

**SIMPLE MATHEMATIC FOR PRESCHOOL USING
AUGMENTED REALITY**

TUAN MOHAMD SHAFIQ BIN TUAN MOHD ZAHID

**Bachelor of Computer Science
(Graphic and Multimedia Technology with Honor)
UNIVERSITI MALAYSIA PAHANG**

ACKNOWLEDGEMENTS

First, praise to Allah since i successfully complete this thesis part for psm. I would like to express my special thanks to my supervisor, Dr. Bariah Binti Yusob, and the final year project coordinator, Dr. Al-Fahim bin Mubarak Ali for guiding me to complete this thesis. I also would like to thanks to my parent for giving me motivational and financial support. Did not forget too, my fellow friends for helping me in finding the information and give moral support to me. Finally, to the people who helping me directly and indirectly in this thesis.

ABSTARK

Simple Mathematic adalah alat yang direkakan untuk pelajar prasekolah untuk membantu mereka dalam mempelajari subjek matematik dengan cara yang lebih menarik dengan menggunakan teknologi realiti bertambah. Alat ini juga membantu para guru untuk mengajar pelajar menjadi lebih mudah difahami dengan menarik minat dan penyertaan pelajar. Augmented Reality (AR) adalah objek maya 3D yang diintegrasikan ke dalam persekitaran sebenar 3D dalam masa nyata. Teknologi AR dapat membantu pelajar meningkatkan pembelajaran mereka dengan lebih cepat dalam persekitaran yang lebih menyeronokkan. Projek ini dijalankan berdasarkan model ADDIE yang merangkumi proses analisis, reka bentuk, pembangunan dan penilaian. Setiap proses dinilai menggunakan penilaian formatif. Pada akhir projek penilaian singkatan mengenai fungsi dan interaktiviti sistem untuk mengesahkan prestasi alat pembelajaran.

ABSTRACT

Simple Mathematic is a tool that is developed for preschool students to help them in learning mathematic subject in more interesting way using augmented reality technology. This tool also helps teachers to teach the students to become more understandable by getting the students' interest and participation. Augmented Reality (AR) is a 3D virtual objects that are integrated into 3D real environment in real time. AR technology can help the students to improve their learning faster in a more fun environment. This project is conducted based on ADDIE model that include the process of analysis, design, development and evaluation. Each process is evaluated using the formative evaluation. At the end of the project a summative evaluation on the functions and interactivity of the system to validate the performance of the learning tool.

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CHAPTER 1

INTRODUCTION

1.0 Introduction

The Simple Mathematic for Preschool Kids using Augmented Reality is developed the purpose of helping preschool kids to learn Mathematic subject in more interesting way. This tool can help teachers to teach these kids to become more understandable in learning mathematic subject. Augmented Reality (AR) are not something unfamiliar in education nowadays. However, the usage of AR for preschool is rarely used. Then, the development of this tools will be used for preschool. The main purpose of this courseware is to help the school teachers to teach simple Mathematic subject the kids in their learning process. Teacher used their own books and 2D flashcard to make the kids understand the learning modules by using the conventional techniques.

1.1 Introduction to Preschool Education in Malaysia

The Ministry of Education (MOE) has started in implementing the annex preschool program as a project based on the decision made by the Cabinet on 18 December 1991 to create preschool in 1992. Meantime, the Cabinet meeting agreed that the MOE could continue to expand the preschool from 2002 on 6 June 2001. Since then, the preschool program has been conducted in line with the existing policies.

The Education Act 1996 provides for preschool education, primary education, secondary education, post-secondary and higher education in the National Education System. MOE is responsible to give serious attention to the development of preschool including the establishment of kindergartens, the minister's power to establish and maintain kindergartens, preschool curriculum, medium of instruction and teaching of Islamic studies.

There are a few objectives of preschools in Malaysia. Firstly, having a positive personal traits, character and self-concept to be a patriotic citizen. Then, using Malay correctly and developing language and communication skills and also using English in daily life based in line with its status as the second language. Last but not least, having cognitive skills to think and solve problems also one of the objective of preschools in Malaysia.

1.2 Introduction to Augmented Reality

Augmented Reality (AR) is a 3D virtual objects that are integrated into 3D real environment in real time (R.T. Azuma, 1997). It offers a different set of affordances from the various technological interventions. It is mean that AR will be used differently from other technologies when it is applied in education.

Firstly, AR requires the combination of virtual elements and real environment. Milgram and Kishino (1994) made the conceptual that AR as part of a virtuality continuum. Virtuality environment is the purely real environment on one side while the other side is the purely virtual environment. AR sits between these two extremes.

Secondly, AR requires three-dimensional registration such that the virtual element are aligned to the real environment. Next, the third AR requirement is real-time interactivity with the virtual elements. Thus, the virtual elements must be like real element in the real environment.

Augmented Reality is a next generation interface that affords a different wat of interaction with the information. This interaction used to develop better learning experiences.

1.3 Project Background

Learning is something that is very important as a medium to gain knowledge. However, there are lot of way of learning and also teaching. One of the way is by using Augmented Reality (AR). AR is a type of virtual reality that virtualizing the world's environment into computer. An augmented reality system developed the combination of the real scene viewed by the user and a virtual scene generated by the computer that augments the scene with additional information. The virtual scene is created by the computer that designed for increasing the user's sensory perception of the virtual world they are seeing or interacting with it. Therefore, Simple Mathematic tool are designed using Augmented Reality that focused on preschool kids.

AR technology can help them to improve their learning of mathematic subject faster. AR can be implemented in the school curriculum and key stages to enhance the interactive learning environment. Every preschools have their own way to teach kids. Kids are love to play more than learn at their age. Therefore, AR is used because of the interesting way of using it.

AR systems have been widely demonstrated in different research area and have had much success in gaining a good factor from those who have experience it (Billinghurst, 2002).

The best way to help preschool kids to understand Mathematic subject, they can start using Augmented Reality because it can make more realistic and fun. They can learn by using book where inside the book, they can used symbol card because this is one of the alternative ways that can help them. This card can be created in multiple colors, music, and animation. Furthermore, this application can attract them in their learning.

1.4 Problem Statement

The method of learning simple Mathematic subject for preschool kids by using non-interactive tools in learning have raising a lot of problems such as kids do not interest to learn. The problem are:

- 1.3.1 Preschool kids slow in learning the Mathematic subject.
- 1.3.2 Augmented Reality technologies not been exposed to preschool kids in their learning.
- 1.3.3 Preschool kids do not learn Mathematic subject in interesting way.

1.5 Objective

Based on the problems statement, the objectives of this project are:

- i) To integrate Augmented Reality approach in learning simple Mathematic.
- ii) To develop the teaching and learning tools for preschool kids.
- iii) To test the proposed tools of simple Mathematic for preschool kids at range age 3 to 5 years old by assessing the kids through exercise in tools.

1.6 Project Scope

The development of this project has involving two users which are teachers and kids. Teacher who teach Mathematic subject will conduct how to use this tools when teaching preschool kids. The others user for this project is preschool kids at the age between 3 to 5 years old that learning Mathematic subject in their class.

1.6.1 User

- ✓ Kids
 - Preschool kids from age 3 to 5 years old.

- ✓ Teachers
 - Teachers who teach mathematic subject for preschool.
 - Test the coursework.

1.6.2 Subject

- Simple mathematic for preschool.
 - Counting
 - Addition
 - Subtraction

1.6.3 Approach Technique

- Augmented reality

1.7 Chapter Summary

This thesis consist of five chapters. Chapter one discuss on the introduction to the Simple Mathematic for Preschool Kids using Augmented Reality. This project is developed to help preschool kids to learn Mathematic subject in more interesting way.

The method of learning simple Mathematic subject for preschool kids by using non-interactive tools in learning have raising a lot of problems such as kids do not interest to learn. The first problem is teaching and learning tools using augmented reality does not been practice

in preschools. Then, teachers used manual way in teaching and learning session in their class. Lastly, preschool kids do not learn Mathematic subject in interactive way.

Therefore, this project is developed with the purpose of helping preschool kids to learn Mathematic subject by using Augmented Reality. The benefits that the kids can gain from this tool is they can learn Mathematic easily. Then, this tool also can increase their interest in learning and also increase their abilities of learning.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter discusses about the existing AR systems that have been developed which is similar to the project. The purpose of this Literature Review is to identify and also to analyse the concept of these existing AR systems before implementing it into the project.

2.2 Augmented Reality

Augmented reality (AR) is defined as an interactive experience of a real world environment whereby the objects that reside in the real world are augmented by computer-generated perceptual information with multiple sensory including visual, auditory, haptic, somatosensory, and olfactory. AR also defined as a combination of real scene viewed and a virtual scene generated by computer. It is an augmented of human perception by human sense. The virtual objects are superimposed on the real scene and should appear where they are supposed to be from any view point in all dimensions.

