

ARMyPat: Mobile Application in Learning Malay Historical Patriots Using Augmented Reality

Mudiana Mokhsin¹, Amer Shakir Zainol², Emma Nuraihan Mior Ibrahim³, Mohd Husni Mohd Som⁴ and Kamarul Ariffin Abdul Basit⁵ and Amir Afwan Azman⁶

^{1,3,5,6} Faculty of Computer & Mathematical Sciences, Universiti Teknologi MARA, 40450, Shah Alam, Selangor, Malaysia

^{1,2,4} Institute of Malay Thoughts and Leadership (IMPAK), Universiti Teknologi MARA, 40450, Shah Alam, Selangor, Malaysia

² Faculty of Art and Design, Universiti Teknologi MARA, 40450, Shah Alam, Selangor, Malaysia

{mudiana,emma}@tmsk.uitm.edu.my, amers781@salam.uitm.edu.my,
husni820@salam.uitm.edu.my, amirafwan94@gmail.com

Abstract. In the era of evolving technology, the generation who was born in 1995 onwards or known as Gen Z in Malaysia are becoming less interested in knowing and learning about Malay Historical Figures. Currently, the medium or tool applied in learning about Malay Historical Figures is only by using textbook as reference in the classroom. Looking at this scenario, this project attempts to attract their interest in learning historical information, especially about Malay Figure by converting the text or image information into an interactive learning method. The approach for this project is by implementing an augmented reality technology where the interactive fighting game has been embedded. The objectives of this study are to identify the requirements, design and develop Augmented Reality mobile learning application about Malay Historical Figures with the commercial name of *ARMyPat* (Augmented Reality based in Learning about Malay Patriots). This application prototype will be compatible for the Android platform mobile devices and the target user for this application are students aged between 10-15 years old who learn the historical subject at school. The project methodology is ADDIE model that covered analyses, design, develop, implement, and evaluation phase since this methodology is suitable for the interactive learning development process. The students can obtain the information such as the summary of character, biodata, heritage and contribution interactively. For 3D character model view, they can learn and know the attraction of the martial art which is Silat. Therefore, they can learn a few movements of the Silat martial art. The last part is an interactive fighting game whereby it can bring the students to the fighting action in real environment and encourage them to know about the heroism characters of that Malay Historical Figure. In the end, this application is to encourage young generation patriotism spirits towards Historical Figure in Malaysia by utilizing augmented reality technology.

Keywords: Augmented reality, mobile learning, mobile game, Malay figures, ADDIE research methodology

1 Introduction

Malay historical figure is famous and very important people. They have significant contribution to the country. In education, the students will learn about Malay Figures such as Tun Mahathir, Tun Hussein Onn and Tun Abdul Razak especially in the historical subject. Some of them struggled to get independence and make efforts to ensure that our country is peaceful. Many people wonder why everyone must know the contribution of Malay Figure. The reason is to create patriotic spirit among the citizen [1]. Hang Tuah is a very popular and legendary warrior in Malacca. He is the most illustrious Malay historical hero and leader of a closely-knit band of Melaka's finest warriors - Hang Kasturi, Hang Lekiu, Hang Lekir and Hang Jebat. He was considered as one of the greatest *silat* masters and more powerful than the other warriors at that time. Nowadays, Hang Tuah's legend is still popular in Malaysia. According to Jamil [2], Hang Tuah's story is true and known as a symbol of glory during the reign of Malacca sultanate. He stated that whether it is in the form of manuscript or historical record, the life story of Hang Tuah is the most valuable legacy for today's generation and future. However, the rest four close friends of Hang Tuah are not widely known and receive less popularity as compared to Hang Tuah.

In the school's history learning environment, the current method used by the teachers is by using textbooks which is an unattractive way of learning as it is a one-way learning approach. The content and learning process are supposed to be more interesting for education by including the combination of audio, video, games or other interactive media to attract students to learn history. The idea to combine education with entertainment, or popularly known as edutainment has been used before. Therefore, to visualize the historical content, the use of Augmented Reality application is used as one of the methods to attract students to learn interactively. This effort is in line with the Malaysia government agenda towards education 4.0 where an immersive technology has been embedded in the teaching and learning process. Augmented reality can help the user to interact with real and virtual environment with a tangible interface that consists of combination of words, specific information and 3D models [3]. This technique can deliver the information by using many kinds of multimedia elements. The user will interact with visual object in a real environment. Therefore, it will increase the understanding of the user and at the same time improve the learning process. Billinghurst [3] stated that by learning using Augmented Reality, especially for history subjects, it can offer vivid information and character's emotion compared to traditional ways. By traditional method, the historical situation of figure can only be described by words, images and oral report [4]. Learning Malay Historical Figure using Augmented Reality mobile application is believed to be the way to attract the young generation to learn about it. Apart from that, in Venice, Italy, there is an Augmented Reality application game called *VeGame* which guide the user in learning about the historical places such as churches, monuments and etcetera in giving a new experience to the tourist [5]. It is one of the Augmented Reality

applications that expose on the historical information. In London, England, there is also an augmented reality application called *Shakespeare's Globe 360* by Sam Wanamaker, which had a vision to provide theater to all children. This mobile app carries out primary purpose of theatre by bringing history to life. Learning about the performing arts, alongside its history will provide new depth to the content of both arts and English classes. AR lets students explore the theatre and feel the atmosphere of it. AR supports education in a way that was previously impossible. For instance, adding a virtual reality headset to this app will take the experience to another level, by bringing the user inside this historic theatre [6].

