.2 Background Study	2
1.3 Problem Statement	3
1.4 Project Objective	5
1.5 Project Significance	5
1.6 Project Scope	6

CHAPTER 2 LITERATURE REVIEW

2.1 Gamification	8
2.2 Board game	9
2.2.1 Board Game as Education Tool	9
2.2.2 Story-driven Board Game	10
2.3 Augmented Reality	11
2.3.1 Augmented Reality in Education	11

2.4	Augmented Reality Board Game	12
2.5	Comparative with Past Develop Product	13
2.5.1	Detail Comparison	16
2.6	Methodology Comparison	17
2.6.1	Scrum	17
2.6.2	Rapid Application Development	19
2.6.3	ADDIE	21
2.	Conclusion	22

CHAPTER 3 RESEARCH METHODOLOGY

3.1	Research Methodology	23
3.2	Phases in ADDIE	24
3.3.1	Analysis	24
3.3.2	Design	25
3.3.3	Development	26
3.3.4	Implementation	27
3.3.5	Evaluation	28
3.3	Gantt Chart	29
3.54	Conclusion	30

CHAPTER 4 PRODUCT DEVELOPMENT

4.1	Introduction	31
4.2	Nunuk Ragang Information	32
4.3	Product Development	33
4.3.1	Board Game Element Development	33
4.3.1.1	Initial Design Path	33
4.3.1.2	Final Design Path	35

4.3.2	Tadon App Design	38
4.4	Integration and Optimization	40
4.5	Result	41
CHAPTER 5 TESTING AND ANALYSIS		
5.1	Introduction	45
5.2	Tadon AR Board Game Setup	46
5.3	System Usability Scale Method	46
5.3.1	Usability of Tadon AR board game	49
5.3.2	Tadon AR Board Game Implementation	50
5.3.3	Tadon AR Board Game SUS Results	51
5.4	Conclusion	53
CHAPTER 6 CONCLUSION AND SUGGESTION		
6.1	Summary Of The Study	54
6.2	Cultural Heritage History Topic	55
6.2.1	Objective 1: Describing Information	55
6.2.2	Objective 2: AR Board Game	56
6.3	Future Work	57
REFERENCE		58

TABLE LIST

Table No.		Muka Surat
Table 1.0	Comparative Table (Chapter 2. First table)	13
Table 2.1	SUS Adjective Rating	53
Table 2.2	Average SUS Score of Tadon AR Board Game	55

FIGURE LIST

No. Rajah		Muka Surat
Figure 1.1	Ken Schwaber Scrum Development Process (Chapter 2. First figure)	18
Figure 1.2	Phases in RAD methodology (Chapter 2. Second figure)	20
Figure 2.1	ADDIE Methodology Phases (Chapter 2. Third figure)	25
Figure 2.2	FYP 1 Gantt Chart (Chapter 3. First figure)	31
Figure 2.3	FYP 2 Gantt Chart (Chapter 3. Second figure)	26
Figure 3.1	Initial Game Board Design (Chapter 4. First figure)	37
Figure 3.2	Explore Card Initial Design (Chapter 4. Second figure)	37
Figure 3.3	Question Card Initial Design (Chapter 4. Third figure)	38
Figure 3.4	Fate Cards Initial Design	38
Figure 3.5	Final Game Board Design	39
Figure 3.6	Final Explore Card Design	40
Figure 3.7	Final Question Card Design	40
Figure 3.8	Final Fate Card Design	41
Figure 3.9	Tadon App Architecture Diagram	42
Figure 3.10	Tadon AR Board Game start menu	45
Figure 3.11	Tadon AR Board Game Story Options	46
Figure 3.12	Dice Throwing Animation	46
Figure 3.13	UI for Board Game Tile Counter	47
Figure 3.14	QnA UI with Timer	48
Figure 3.15	QnA Result Feedback UI	49
Figure 3.16	Explore Card Event UI	49
Figure 4,1	Software Usability Scale template	51
Figure 4.2	Software Usability Scale Flow	51