AR is interesting to use because it enhance user's perception of interaction with the real world and also potential for productivity improvements of real world tasks. AR also interesting to use for research purpose because it relatively new field with many problems and some progress recently.

2.2.1 Types of Augmented Reality (AR)

There are a few types of AR techniques. The following section describes these difference types of them.

2.2.1.1 Projection Based AR

Projection based AR is an AR projects digital images on physical objects in the physical space. It works by projecting artificial light onto real surfaces. It allow for human interaction by sending light onto surface and then sensing the human interaction of that projected light. The user's interaction is detected by differentiating between a known projection and the altered projection that cause by user's interaction.

2.2.1.2 Marker Based AR

Marker based augmented reality also known as Image Recognition uses a camera or others type of visual marker such as a QR or 2D code, to produce a result only after the marker is sensed by a reader. It use a camera on the device to distinguish a marker from any other real world object. Simple code are used as the markers because they can be easily recognized and do not require a lot of processing power to read.

2.2.1.3 Markerless AR

Markerless augmented reality uses GPS, digital compass, velocity meter, or accelerometer which is embedded in the device to provide data based on location. It also known as location based, position based or GPS augmented reality. It is most commonly used for mapping direction or finding nearby business.

2.2.1.4 Superimposition Based AR

Superimposition augmented reality replaces the original view of an object either partially or fully with a newly augmented view of the same object. Object recognition plays a main role in superimposition based augmented reality because the application cannot replace the original view with an augmented one.

2.3 Review of Existing Augmented Reality Systems

This section will be discussed on three existing AR systems that has been analyzed which are Math World AR (Houghton Mifflin Harcourt, 2017), AlphaNum – Augmented Reality Kids Learning App (MSAHKOO Studios, 2018) and WizarKids – Augmented Reality Kids Book (Wizar Learning Solutions Pvt Ltd, 2017).

2.3.1 Math World AR

Math World AR is an augmented reality game that turns the kids’ book cover into a fun, unique learning experience. To play, open the app and scan either the Student Activity Book or the Teacher’s Edition cover from any grade using a smartphone or tablet. Then watch an augmented reality game pop right out of it.

There is one game level for every unit in every grade (K-6). Math World AR gets students out of their seats and practicing the math that they are learning. It also can serve as a short, fun homework activity.



Figure 2.1 Main Page of System

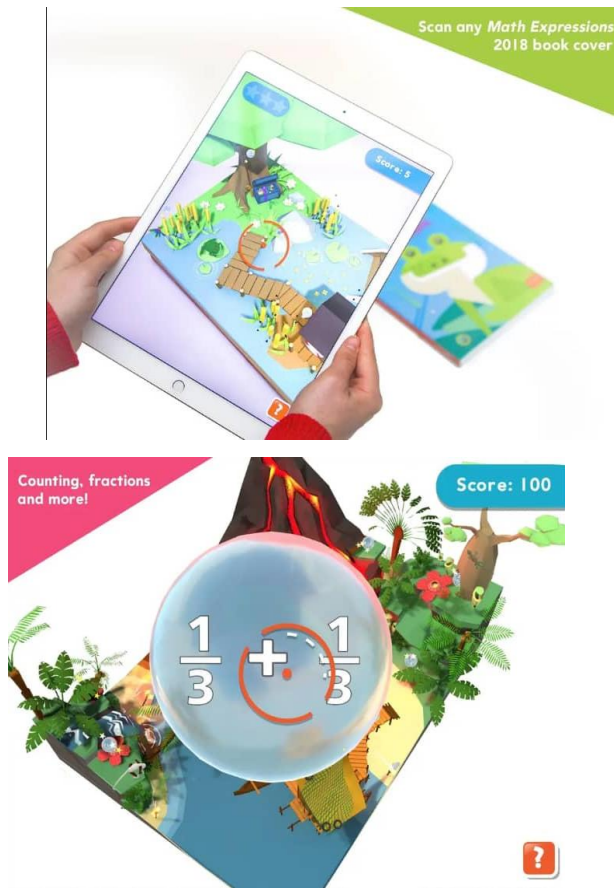


Figure 2.2 Math World AR interface

2.3.2 AlphaNum – Augmented Reality Kids Learning App



Figure 2.3 AlphaNum

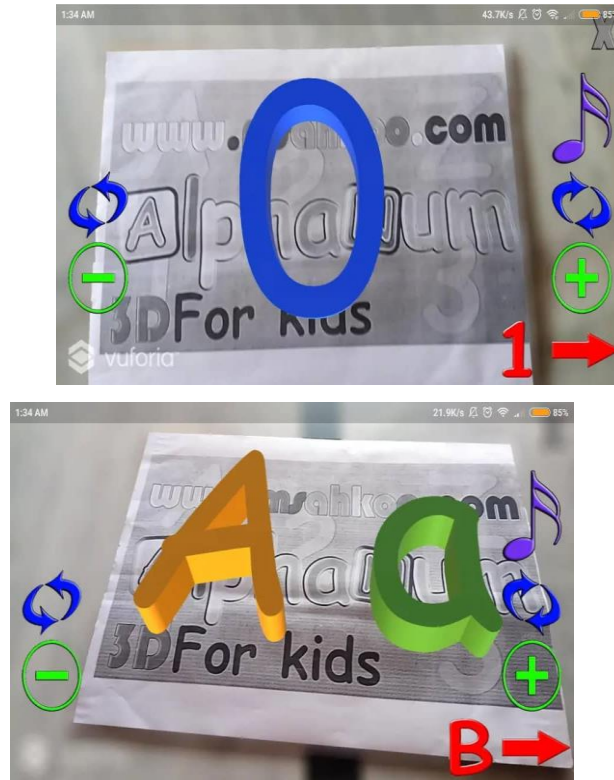


Figure 2.4 AlphaNum interface

AlphaNum AR Learning is a fun way to teach English alphabets and counting for the kids. This is the fun interactive way to teach alphabets to the kids. With AlphaNum AR, learning become more fun. When a device such as mobile phone or tablet pointed at the printed marker, a beautiful 3D alphabet or number will pop out on the screen. It is looks like in real world.

Augmented Reality AlphaNum app for kids are changing the way children learn alphabets and numbers. With the technology of AR, alphabets and numbers become interactive and 3D for children who are learning letters and letter sound and number also.

Children are love to play around with the cards while learning the letters of alphabets and numbers. There are 26 beautiful alphabets and 0 to 9 numeric to help children learn.

2.3.3 WizarKids – Augmented Reality Kids Book

WizarKids is a platform meticulously-crafted to overcome the existing shortcoming in the education system. The young minds cannot comprehend the need and reason behind what they read in the textbook or watch in the video, thus lacking a precise understanding throughout. WizarKids allows the kids to bridge this gap. It is a one-stop application where

they learning skills develop through play and interaction, thus making the learning process more engaging and dynamic than ever.

Just scan the printed flash cards, coloring books, picture books, story books or witness the process in which the creatures come alive and bustle.



Figure 2.5 Main Page for WizarKids

2.2.4 Comparison of the existing systems

Each of these existing AR systems which are Math World AR, AlphaNum – Augmented Reality Kids Learning App and WizarKids – Augmented Reality Kids Book, have their own specification. The specified are as shown in table below including the proposed system which is Simple Mathematics for Preschool.

Table 2.1 Existing AR Systems Specification

Product Name	Math World AR	AlphaNum – Augmented Reality Kids Learning App	WizarKids – Augmented Reality Kids Book	Simple Mathematics for Preschool
Medium Usage	Books, smartphone	3D Flash card, smartphone	Books, smartphone, flash card	Smartphone, Flash card
Application Size	78MB	26MB	200MB	90MB (estimated)
Android Require	4.0 and above	4.1 and later	4.4 and later	4.0 and above (estimated)
Range Age	4 years old and above	3 years old and above	Children	3 – 5 years old
Subject	Mathematic	English	English	Mathematic
Technology	Mobile Phone, iOS and Android	Mobile Phone, iOS and Android	Mobile Phone, iOS and Android	Mobile Phone, iOS and Android
Advantage	Does not collect any personally identifiable information	Can be download from Plays Store	Can be download from Plays Store	-Does not require any personal information -Done not require internet connection
Disadvantage	Need to be supervised	Big size	Used huge storage	Need to be supervised

There are not much differences between Simple Mathematics for Preschool and others 3 existing systems. The proposed system use mobile phone and flash card as medium to use the application. The size of this system is estimated around 90MB and require android 4.0 and above. This proposed system is focused on preschool kids, so the age range is 3 to 5 years old.