Malaysia has many historical figures, but most of today's generation is less sensitive about the matter because they were born after independence and do not understand the importance to know about historical figures [7]. Nowadays, young generation in Malaysia is less interested to read or know about the country's historical figures. They only learn about historical figures at school during History subject. Talin [8] stated in her study that History is not a popular subject in schools as students complained that the subject is not interesting as they must memorize a lot of facts. However, to prevent this situation from happening which may cause the younger generations to forget the contribution of historical figures in Malaysia; historical figures need to be presented in a form that can attract students to learn about it. The idea of this study is to convert the historical figure's information into interactive form of knowledge sharing by using Augmented Reality. It is a known fact that the younger generation nowadays is addicted to use digital device such as computer, and mobile phone. Despite the situation, learning through mobile application has not been productively promoted as an alternative learning method because the education system is still confined to the conventional way of learning through media such as newspaper and television [9].

Learning approach using mobile applications is still not very popular in the school environment in Malaysia. Learning approach is still based on the traditional method of learning-centered class which is mostly geared towards examinations. As the technology advances, the students will feel frustrated since there are so many entertainment alternatives out there which are more interesting than learning traditional method [10]. Some previous studies proved that most teachers are still using the traditional way of teaching the subject in the classroom [11] [12]. However, since most students now were born in the digitalized age, naturally they will be more motivated when learning using technologies' application such as Augmented Reality [13] [14]. Therefore, the intention of this project is to use Augmented Reality that can effectively attract students to learn about historical figures in Malaysia.

2 Literature Review

Augmented Reality (AR) is a new technology that integrates the digital information of the real environment to the user [15]. Usually user only sees the information directly from the book and paper. Nowadays, the technology that view the elements of a

physical or real environment are augmented by computer generated sensory input video, sound and image. The objective of Augmented Reality is to capture the meaning and information of the place or real object.

The tremendous importance of AR technology is proven by various investments made all over the world to explore the usage AR. For instance, AR offers engaging entertainment, particularly in the media. It allows designers with the opportunity to develop new kinds of appealing entertainment that offers more emotional and intimate characters. AR technology also assists in facilitating the development of better buildings. In the same manner that AR is transforming the entertainment and media industry, it is also influencing the construction environment. AR shows tremendous potential in benefiting the education and learning environment while applications in other areas such as the medical environment are also feasible [16]. In the gaming environment, AR is showing remarkable potential. It is facilitated in the integration of audio and visual material that provides the user feelings as though they are in the real environment. Compared to virtual reality that demands confined space or separate area to develop immersive environment, AR utilizes the real environment and establishes its own playing field. Virtual reality demands the usage of specific VR headsets while just certain AR systems need them. For the AR games, they expand the playing field on the real world's diversity to ensure that the game remains interesting [17]. Currently in school, traditional ways in education are still used. The students must follow all the knowledge and learning instruction arranged by the teacher face-to-face [18]. Moreover, the learning process still uses paper. This method of learning does not share dynamic information such as motion or movement. Although the conventional method is very useful, there are rooms for improvement to spark the interest in learning. Since technology begins to grow, the combination of technology has affected the learning system. The use of technology in learning and teaching provides the attraction to develop an engaging, authentic, realistic and extremely fun learning environment [19]. It is also found that the student engagement and understanding of the content increase when learning using technology. Therefore, many technology applications have been combined with education such as the use of computer, multimedia, internet, mobile devices, virtual reality and augmented reality. The increase in usage of mobile devices has led to the introduction of Augmented Reality application for mobile learning.

Mobile AR offers educators and designers with new ways of developing the situation and improving the context of the mobile learner. One of the major concerns about AR is that the augmenting encounters in real-world settings regardless of the location of the learner. Technologies used in AR have the capacity to leverage on location, experience, situation, or environment to entirely new avenues of understanding and meaning. AR games are significantly altering people's ways of learning while using mobile devices. When considering a mobile learning game, it is crucial to emphasize on several major aspects unique to mobile augmented reality. Utilization of information that support the learning process using the AR is done by merging mobile together with AR facilities. These comprise of the user's mobility, the geographical position of the user, physical environment for engagement in learning, and linkages between informal and formal learning. Furthermore, in the event of mobile learning

games using AR, emphasizing on the “interaction modes” is essential since the modes interact with each other to offer learners passive overlaps of information based on their gestures, physical location, or movements. AR games can also involve the learners in investigative mode for the purpose of discovering or solving a problem [20].