LIST OF ABBREVIATIONS

AR	Augmented Reality
TnL	Teaching and Learning
CH	Cultural Heritage
UI	User Interface
UX	User Experience
API	Application Programming Interface
SDK	Software Development Kit
3D	Three-Dimensional
Vuforia	A software development kit for creating AR experience
Unity	A game engine used for developing application
C#	Programming language used for Unity





CHAPTER 1

INTRODUCTION



Sabah is rich with traditions and culturally diverse, with more than 30 different ethnics living together as a homogeneous community while still retaining one's culture, tradition, art, customs, and festivals. Kadazandusun tribe which is the largest ethnic category in Sabah (Fam, Syed Annuar, Lai, & Ingko, 2020) with around 40 sub-ethnics are spread over Sabah as for instance, Tatana Dusun in Kuala Penyu, Tobilung Dusun in Kota Marudu, and Rungus Dusun in Kudat to name a few. The existence of diverse sub-ethnics results in different dialects, the effect of pronunciation, vocabulary, and grammar (Juanis, Saleh, Ghazali, Mahat, Hashim, Nayan, & Kurnia, 2022). Based on oral tradition that has been passed down through generations on the migration that results in this diverse sub-ethnic, it tells that Kadazandusun originate somewhere in



Tampias, settlement near sungai Liwagu and sungai Gelibangan where the Nunuk Ragang monument was built.

Moginakan is celebrated here to commemorate the rich history and origin, ever since the Nunuk Ragang monument was built in 2004 with the aim that communities will remember where they came from and why we belong to the same stock of people (Rozelle, 2021). However, recent pandemic caused the site to be unused since big event with huge crowds are not allowed. Furthermore, issues like maintenance and site location made it less familiar to outsiders. That being the case, development of application is to be conducted for better preservation and presentation.

With the rapid development of technology, it becomes more apparent that tools that were once limited for certain organizations only are now more accessible for the masses, augmented reality is one example. Augmented reality or AR is when a multimedia material is being superimposed as a virtual object in the real world which enables students to interact with (Morimoto, Kobayashi, Hirata, Otani, Sugimoto, Tsukamoto, & Mawatari, 2021). This creates a more appealing visual and ease to get hands-on experience. Further AR has been implemented in education for quite some time, going forward into Education 5.0, to improve Teaching and Learning (TnL) outcomes as it is great in retaining student attention and keeping them motivated throughout the session (Hao & Lee, 2021). Game-based learning along with this emerging technology like serious games, board games for instance, has brought



benefits including increase in involvement in projects and skills, and the application in a real context. Similarly, it have allowed the emergence of distance learning and fostered greater innovation in teaching methods inside and outside the classroom (Almeida & Simoes, 2019).

In general, board games implementation in presenting information especially a story-driven based serve as a great way to tie the content together, making it more meaningful for the general public. It is easier for anyone to get immersed and experience which is significant in learning perspective with cultural heritage (Malegiannaki, Daradoumis & Retalis, 2021).



1.3 Problem Statement



We are moving forward to a digital information world where everything is at your fingertips and technology is helping to advance education. That being the case, it is noticeable that utilization of these kind of tools for preserving the historical cultural knowledge as well as a media to introduce to foreign people to attract tourist to the site as being utilize to help less exposed areas (DaCosta & Kinsel, 2022). Similarly, Nunuk Ragang has a similar situation, with the site being further inland and less exposed area. These includes ;

- a) Nunuk Ragang monument isn't a well know name despite its connection to Kadazandusun heritage



b) Current method on passing on the knowledge is monotonous

First, Nunuk Ragang monument is about one hour drive from Ranau, through the Ranau-Sandakan highway, sited near a village named Tampias. After reaching KM54, there will be Liwogu Bridge followed with Nunuk Ragang sign board to turn right for another 0.7KM. It is a fairly long journey to visit a place that you only get a change to view from the outside since there are fences, and only open during festive celebration, Moginakan, since it's not guarded by anyone. Traveling package often doesn't include a visit to the monument due to this reasons. Additionally, those who travel long distance might be less aware of the cultural heritage in distance region (Xue & Zhang, 2020) thus tourists often overlook the site as one of the place that they can visit. As a result, Nunuk Ragang Monument often unoccupied. Therefore, application help to present the site, in an educational way to help preserve the knowledge.