2.4 Chapter Summary

This chapter is discussing about literature review where the content are about augmented reality and existing augmented reality systems that are related to this project. Augmented reality is defined as an interactive experience of a real world environment whereby the objects that reside in the real world are augmented by computer-generated perceptual information with multiple sensory including visual, auditory, haptic, somatosensory, and olfactory. There are 4 types of augmented reality such as marker based AR, markerless AR, projection based AR and superimposition based AR.

Second, there are 3 existing AR systems that has been studied which are Math World AR, AlphaNum – Augmented Reality Kids Learning App and WizarKids – Augmented Reality Kids Book to identify the features of these systems. Based on the existing AR systems that has been discuss, it shown that each of the systems have their own specification. However, these existing system still lacking and need attention for improvement for future action. The similarity of these existing AR system which is they used mobile smartphone as a medium usage for the children to use these application. This chapter shares better understanding of the concept of the existing systems on how the augmented reality system based works.

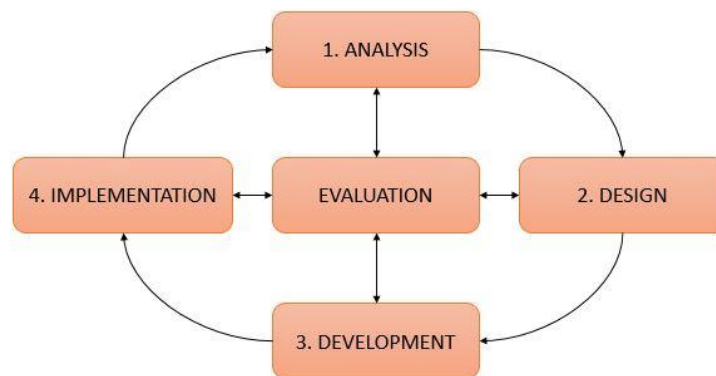
CHAPTER 3

METHODOLOGY

3.1 Introduction

This chapter will discuss about suitable methodology that need to be implement for the Simple Mathematic for Preschool Kids using Augmented Reality. This project is developed based on chosen model methodology is Analysis, Design, Development, Implement and Evaluate (ADDIE) Model. The purpose of methodology is to ensure the project can be completed within the time and budget that has been planned. This method consists of five phase of development (as shown in Figure 3.1) which are:

- I. Analysis phase
- II. Design phase
- III. Development phase
- IV. Implement phase
- V. Evaluate phase



q

Figure 3.1 ADDIE Model

This project used ADDIE Model as the development methodology. Many educators and instructional designers alike have used ADDIE Model method as framework in designing and developing educational programs. ADDIE Model is a model of the Instructional System Design (ISD) family. It has evolved several times over the years to become iterative, dynamic, and user friendly. Therefore, for this project, ADDIE Model methodology is chosen to develop the purpose application.

3.2 ADDIE Model

There are many types of methodology that can be used as development method in developing application. However, this project used ADDIE Model as the development methodology to develop The Simple Mathematic for Preschool using Augmented Reality. The reason of choosing AADIE Model is because many of the educators and instructional designers alike have used ADDIE Model method as framework in designing and developing educational programs. ADDIE Model also suitable for this project because it is basically systematic and used step-by-step framework to ensure the project development and learning can be done structurally.

3.3 Framework of the Project

The figure 3.2 is the framework of ADDIE Model that has been used to complete the project for “The Interactive Mathematic for Preschool using Augmented Reality”.

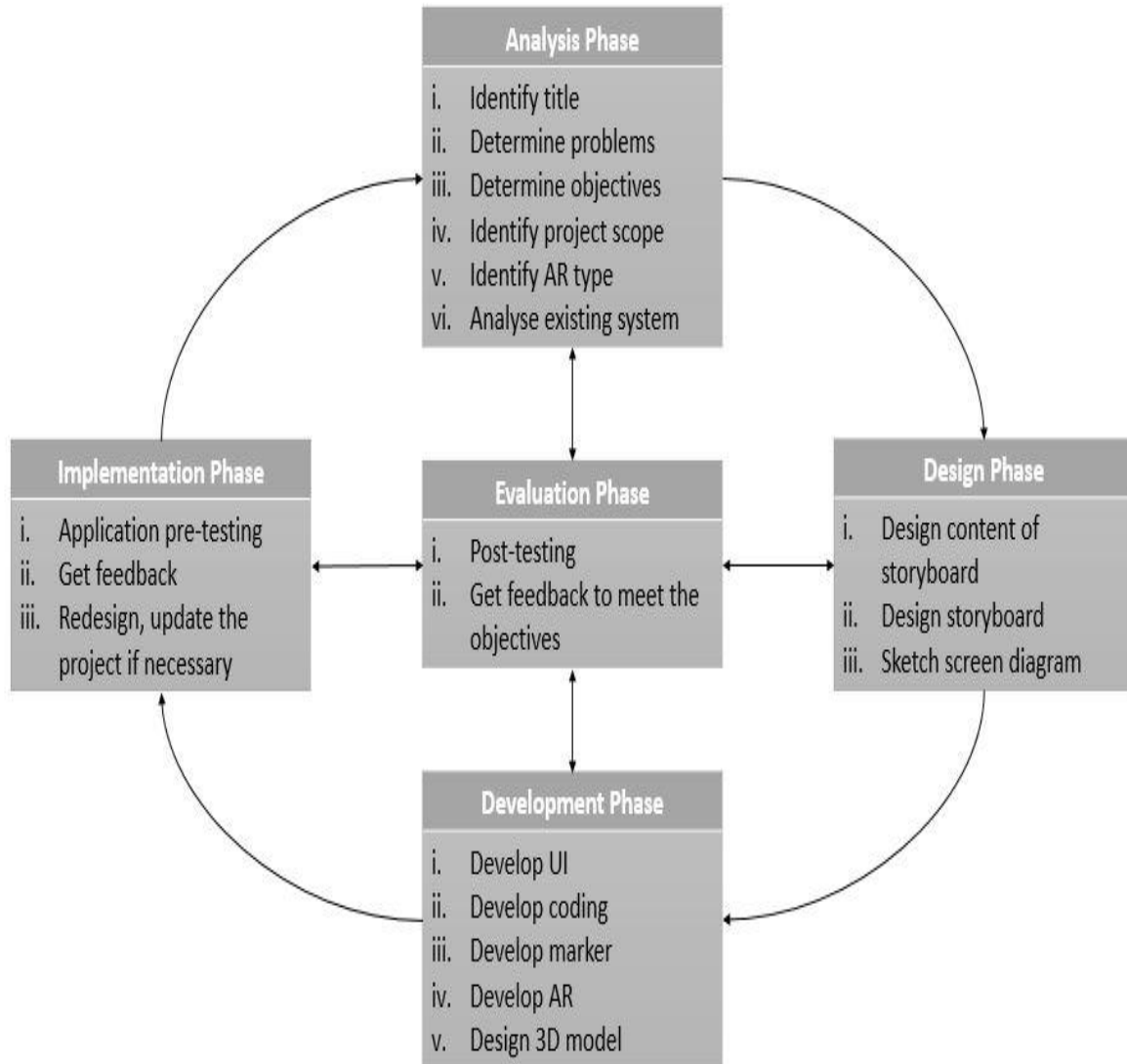


Figure 3.2 Project Development Framework based on ADDIE Model.

3.3.1 Analysis Phase

The first phase of ADDIE model is Analysis phases. This phase is the most important process where it help us to determine the basic process of development. The problem statement for this project is identified in this phases. Not just that, the project objectives and scope of the project also are determined. However, the first thing that we are identifying is the title for the project. The title for this project is “The Simple Mathematic for Preschool using Augmented Reality”.

Augmented Reality (AR) is a latest technology that being used but old method is still being used as references tools for education. Then, the issues that occurred in this phase have

been determined where one of the issues is teaching and learning tools using AR does not been practice in preschool. Due to this issue, an application using AR has been chosen to be developed that can used in teaching and learning for preschool students. After that, the information about AR have been looking through Internet briefly in order to know what the definition of AR is. The objectives of this project also been determined where it is to implement AR approach in learning.

Next, the scope of the project during this phase have been identified. The development of this project has involving two users which are teachers and kids. Teacher who teach Mathematic subject will conduct how to use this tools when teaching preschool kids. The others user for this project is preschool kids at the age between 3 to 5 years old that learning Mathematic subject in their class.

The types of AR that exists also have been analysed which are Projected Based AR, Marker Based AR, Markerless AR, and Superimposition Based AR. Then, Marker Based AR has been chosen as the AR type that are going to be developed in this project where it used a camera in the mobile phone to distinguish a marker from the flash card.

Not just that, some review on existing systems that have developed by other developer also have been done. Then, the specifications of these systems are being compared and analysed the specifications that we need in developing this project.