Nowadays, education field had used Augmented Reality technology for the end user. Furthermore, many people use smart phones that include this technology. The reason why this technology had been used for educational purpose is because the features available in Augmented Reality can make the students easy to understand during the learning process and become more fun. Most of Augmented Reality application currently focuses on personalization area that need the agent approach to create the best learning experience. According to the Bower et al. [21], learning through Augmented Reality can increase motivation to the learner because it is realistic, fun and interesting. AR has the capability to display the information in various forms of media and above virtual real-world environments. It also helps to improve the student thinking capabilities, problem solving and communication skills. This is due to the reason that the Augmented Reality can do impressive hybrid-learning [22]. Students who have problems to visualize in any learning concepts can be helped using Augmented Reality technique. The students will be able to see the 3D design like a real situation. Besides that, Augmented Reality can increase the level of interaction between the subject’s content with the students in terms of physical exploration [23]. By using this technology, the attraction towards learning among the students can be increased. Mobile devices have great features, can be accessed anytime and everywhere and at the same time can access the internet usage with affordable price [24]. Smartphones, tablets and wearables are examples of mobile devices that have the capability in computer vision, cloud computing based on mobile and cooperative in networking which allow the science fiction to be transformed into a reality vision using Mobile Augmented Reality (MAR). Even though the mobile devices have some constraint compared to traditional computer, their systems have many sensors that are very useful to develop MAR applications. The intensive parts execution process can also be assisted by the remote server. The technology in mobile devices had been improved such as the built-in camera, mobile cloud computing, resources for computer and sensors. This is the reason why AR has very high potential usage and development in mobile devices. Since the rapid growth between human computer interaction, computer vision and mobile cloud computing, the user can feel the new experience of interaction and get the information in various ways using the mobile devices. Currently, Mobile Augmented Reality (MAR) had been used in many fields such as entertainment and advertisement, tourism and navigation, assembly and maintenance and lastly for education and training. The Figure 1 below shows the existing application using Augmented Reality in mobile devices.

System	Hardware platform	Software platform	Display	Tracking	Network	Collaborative	Indoor/outdoor	Application field
MARS	notebook computer	IABAR/ Ruby	optical see-through HMD	RTK GPS, orientation tracker	campus WLAN	multiusers	indoor, outdoor	Tourism, Navigation
ARQuake	notebook computer	Timath-evc5	optical see-through HMD	GPS, digital compass	WLAN cable network	single	indoor, outdoor	Entertainment
BARS	notebook computer	unknown	optical see-through HMD	inertial sensors, GPS	WWAN	multiusers	outdoor	Training
Medien.welten	PDA	Stadiers-tube ES	video see-through screen	visual tracking marker	WLAN	multiusers	indoor	Education, Entertainment
MapLens	mobile phone	unknown	video see-through phone screen	tracking nature feature	WWAN	multiusers	indoor, outdoor	Tourism, Entertainment
Virtual LEGO	mobile phone	UMAR	video see-through phone screen	visual tracking markers	unknown	single	indoor	Authoring, Assembly
InfoSPOT	Apple iPad	KHARMA	video see-through pad screen	sensors, geo-reference visual markers	WWAN	single	indoor	Information Management
Pokemon Go	mobile phone	Android & iOS	video see-through screen	GPS, digital compass	Internet Access	multiusers	indoor, outdoor	Entertainment
Ingress	mobile phone	Android & iOS	video see-through screen	GPS, digital compass	Internet Access	multiusers	indoor, outdoor	Entertainment

Fig 1. The existing application that using Augmented Reality in mobile [24].

Augmented reality has been used on desktop computing. Some of Augmented Reality applications use the components of website infrastructure, but not every part can be used to develop Augmented Reality applications. AR is a system that enhances the user's view in real-time by using generated image or other inputs by the events with the specification of AR. By using the most popular product for AR such as Oculus Rift and Google Cardboard, it usually makes the content of AR application more interactive and improves the user experience. Previous studies also discussed about the usage of Augmented Reality on web technology. For example, as an open source, Argon Augmented Reality web browser tries to combine the existing technology for web development. The Argon apps have commercialized the Augmented Reality mobile application to the compatible mobile devices. The Figure 2 shows the browser architecture that includes a framework called "Augmented Reality Framework" (AREF), whereby this is the framework that has been referred in developing the application. Modules in the framework are illustrated below.

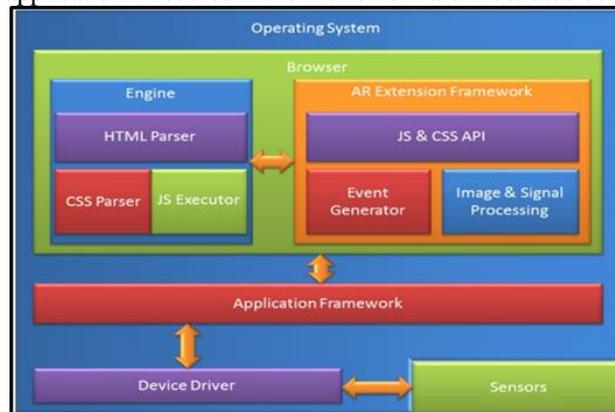


Fig 2. Extended Browser Architecture with AR, CSS and JS [25].