Secondly, Nunuk Ragang Monument was built as a memorial near Tampias, on account of the site traditionally considered as the origin of Kadazandusun ancestors. Early history of Kadazandusun settlement is identified in the tale of Nunuk Ragang (Bayan Red Fig Tree), which is believed to have been located near sungai Liwagu and Sungai Gelibangan (IHN, 2007; Luping, 2009; tangit, 2018, as cited in VBP, 2021). The tale have been passed down to younger generations via oral tradition, as a way to preserve the information about the myth. The Moginakan festival are celebrated on the first weekend of July every year here, at Nunuk Ragang to honour ancestor and beginnings, as in the myth of the Kadazandusun originate. Aside from a reunion



festival, it also serve a great opportunity on sharing and passing on the traditional knowledge to people visiting there, as it not limited to only Kadazandusun. This is great for those who could visit Nunuk Ragang Monument sometimes in July, when the Moginakan is celebrated and watch the rituals and other traditional activity. On the contrary, the other option left are blogs, articles, and Youtube slides to learn about the site, where mostly only tell about the tale with no visual artifact that can be seen present in the monument. Therefore, with serious game form wish to package the information as a whole so people get to learn about the site better.

1.4 Research Objective



The objective of the project are as follows :

- a) To describe the information on the cultural heritage site.
- b) To develop AR environment with sets of activities and question to be added into the board game.

1.5 Project Significance

Through a deeper study on Nunuk Ragang monument, with better understanding on its significance, the proposed application will bring a finer and more robust presentation of the information that is not only limited to the Kadazandusun people but also others that might be interested in learning more about the Kadazandusun mythical story that have been passed down through oral tradition and the culture. Moreover, it will also





bring new light to the site so that more people would know its existence therefore opening more opportunity for further development.

a) Historical knowledge learning

Nunuk Ragang holds some artifact and acts as a tribal mini-museum where people can visit and explore the cultural heritage. This application will bring the knowledge so people able to gain more understanding on the cultural heritage site without having to travel far. Additionally, the game-based approach will help gain student motivation in learning.



b) Tourism and attraction

With the recent pandemic, it is noticeable that tourist count decrease, going from roughly around 567,000 to 30,000 in February of 2021 (Rechard, Kadir & Mukhtar, 2021). This project will provide new light to the place that tourist can visit as a result of the introduction that the application provide.

1.6 Project Scope

The scope of study for this project includes the previously discussed problem statement on the Nunuk Ragang monument and the significant behind the monument, with regard on the stated objective. The scope of the project development :



- i. The Augmented Reality (AR) application is build on a Unity game engine along with Vuforia for the marker-based tracking, where several different marker being used for the elements on the game board and player marker. This application will work on any android smartphone with Android 8 and above.
- ii. The 3D model are low poly for easier loading time, viewing, and editing. This will be done on Unity. Game board will be drawn with the marker on IbisPaint X.
- iii. The admin capabilities on updating content are to be done on Firebase Real-time Database. This is to enable any changes if required.

As for the application functions, it will be divided into several module with each store different multimedia type which are:

- i. Recognition module for the marker feature, this is to scan any any visible marker that has been specified to the computer structure in the application to the back camera
- ii. Multimedia module for the necessary video, audio, and 3d structure to support the learning material.
- iii. Text module where mainly further reading on specified structure is being display.