There are several key component that need to be utilized to ensure the analysis is meticulous such as course content and document, the internet and syllabi. A structure can be determine with some help of online materials as the guide for the syllabus. At the end of the program, the analysis can be conducted to determine the topics or subjects that want to be included in the project.

3.3.2 Design Phase

The Design Phase is the phase where designing process happened in the project. In this phase, the information that have been gathered from analysis phase have been used to create an application. There are many way in designing this application.

Firstly, the content of the storyboard have been used about the project that need to be included in the storyboard. Then, the storyboard being designed one-by-one. The design the storyboard need to be designed first before designing the application using AR. After that, the screen design of the application also being sketched in this phase.

ADDIE Model have been approached systematically with a logical, orderly process of identification, development and evaluation of planned strategies for the target achievement of the project's purposed. This systematic approach is ensure that everything falls has the goal of achieving the project's targets within a set of strategies.

3.3.2.1 Storyboard

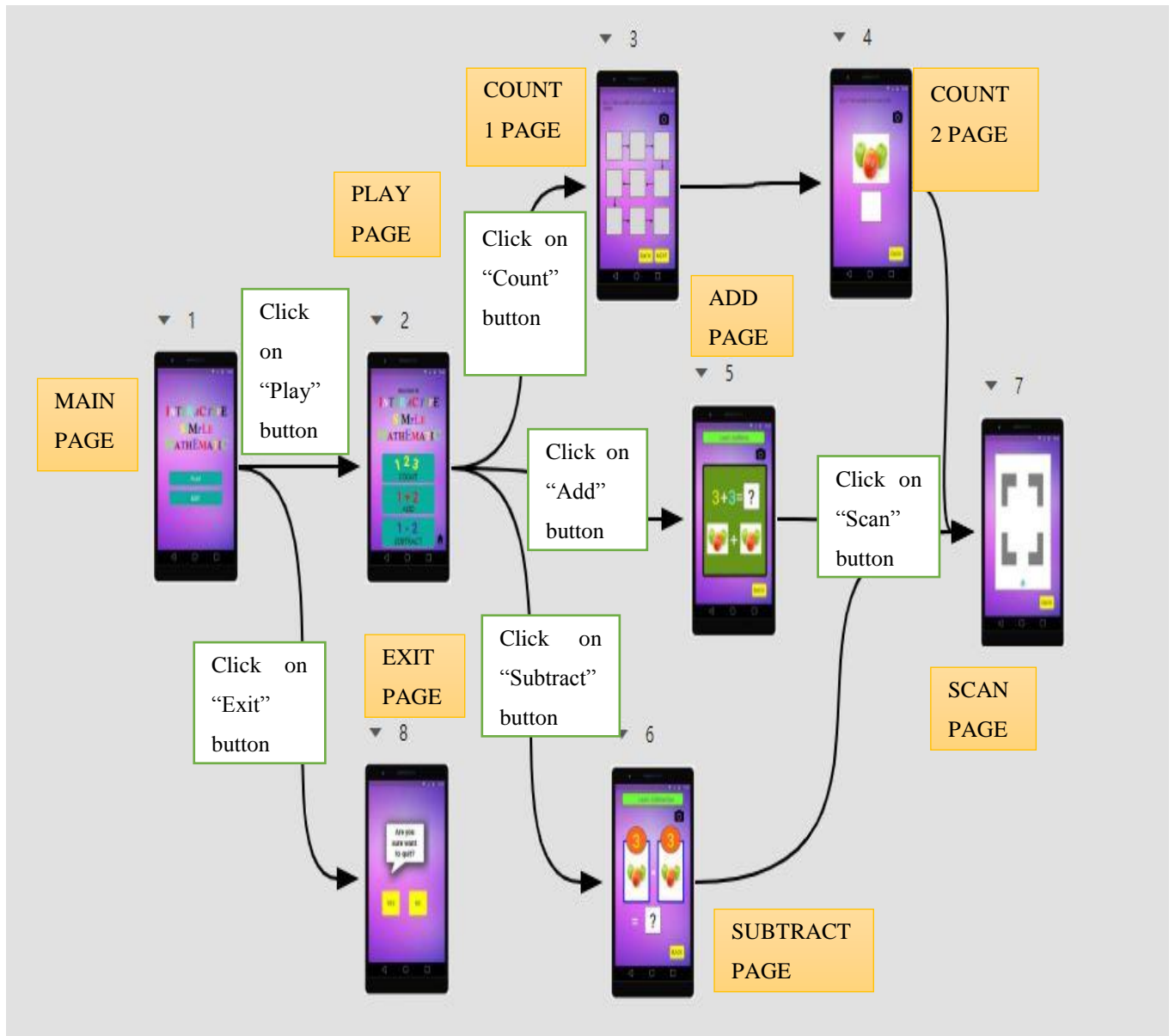


Figure 3: Simple Mathematic Diagram

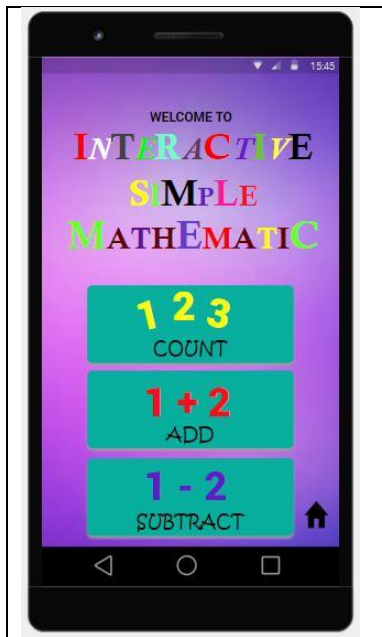
Main page



Description:

In main page, there are 2 button provided which are “Play” button and “Exit” button. For the “Play” button, when the user click on this button, the application will jump into Play page while it will jump into Exit page if they click on “Exit” button.

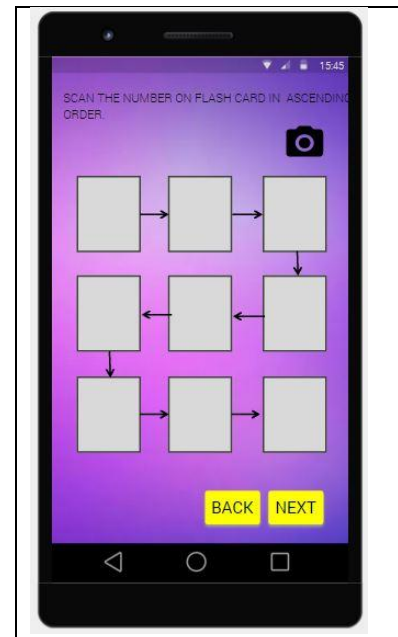
Play page



Description:

Play page consist of 3 button which are “Count” button, “Add” button and “Subtract” button. If the user want to learn on counting number, they can click on “Count” button and it will jump into Count 1 page. If they want to learn on addition, they can click on “Add” button and it will jump into Add page. If they click on “Subtract” button, the page will jump into Subtract page for subtraction learning.

Count 1 page



Description:

This page will show blank box for the user to fill in the number in ascending order by scanning the flash card. They can the card by click on “Camera” button on the top of page and it will jump into Scan page. After they scan the card, the box will be filled with the number that have been scanned before. For “Back” button, page will jump back into Play page while “Next” button is for jump into Count 2 page.

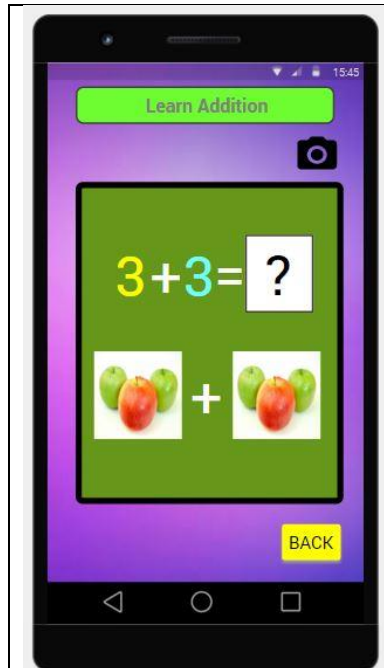
Count 2 page



Description:

This page will show an image that user need to count how many the thing consist in that image. Then, they need to scan the flash card of the number that they have been counted by clicking on Scan button and it will into Scan page. After canning, the blank box will be filled the number that have been scanned earlier. The, they can click on “Back” button after they finish answer the question and the page will jump into Play page again.