Even though there are many significant benefits in using Augmented Reality during learning activity, there are some issues that need to pay attention on. Research had shown that some student do not know and have lack of information about this technology. As a way to reduce the problem, the students were given some instructions as exposure before they use Augmented Reality technology. Another

reason is it was difficult for the user to find the 3D for virtual contents of Augmented Reality on their mobile device because of the screen limitation [26].

The Integrated Curriculum for Secondary School (ICSS) announced that History is the core subject for the lower secondary and upper secondary in Malaysian schools. This subject has been included in class timetable. For Sijil Pelajaran Malaysia (SPM) level, the Ministry of Education stated that History subject is one of the compulsory subjects for the students to pass. History is considered as an important subject because according to Johdi et al. [27], learning History subjects can improve the students' understanding of human being in order to make critical judgement to prepare an individual to handle any problems.

3 Research Methodology

The research methodology is described as a logical way to solve a task. The discipline is to research what type of methodology to be chosen. It consists of the process to explain, define and forecast about their task and it is called research methodology. By doing the research methodology, researchers can gain knowledge and describe the task strategy of the project [28]. The methodology used for this research is ADDIE model. The acronym of "ADDIE" was described by [29], in his book "A Handbook of Instruction and Training Program Design" as the generic Design Model of Analyse, Design, Development, Implementation, and Evaluation (ADDIE).

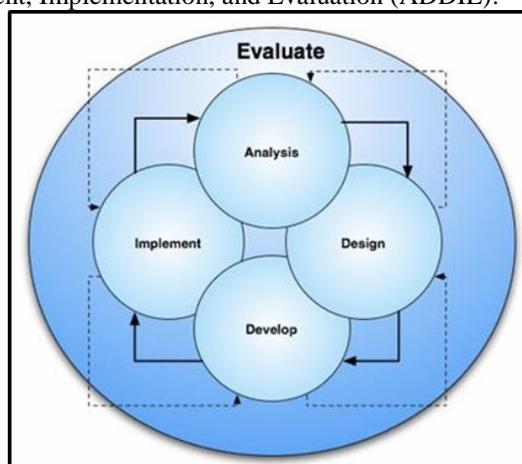


Fig 3. ADDIE model [29]

For this application, ADDIE methodology is found suitable because it is an interactive learning application. The step by step process methodology during the development is very important especially during certain stage when problems occur. By using ADDIE method, this research could access the previous phase and repeat the process again when problems happened during the research process. According to Linda [30], the ADDIE methodology process is an effective and efficient design for teaching which helps with instructional design. Analyzing learners' problem and needs,

designing the instructional design which includes activities and material are the components of the instructional design.

i) Analysis Phase

Firstly, the details related to the project such as problems need to be identified. At this phase the analysis resources must be not less than five years back to make sure it's up to date, and can be accepted to be applied in the current year. The problem statement in this project is that the young generation is less interested to know about national figures in Malaysia. After the problem had been defined, next step is to make sure the best method to provide solution for the problem. To find the best method, the target user had to be identified. As the project was meant for students who learn the History subject in their schools, the method used for this study is AR. Along the process of researching the resources, objective and scope are used to ensure that resources relate to the topic. The resources taken from numerous sites, journals and books were then compared to gain better results.

Table 1. Summary for analysis phase

Research Objective	Phase	Activity	Technique	Deliverable
To identify requirements for augmented reality, mobile learning application about Malay Historical Figures	Analysis	<ul style="list-style-type: none"> Identify the problem statement Identify the objective Identify user requirement Identify the projects significant Define functional and non-functional requirement 	Conducting observation on previous similar system that focus on historical figures Read from article, journals and previous re-search. Produce Gantt chart	List of problem statement List of objectives List of user requirement List of project significant
		<ul style="list-style-type: none"> Estimated project planning 	Produce project schedule tools using Microsoft Project	Gantt chart

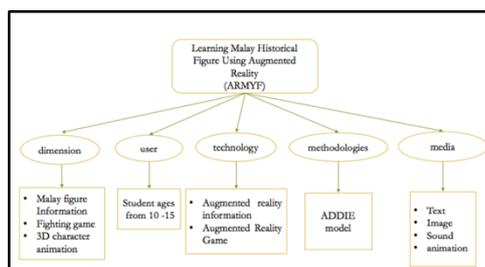


Fig 4. Brief description of Project Analysis

ii) Design Phase

After the completion of the analysis phase, the next step is the design phase which is needed in order to develop this application. In design phase, the use case diagram

was first designed using Microsoft Visio. Use case diagram or usually referred as behavior diagram, was used to list all set of actions performed by the system's user. After that, the design for prototype using paper sketching was made for system interface to show the activities and process. The purpose for prototyping process is to make sure that the development phases run easily. The design was derived from the analysis that had been done to develop this application. Besides that, the activities for application design flowchart and storyboard were also covered in this phase. This project application has three components which are the main activities for this project. Firstly, the information on Malay figure was explained at information part. It contained a navigation button to attract the student's interest to learn. The second one was interactive game for the students. Because the nature of students like to play games, the game was designed based on fighting scenes to increase the understanding and help the user to think fast which will activate their brain to act fast based on the fighting necessity in the game. Last but not least is the usage of Augmented Reality technology which was included in the information and fighting game. The users need to focus their phone camera to the picture of Malay figure on the paper and then the animation of character plus the information will appear on the phone screen. This system used fighting game as way to attract students to know about Malay figure using interactive games.