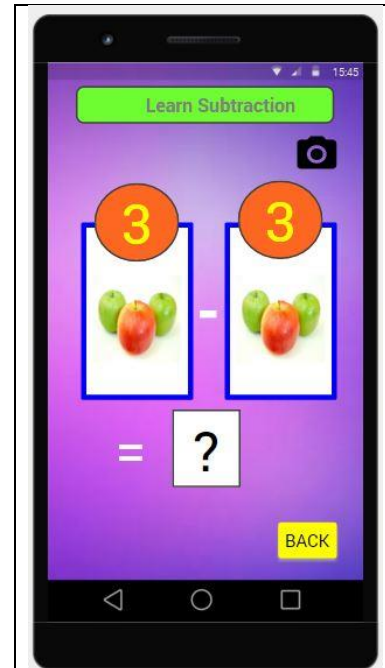
Add page



Description:

The page will show addition of 2 number with blank box and 2 image for the users to count. Then, they need to scan the flash card of the number that they have been counted by clicking on Scan button and it will into Scan page. After canning, the blank box will be filled the number that have been scanned earlier. The, they can click on “Back” button after they finish answer the question and the page will jump into Play page again.

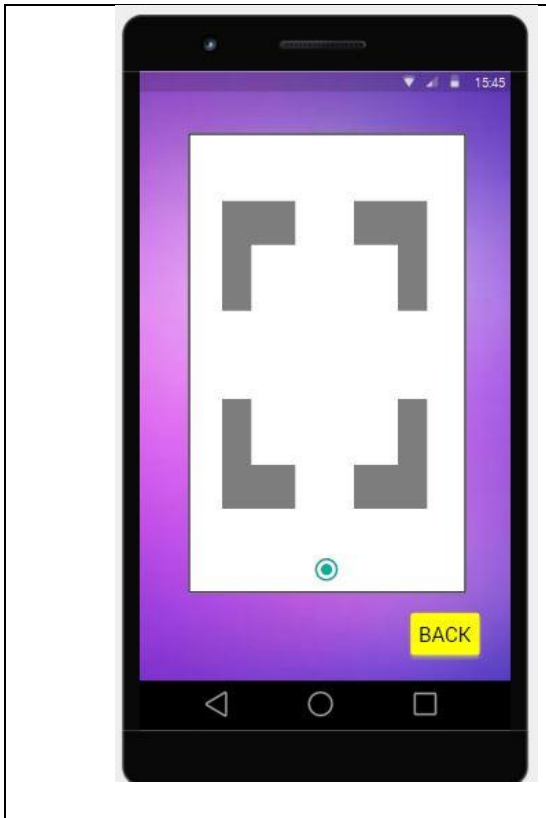
Subtract page



Description:

The page will show subtraction of 2 number with blank box and 2 image for the users to count. Then, they need to scan the flash card of the number that they have been counted by clicking on Scan button and it will into Scan page. After canning, the blank box will be filled the number that have been scanned earlier. The, they can click on “Back” button after they finish answer the question and the page will jump into Play page again.

Scan page



Description:

This page is used for scanning function. The users can scan the flash card after they click on Camera button. They need to scan the card by clicking on Snap button and the page will jump back into previous page. If they want to go back into previous page without scanning, they can click on “Back” button.

Exit page



Description:


In Exit page, it will ask the users if they are sure want to exit the application or not. If they want to exit, they can click on “Yes” button. Otherwise, they can click on “No” button if they want to continue using the application. This page will be shown after they click on “Exit” button from Main page.

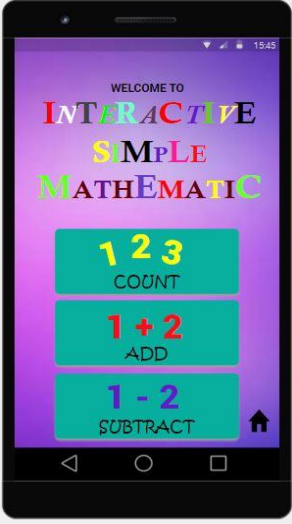
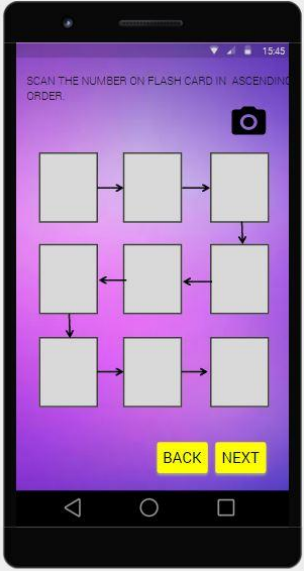

3.3.3 Development Phase

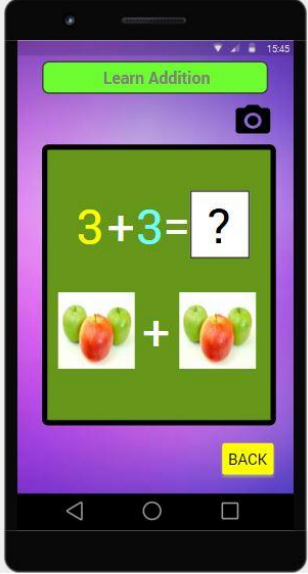
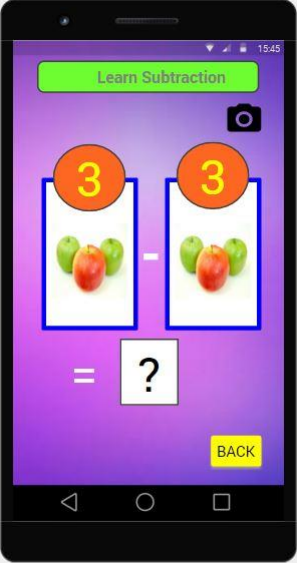
The development phase is where the production and testing of the methodology started. We develop the content and learning interactions outlines in this phase. During the development phase, content is written while graphics, audio, and photography are produced. There are three tasks included in this phase which are drafting, production and evaluation.

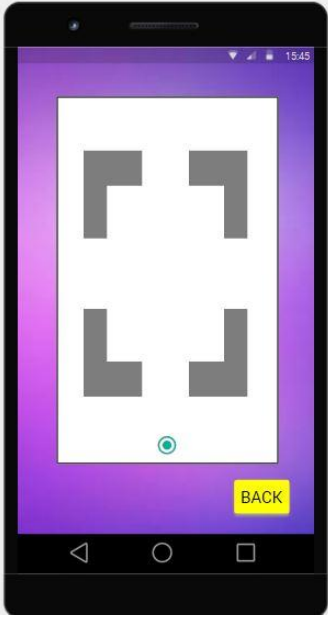

In this phase, we design the 3D model using Autodesk Maya software after the sketching is done. All the 3D model is designed based on the sketching part. We choose Maya Software 2016 versions as it consists many of software versions. This is previous version before the latest one which is 2018 versions. This software consists of many tools that can be used such as extrude, rotate, shape, resize and many more.

After that, we design the user interface of application using Justinmind Prototype software where it is open source software and easy to use. The interface is designed based on sketch in the storyboard. This interface will be used as application interface for user to play the application.

No.	PAGE	SCREEN DIAGRAM
1	Main	

2	Play	
3	Count 1	
4	Count 2	

5	Add	 <p>The image shows a smartphone screen with a purple background. At the top, there is a green header with the text "Learn Addition". Below the header, the equation $3+3=?$ is displayed in large, colorful numbers. Underneath the equation, there are two small images of baskets containing three fruits each (two green apples and one red apple). A plus sign is placed between the two baskets. At the bottom right of the screen, there is a yellow button labeled "BACK". The Android navigation bar is visible at the very bottom.</p>
6	Subtract	 <p>The image shows a smartphone screen with a purple background. At the top, there is a green header with the text "Learn Subtraction". Below the header, there are two baskets of fruit, each containing three fruits. Above each basket is a red circle with the number "3" inside. A minus sign is placed between the two baskets. Below the baskets, there is an equals sign followed by a question mark in a white box. At the bottom right of the screen, there is a yellow button labeled "BACK". The Android navigation bar is visible at the very bottom.</p>

7	Scan	
8	Exit	

Then, we develop the marker of object on flash card using Adobe Photoshop and develop it coding before printing it on the flash card. This marker is static marker where the AR object only will be shown on the flash card. If the flash card removed, the AR object also will be disappeared.

3.3.4 Implementation Phase

The Implementation Phase is the modification of the project continuously to ensure the maximum efficiency and positive results are accomplished. This phase is to ensure the application is meet to the objectives of the project and to test the application if it work well or not. During this stage, we do some pre-test of the application to test either it work well or not. We pick some people to be the tester. The flash card will be given to the tester to test the application. After they finish testing, we gather some feedback on the application from them as a review for further step. After that, we analyze the feedback gathered and we redesign and update the application if it necessary to ensure the project can be delivered effectively.

3.3.5 Evaluation Phase

The last phase of the ADDIE method is Evaluation phase. During this phase, we determines what success will look like and how it will be measured. The evaluation phase is to see how much the discoveries met in the Analysis phase including expectations of the user and the objectives.

Evaluation consists of post-testing of the application for specific criterion that related with the objectives and providing opportunities for the feedback from the users. In this phase, the feedback on effectiveness of the application including lesson, course or materials will be assembled. If the feedback meets the objectives of the project, then it can be considered as success. If it not meets the objectives, revisions in the design may be necessary.

3.4 Software and Hardware

The following table concludes the hardware and software that will be used in the development of Simple Mathematic using Augmented Reality.

Table 3.1 Software Requirement

Software	Purpose
Microsoft Window 10	Workspace Station
Microsoft Word 2013	Project Documentation

Microsoft Power Point 2013	Project Presentation
Adobe Photoshop CS4	Marker Editing/Creating
ARToolKit	AR creation
Justinmind Prototype	UI design
AutoDesk Maya 2016	Modelling 3D object

Table 3.2 Hardware Requirement

Hardware	Purpose
Notebook/ PC	Workspace and testing
Mobile phone	Marker detector
Flash card	Visual marker

3.5 Gantt Chart

Specific arrangement is compulsory to ensure the project can be completed within the time that has been planned.

3.6 Chapter Summary

In this chapter, we discuss about the methodology that we used for the development of the project. We choose ADDIE Model as the project development because this model is basically step-by-step frame and general to ensure the smooth of the development and learning of the project.

Then, we explained in detail every of the steep in ADDIE model in the framework of the Simple Mathematic project. The objective of framework is to ensure that every phase has its own importance. Not just that, framework also can help us to follow the step of ADDIE model consecutively.

Software and hardware that will be used or have been used also been discussed in this chapter. All the software and hardware used is good software and support most of types of file formats.

CHAPTER 4

DEVELOPMENT

4.0 Development Phase

During development phase, Simple Mathematic application is developed to interact with Augmented Reality (AR) technology. The application will detect the marker by using camera and create a functioning application. This application is developed using several software and plugin in order to work. A step by step process is taken to ensure the application is working.

4.1 Creating Marker Using Adobe Photoshop Cs4

Adobe Photoshop CS4 is used in creating the flashcard marker for the application. The flashcard is created by editing the designing image and insert some external image into it to make it more creative. The flashcard creation is started by choosing the scale. For Number flashcard, the scale is 480x800 pixels of phone screen size while the scale for others flashcard is custom with the size of 480x360 pixels. 10 flashcard is created for the Number flashcard from 0 to 9. 1 flash card is created for each of the introduction of Counting, Addition and Subtraction while 5 flash card is created for Addition and Subtraction activity. The images created will be used to detect the marker in Unity3D software later on.

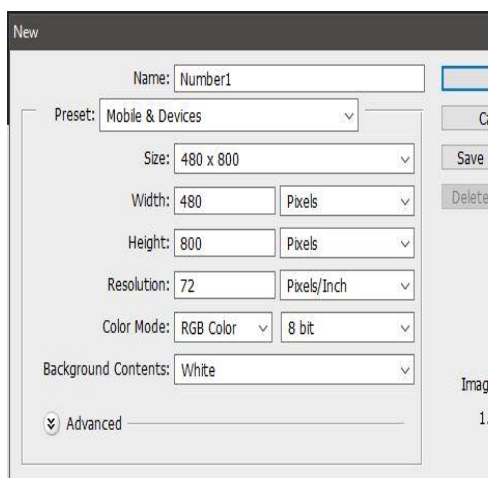


Figure 4.1,1 The resolution of Number Flashcard

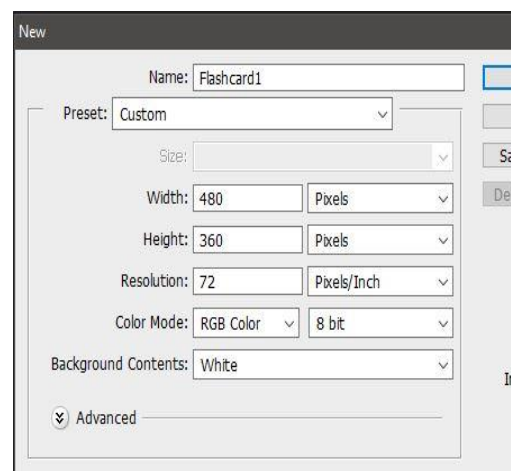


Figure 4.1.2 The resolution of others flashcard

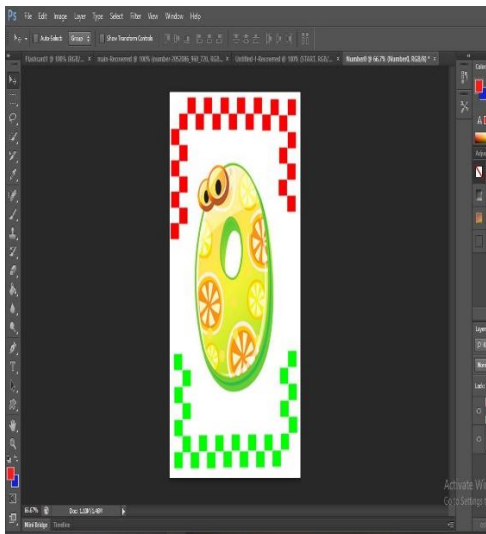


Figure 4.1.3 Number Flashcard

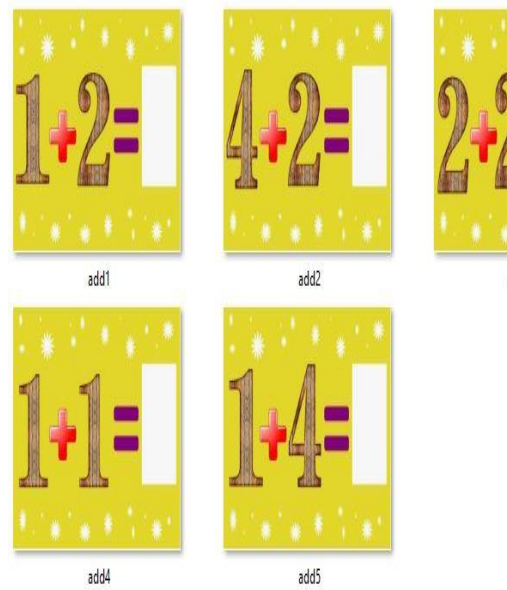
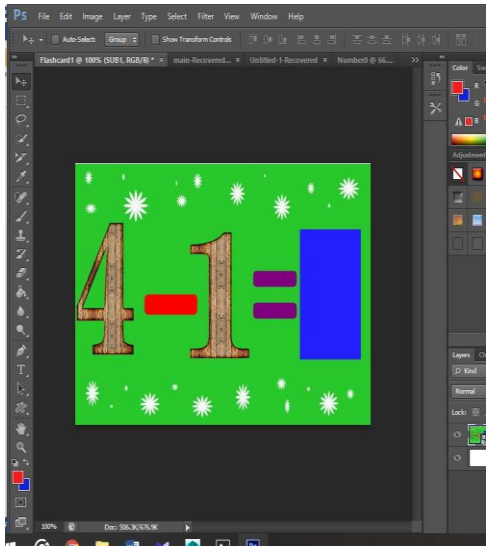


Figure 4.1.4 Addition Activity Flashcard



SUB1



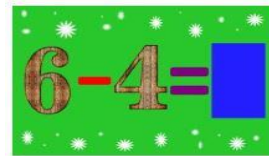
SUB2



SUB3



SUB4



SUB5

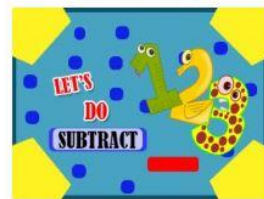
Figure 4.1.5 Subtraction Activity Flashcard



INTRO(Addition)



INTRO(Count)



INTRO(Subtraction)

Figure 4.1.6 Introduction Flashcard

4.2 Creating 3d Model In Autodesk May

3D model that has been used is created using AutoDesk Maya software. 3D model is needed for interaction between the marker and camera. When the camera scan the image, this 3D model will pop up on the screen. The model is designed with basic polygon that will take shape and become the desired objects. Maya software provided some tools such as scale, move, rotate and etc which is used to create the model.