Table 2. Summary for design phase

Research Objective	Phase	Activity	Technique	Deliverable
To design augmented reality, mobile learning application about Malay Historical figures	Design	<ul style="list-style-type: none"> • Design use case diagram • Design storyboard 	<ul style="list-style-type: none"> • Microsoft Visio which provides tools to design use case diagram • Using JustInMind software 	Use case diagram
		<ul style="list-style-type: none"> • Design 3D character model with an animation • Design interface and button • Producing the flow of application design 		<ul style="list-style-type: none"> • Using Blender software • Using Unity 3D software • Using Microsoft PowerPoint

This part describes the flow of the application prototype; Figure 5 shows the application design flow. Firstly, after user click the icon of the application, the home page will appear. The home page contains two buttons which are for navigating to the game section and learning section. At learning section, users can select any Malay figure that they want to know. To play the game, the user can click the game button at the game section page.

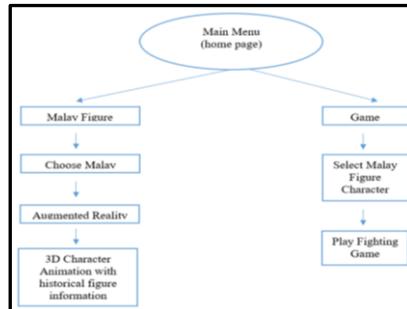


Fig. 5 ARMyF Application design flow

iii) Development

After the analysis and design phase completed, the results were used as guidelines to proceed to development phase. In this phase, software and hardware were both needed to build the project using Augmented Reality. The technique used for this development was marker techniques to display the virtual information directly to the user using mobile devices. The types of coding used to build this application were C# and Java. The most important part is to develop the main functionalities of the application.

Table 3. Summary of development Phase

Research Objective	Phase	Activity	Technique	Deliverable
To develop augmented reality, mobile learning application	Development	<ul style="list-style-type: none"> Develop the project using augmented reality and game 	<ul style="list-style-type: none"> Use augmented reality marker techniques to display the virtual information directly to the user using mobile devices Use unity 3D to develop the augmented reality game Before and Unity 3D software to create mobile applications that using augmented reality 	<ul style="list-style-type: none"> Marker-based augmented reality application 3D game augmented reality fighting game
		<ul style="list-style-type: none"> Development of augmented reality application 		<ul style="list-style-type: none"> Augmented reality, mobile learning application about Malay historical figures (ARMyF)

Before getting started, there are a lot of matters that need to be considered for Augmented Reality (AR) application such as to extend the functionality of a mobile software offering. The truth is, there are many ways to approach the design and

development of an AR app and the best approach depends on the requirements of the project. It is always best to start with the end result in mind, establish the key measures of success and ensure a mechanism by which to measure the performance of the application that has been established. Measuring success can be tricky and therefore having the right data and analysis is essential. To make it successful, there are five steps or processes in the development of an augmented reality game as shown in Figure 6.

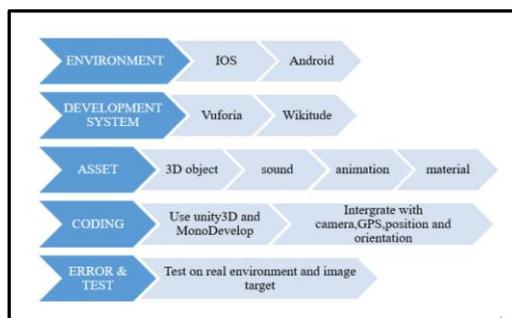


Fig. 6 Augmented Reality Game Development Process

iv) Implementation

For implementation phase, after the development of the application is completed, it needs to be installed and transferred to smartphone using Android Studio as a platform to run it. Therefore, the user would be able to test the application and then the responses were taken to make sure the application achieves the project objective.

v) Evaluate

Finally, the feedback and responds from the user was taken to improve the application. To complete this evaluation process, a few students were selected to do testing of the system. The results of the test and user feedback are very important in order to improve this application.

Table 4. Summary for implementation and evaluation phase

Research Objective	Phase	Activity	Technique	Deliverable
To develop augmented reality, mobile learning application about Malay historical figures	Implement	<ul style="list-style-type: none"> Transfer and install to smartphone as a platform 	<ul style="list-style-type: none"> Using android studio 	<ul style="list-style-type: none"> An application prototype completed install User feedback
	Evaluate	<ul style="list-style-type: none"> Feedback and responds from the user is taken to improve the application 	<ul style="list-style-type: none"> Select 5-10 students to do the testing of the system 	<ul style="list-style-type: none"> Result of testing

4 Analysis and Findings

This section discusses about discoveries of the entire stage which covered three objectives that have been achieved which are; user requirements, design and development of Learning Malay Historical Figure using augmented reality (ARMyF). In this section, the point of convergence of the paper is shown. User requirements are needed for any project, especially when developing mobile application projects. Use case, functionality and non-functionality interact with the use cases. Below Figure 7 shows the use case diagram for the development of ARMyF.