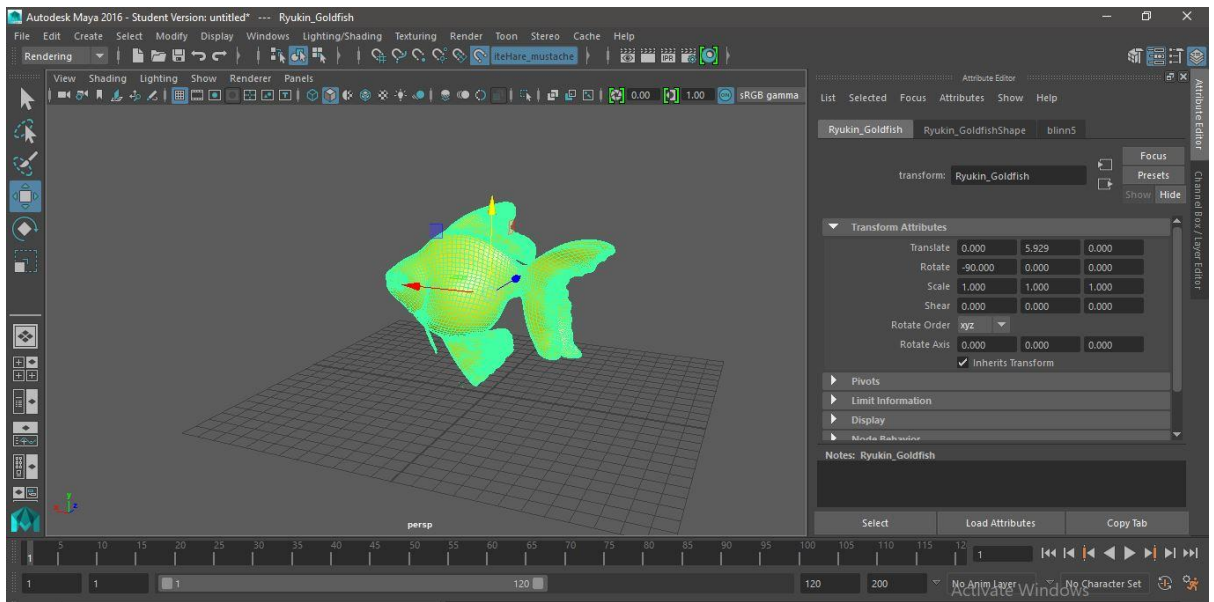


Figure 4.2.1 Process creating the 3D model

4.3 Creating Marker In Vuforia Unity3D

Vuforia is one of the plugins in Unity3D software and it requires an internet connection to use the software. Firstly, we need to create the license key from License Manager in Vuforia's webpage. The License Manager provides the tools and information needed to create and manage the license. Each license key can only be used in a single application. After that, the database of the target is created from Target Manager where the image of the flashcard that has been created in Photoshop is uploaded into the related database. Then, the database is loaded into Unity3D for the creation of the marker.

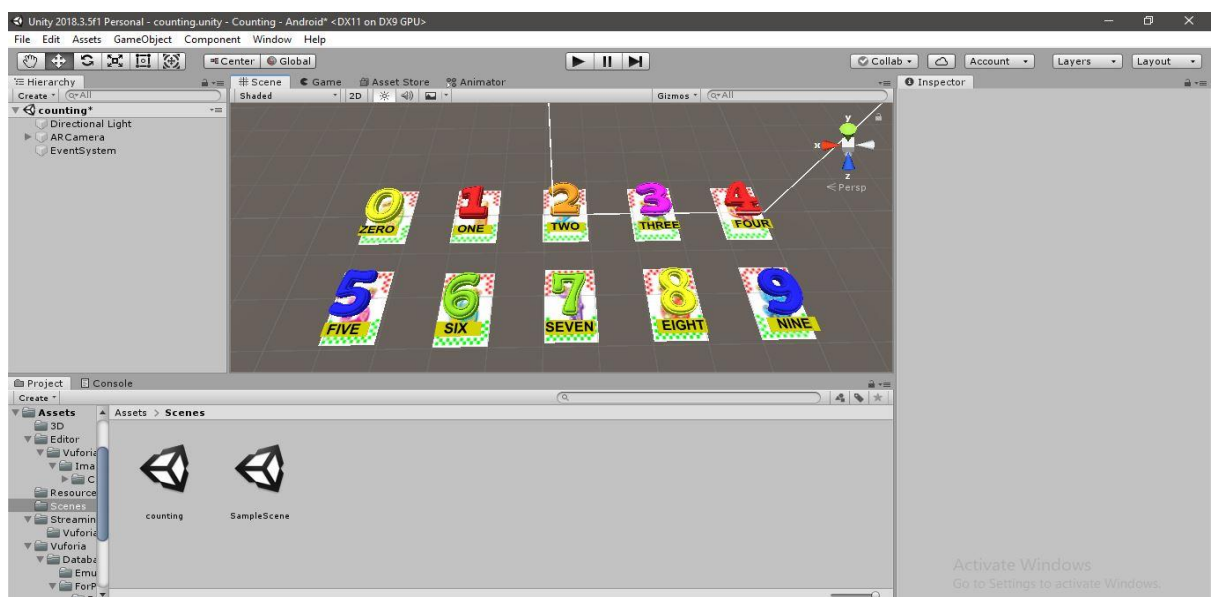


Figure 4.3.1 The creation of marker on flashcard.

4.4 Creating Main Menu For The Application

The background of the main menu is created using Adobe Photoshop where the image is edited and inserted some other image to make it more creative. Then, the image is imported into Unity3D software and loaded as image in User Interface tools. The main menu consists of 2 buttons which are Play button and Exit button. Play button is used to enter into the menu of the application while Exit button is used to exit the application.



Figure 4.4.1 Main Page

4.5 Creating Menu Selection

This page is created same as main menu where its background is created in Adobe Photoshop and then is imported into Unity3D software. This page is loaded after the user clicks the Play button in the main menu page. This page consists of 4 buttons which are:

- COUNTING BUTTON
- ADDITION BUTTON
- SUBTRACTION BUTTON
- BACK BUTTON.

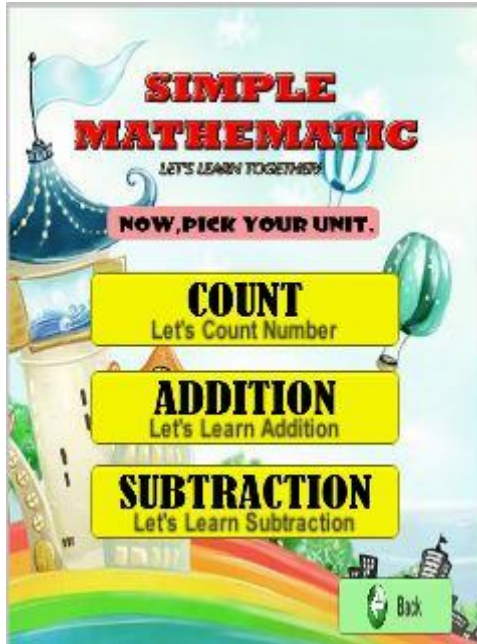


Figure 4.5 Menu Page

4.6 Creating Unit Page (Count, Addition, Subtraction)

The Count page, Addition page and Subtraction page is designed with the same design and consist of 2 button which are Introduction button and Activity button. The Introduction button will jump into a page where user need to scan the Introduction flashcard and it will pop up a video about the flashcard topic. The Activity button will open the page where the user will scan the activity flashcard.

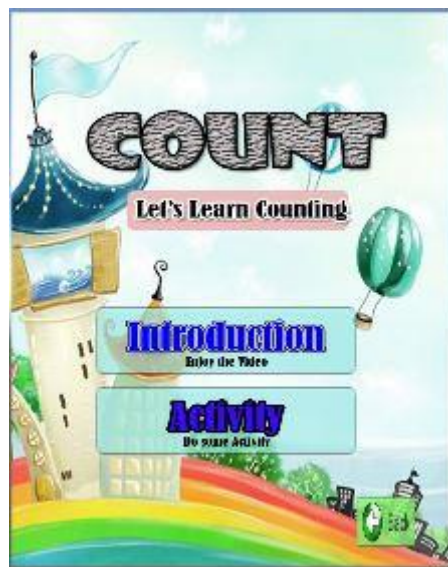


Figure 4.6.1 Count page

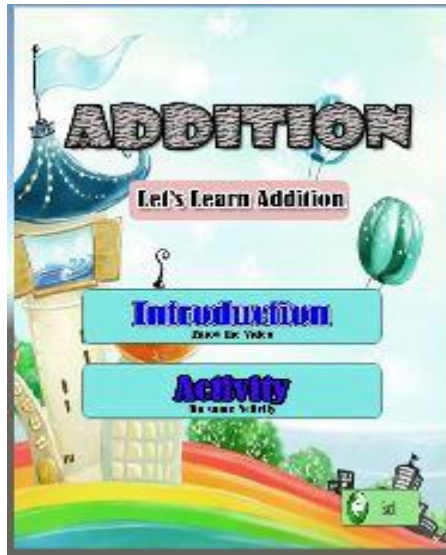


Figure 4.6.2 Addition Page



Figure 4.6.3 Subtraction Page

4.7 Creating Exit Page

Exit page consist of 2 button which are Yes button for quit application and No button for continuing the application. The background of this page is edited using Adobe Photoshop with combining a few image into 1 page.