Functional Requirements are a description of the facility or feature required for development of a system or application. It deals with what the system should do or provide for users. A use case diagram is used to describe the functional requirement. Use case diagram is a depiction of a user's interaction and relationship within a system or application. It contains use cases and role where use case is a list of functionality that the user can perform actions whereas role is an actor.

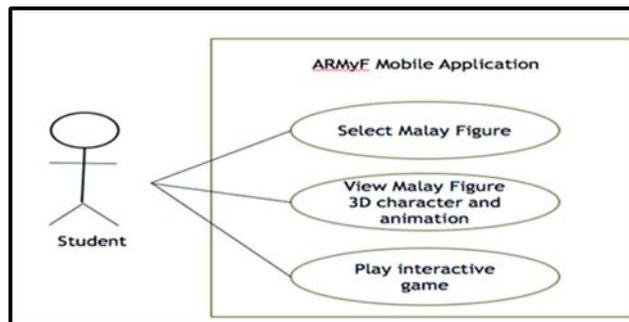


Fig 7. Use-Case Diagram for ARMyF

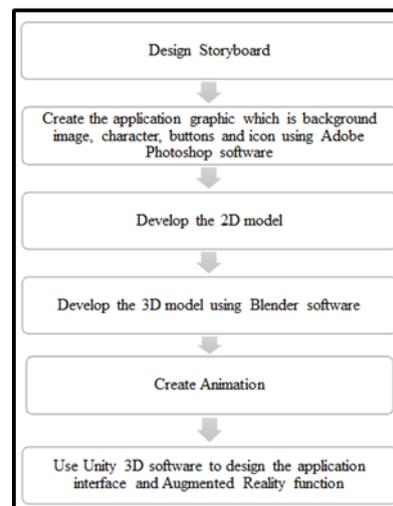
Table 5. Functional Requirements for ARMYF Mobile

Function	Description
Select Malay Figure	Students can choose Malay figure that they want to know about
View 3D model and animation	Student can view 3D character model and animation with an interactive sound
Play an interactive game	Student can play an interactive fighting game and select which character they want to use before starting the game
Implement of augmented reality	Student can watch information and play the game by using augmented reality technology

Table 6. Non-Functional Requirements for ARMYF

Characteristic	Description
Availability	Uptime less than 5 second
Performance	Good performance with minimum constraint
Flexibility	Capability to increase or extend the functionality
Portability	The ease to view on all necessary platform
Reliability	High capability to maintain its performance over time
Usability	Easy to be understood, learned and used by intended user

Several steps of the design process were done to develop this mobile application. It started with producing a use case diagram, designing storyboard, 2D model, 3D model and user interface design. All these processes used different type of tools in order to complete, but the whole design are related to each other. Figure 8 shows the design phase processes in the development of the ARMyF.

**Fig 8.** Design Phase Process

First step was to sketch the process flow of the application by using the storyboard. The storyboard explained the short description about this system. It was developed in the early planning for the design phase and used as a reference to develop the complete application prototype. Next step was creating the application graphic. The application graphic covered application background, game character, buttons and icons. This was followed by the process of designing the 2D model of the character where Adobe Photoshop was used as a tool for this activity. Next was to create the 3D model. The design was based on the same 2D character design, and then it was converted into 3D character. In order to model the 3D character, this study used a tool or software called Blender. After the 3D models had been created, the process to animate the character was executed. As for the augmented reality function and to

design the application interface, a tool called Unity 3D was used. Figure 9 and 10 show the process of creating and animating the 3D model.



Fig 9. The 3D model of the character



Fig 10. Putting the animation elements of the 3D model of the character

As for the user interface, there are three parts in this mobile application prototype. First is a Malay Figure section which displays information about the Malay Figure such as the summary of the character, the biodata and their contribution. Secondly is the 3D character part which shows 3D character model with animation. The final one is the game part where user can play interactive fighting game and use the 3D Malay Historical Figure as the fighting character. Figure 14 shows the game animation flow for all the processes involved at each character. The changes of states from one process to another process are linked to each other to create the reaction during the fighting game. Every fighting button such as kick, punch, walk forward and backward were set at the animation flow as illustrated below (Refer Figure 11, 12, 13 and 14).



Fig 11. Interface for home page of the application



Fig 12. Malay Figure section



Fig 13. Interface for the game section

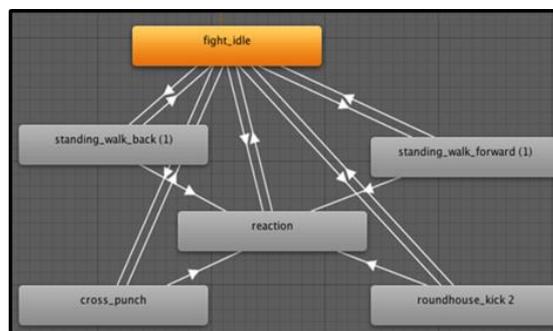


Fig 14. Game animation flow

In the development process, Unity 3D was used as the tools to develop the application. All the completed process in previous stage namely; graphics, audio and 3D models were imported into this process. The next process was to search and edit the audio. To create the best experience for the user, a couple of audio systems were used. Internet browser was used as search engine and the audacity as tool to edit the audio. The final process was to test and evaluate the application prototype. To make sure the application runs smoothly, several tests and evaluations were completed before the application was given to end-user.

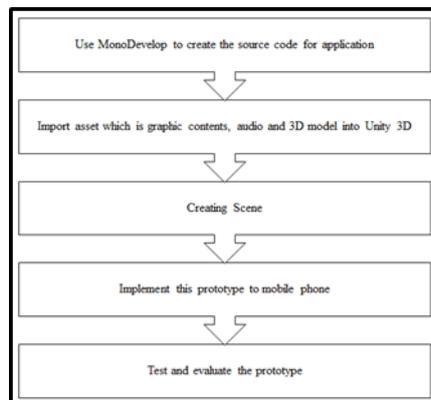


Fig 15. The development process

5 Conclusion and Recommendation

There are many limitations that occurred during the development process. The main issue was when gathering the information about historical figures. It was very difficult to find storybooks about the historical figure so the researchers opted to use the internet. After that, need to find the suitable part to convert the information into 3D design and make it interactive to the user. Secondly, the process to design the 2D character was quite complicated using Adobe Illustrator and then need to convert it into 3D character modelling. This process needs a good skill to imagine the 2D drawing and sketch it using the software. Lastly, the limitation was during the process to create the augmented reality game. The game developed must be relevant to the historical figure and gain interest from the user to know more about it. Even though this project gives a lot of benefits to the user, there is room for improvements that need to be done in the future to improve the application efficiency and effectiveness. The further development of this application prototype needs to be continued after the positive survey and result from the participants. To understand user requirement, the prototype needs to involve expert person such as the teacher and academician. The cooperation between these two groups can make this application more useful. Secondly, better design, interactive animation and smooth model development can be achieved with good computer specs and development skills. Clear audio sound can deliver better understanding of user. With better design and development of the

application, the user will become more attracted to use the application. Lastly, more user testing is required to identify the weaknesses for this application prototype. The numbers of participants especially students need to be increased, for example, select one secondary school and focus on students from 13 – 15 years old. The main focus is to attract the user's attention about Malay Historical Figures. There are many historical figures in Malaysia who can be used as the next development of the application. Therefore, the students can learn History in school by downloading the application on their mobile phones.

This application prototype exposed the user about Malay Historical Figure, which may be forgotten in the next generation since they were born after the Independence Day. The idea to develop an interactive learning version of Malay Historical Figure to bring competitive advantages for the user to learn, remember and know about historical person. The interactive element in this application is a 3D character model with animation and another section is fighting game. Besides that, Augmented Reality technology was used in this application. This technology enables the user to interact with the application and view the 3D object in the real world using their smartphone camera. The user can get the opportunity to know about how Augmented Reality works in mobile application. The fighting game helps to gain user's interest as younger generation nowadays like to play games from their smartphone. The result of this study showed that the application is efficient for the user, which proved that it is successfully delivered and meet the objective.

Acknowledgements

We would like to express our high gratitude to University Teknologi MARA, Shah Alam, Selangor, Malaysia for funding this paper submission via an internal grant called BESTARI (Ref. No: 600-IRMI/DANA 5/3/BESTARI (P) (109/2018)). The highest appreciation also goes to the Faculty of Computer and Mathematical Sciences (FSKM) and Institute of Malay Thoughts and Leadership (IMPAK), Universiti Teknologi MARA, Shah Alam, Selangor, Malaysia.

References

1. Razliqah, R., (2010). Cara2 Meningkatkan Semangat Patriotisme Dalam Kalangan Remaja. Impian Rika.
2. Jamil, M., (2015). Hang Tuah Bukan Mitos. Sinar Online 8 August 2015.
3. Billinghamurst, M., (2012). Augmented Reality in Education. New Horizon for Learning, 12.
4. Duveen, J., & Solomon, J., (1994). The great evolution trial: Use of role-play in the classroom. *Journal of Research in Science Teaching*, 31(5):575-582.
5. Schrier, K.L. (2005) Revolutionizing History Education: Using Augmented Reality Games to Teach Histories. Master of Science Thesis in Comparative Media Studies at the Massachusetts Institute of Technology.
6. Kim, G. (2017). Living History: Education through Augmented Reality. Research Center of the Master of Arts Management Program Heinz College, Carnegie Mellon University Pittsburgh, Pennsylvania.
7. Suliaty, A. (2015). myMetro. Hayati Perjuangan Tokoh Negara. <https://www.hmetro.com.my/node/47468>. Published on Thursday, 30th April 2015.
8. Talin R (2014) The teaching of history in secondary schools. *International Journal of*

Social Science and Humanities Research. 2(3):72–78.

9. Majid NAA, Husain NK (2014) Mobile learning application based on augmented reality for science subject: Isains. *ARNP J Eng Appl Sci* 9(9):1455–1460.
10. Parhizkar B, Gebril ZM, Obeidy Wk, Ngan MNA, Chowdhury SA, Lashkari AH (2012) Android mobile augmented reality application based on different learning theories for primary school children. In: *Proceedings of the International Conference on Multimedia*.
11. Azwan Ahmad, Abdul Ghani Abdullah, Mohammad Zohir Ahmad, & Abd. Rahman Abd. Aziz. (2005). Kesan efikasi sendiri guru Sejarah terhadap amalan pengajaran berbantuan teknologi maklumat dan komunikasi (ICT). *Jurnal Penyelidikan Pendidikan*, 7, 15-24.
12. Anuar Ahmad, Siti Haishah Abd Rahman, & Nur Atiqah T. Abdullah.(2009). *Tahap keupayaan pengajaran guru Sejarah dan hubungannya dengan pencapaian murid di sekolah berprestasi rendah*. *Jurnal Pendidikan Malaysia*, 34(1), 53-66.
13. Liu, T. Y., & Chu, Y. L. (2010). Using ubiquitous games in an English listening and speaking course: Impact on learning outcomes and motivation. *Computers & Education*, 55(2), 630-643.
14. Di Serio, A., Ibáñez, M. B., & Delgado, C. (2013). Impact of an augmented reality system on students' motivation for a visual art course. *Computers & Education*, 68, 586-596. doi:10.1016/j.compedu.2012.03.002
15. Siltanen, S., (2012). *Theory and applications of marker-based augmented reality*. VTT Science 3. ISBN 978-951-38-7449-0 (soft back ed.).
16. Aukstakalnis S (2016) *Practical augmented reality: a guide to the technologies, applications, and human factors for AR and VR*. Addison Wesley Professional, Boston.
17. Lanham M (2017) *Augmented reality game development*. Packt Publishing Ltd., Birmingham.
18. De Freitas S, Rebolledo-Mendez G, Liarokapis F, Magoulas G, Poulouvasilis A (2009) Learning as immersive experiences: using the four-dimensional framework for designing and evaluating immersive learning experiences in a virtual world. *British Journal of Educational Technology* 41(1):69–85.
19. Kirkley BSE, Kirkley JR (2004) Creating next generation blended learning environments using mixed reality. *Video Games and Simulation Techrends* 49(3):42–53.
20. Haag J (2013) Using augmented reality for contextual mobile learning. Retrieved 23 Jan 2018, from <https://www.learningsolutionsmag.com/articles/1310/using-augmented-reality-for-contextual-mobile-learning>.
21. Bower M, Howe C, McCredie N, Robinson A, Grover D (2013) Augmented reality in Education; cases, places, and potentials. In: 2013 IEEE 63rd annual conference international council for education media (ICEM), pp 1–11. <https://doi.org/10.1109/CICEM.2013.6820176>
22. Dunleavy P, Bassili-Gallo JF, Bocci M, Brieba D, Kim T, Tinkler J (2009) *Delivering decentralised public services: how e- government adds value*. Paper for OECD, Paris: OECD
23. Matcha W., & Rambli D, R, A. (2011). Preliminary Investigation on the Use of Augmented Reality in Collaborative Learning. *International Conference on Informatics Engineering and Information Science* volume 254 pp 189-198.

24. Chatzopoulos, D., Bermejo, C., Huang, Z., & Hui, P. (2017). Mobile Augmented Reality Survey: From Where We Are to Where We Go. *IEEE Access*, PP(99), 1. <https://doi.org/10.1109/ACCESS.2017.2698164>
25. Ramanujam. R. S. U., Veluchamy P., & Joy.,B. (2016). Augmented Reality Adaptive Web Content. *IEEE Consumer Communications & Networking Conference, Las Vegas USA*. DOI: 10.1109/CCNC.2016.7444740
26. Lin, T. J., Duh, H. B. L., Li, N., Wang, H. Y., & Tsai, C. C. (2013). An investigation of learners' collaborative knowledge construction performances and behavior patterns in an augmented reality simulation system. *Computers & Education*, 68, 314-321
27. Johdi M, S., Baharom M, & Said A., A. (2013). The significant of History curriculum in the development of active citizen: A critical analysis of the ICSS History, Malaysia. *International Journal of Scientific and Research Publications*, 3(9), 1-8.
28. Rajasekar, S., Philominathan, P., & Chinnathambi. (2013). Research methodology. Retrieved June 12, 2013, from <http://arxiv.org/abs/physics/0601009>
29. Schlegel MJ (1995) A handbook of instructional and training program design. ERIC Document Reproduction Service ED383281.
30. Linda, K (2015). 5 Steps to Developing an Effective Training Plan. Adobe Systems Incorporated. USA.