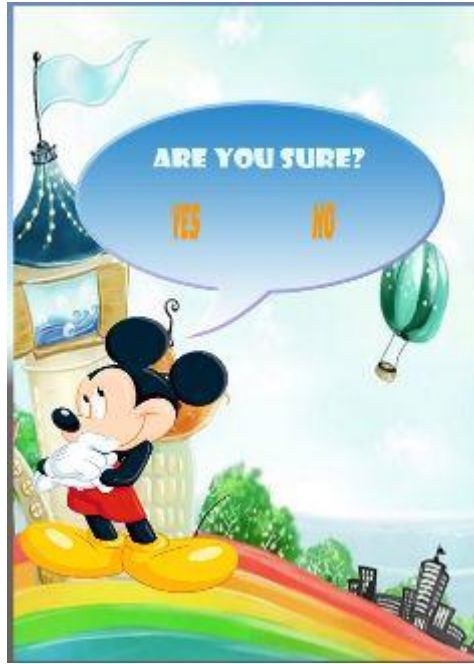


Figure 4.7 Exit page

4.8 Implementation

During the implementation phase, the page is inserted with some coding that make the button works. The coding is necessary for functioning all the button in page.

4.8.1 Coding for Button

This coding is implemented into button function where it is used to change the scene of application into next scene according to scene index required. This coding will call the scene by it scene index that have been declared in the button.

```
using System.Collections;  
using System.Collections.Generic;  
using UnityEngine;  
using UnityEngine.SceneManagement;  
  
public class ChangeScene : MonoBehaviour  
{  
    public void Changescene(int sceneIndex)
```

```

    {
        SceneManager.LoadScene(sceneIndex);
    }
}

```

4.8.2 Coding for Quit Page

This coding is used to exit the application. When user click YES button in exit page, the application will close automatically. Application Quit(); mean that it will close the application after clicking on the button.

```

using System.Collections;
using System.Collections.Generic;
using UnityEngine;
using UnityEngine.SceneManagement;

public class QUIT : MonoBehaviour
{
    public void YesButton()
    {
        Debug.Log("QUIT!");
        Application.Quit();
    }

    public void Changescene(int sceneIndex)
    {

```

```
        SceneManager.LoadScene(sceneIndex);
    }
}
```

4.8.3 Coding for Play Background Audio

This coding is used to play the background sound for all scene continuously. It means that the sound will not replay as it changes to another scene.

```
using System.Collections;
using System.Collections.Generic;
using UnityEngine;

public class BGSoundScript : MonoBehaviour
{
    // Start is called before the first frame update
    void Start()
    {

    }

    //Play Global

    private static BGSoundScript instance = null;

    public static BGSoundScript Instance
    {
        get { return instance; }
    }
}
```

```
void Awake()
{
    if ( instance !=null && instance !=this)
    {
        Destroy(this.gameObject);
        return;
    }
    else
    {
        instance = this;
    }

    DontDestroyOnLoad(this.gameObject);
}
```

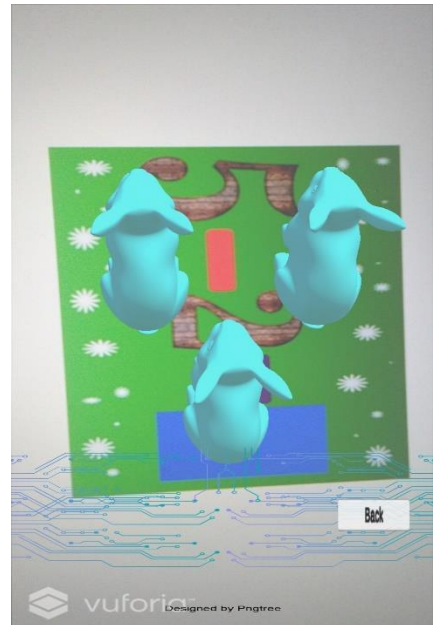
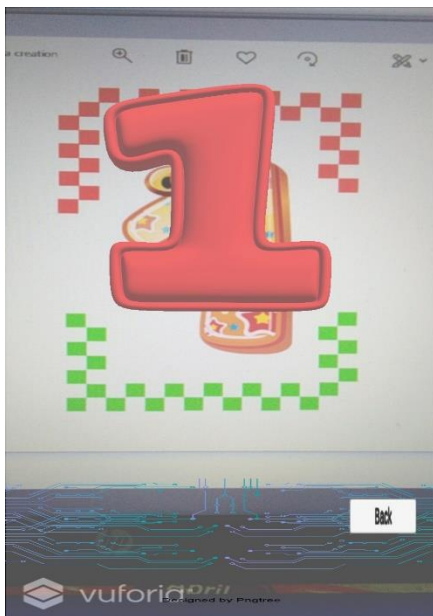

CHAPTER 5

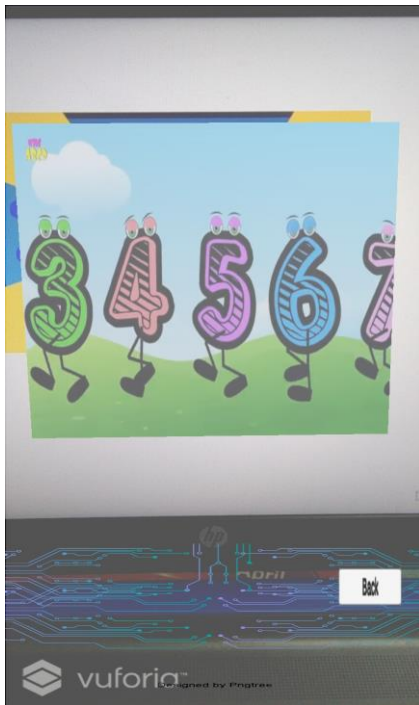
RESULT AND DISCUSSION

5.0 Result And Discussion

5.1 Result

The application was run smoothly during test phase. The application was created using Unity3D with some implementation of C# and Javascript. The following figure shows the output of marker when user interact the application with the marker.





5.2 Recommendation

This application can be improved by creating more interesting features and decreasing the file size so that the kids can download and use it easily. The most constraint for now is the hardware capabilities which is differ for every user where some of them might use a low specification mobile that is not compatible with the application. The application can be used however it might cause the runtime not run smoothly because of lack specification required for the application usage. The page also can be improved by making it more interactive so that user can fell more enjoyable when use the application.

5.3 Conclusion

In conclusion, the title for this project is “Simple Mathematic for Preschool” using Augmented Reality (AR). This project is developed the purpose of helping preschool kids to learn Mathematic subject in more interesting way. This tool can help teachers to teach these kids to become more understandable in learning mathematic subject. The main purpose of this courseware is to help the school teachers to teach simple Mathematic subject the kids in their learning process. There are several issues that have been determined which are teaching and learning tools using augmented reality does not been practice in preschools, the teachers used

manual way in teaching and learning session in their class, and preschool kids do not learn Mathematic subject in interactive way. So, the objectives of the project are to implement Augmented Reality approach in learning simple Mathematic, to develop the teaching and learning tools for preschool kids and to test the proposed tools of simple Mathematic for preschool kids at range age 3 to 5 years old by assessing the kids through exercise in tools.

There are a few types of AR that existed but we choose marker based AR as the type of AR for this project. Then, a review on existing systems also have been done and we determined the specification of system that we will used to develop the application.

Lastly, we choose ADDIE model as project methodology in developing this project because this model is basically step-by-step frame and general to ensure the smooth of the development and learning of the project. Not just that, the software and hardware that will be used or have been used also have been determined for this project.

Throughout this project, it can be seen that how AR technology can bring the differences to the education environment for preschools. Lot of benefits can be gained when implementing AR technology to the kid learning environment. By using this technology, a lot of things can be saved and minimized such as financial and time.

The methodology that have been selected and implemented make the project work easily and organize. The interface have been designed and created as shown in the report with detail information. Software and hardware requirement also been revised in order to support the system usage.

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Appendix – Functional Testing

Name: Nor Zaharah Ayu Binti Maarof

No.	Aspect / Rating	Not good	Good
1.	Smooth installation.		/
2.	Application open smoothly.		/
3.	Main page		
	Play button work well.		/
	Exit button work well.		/
4.	Menu Page		
	Count button work well.		/
	Addition button work well.		/
	Subtraction button work well.		/
	Back button work well.		/
5.	Count Page		
	Introduction button work well.		/
	Activity button work well.		/
	Back button work well.		/
	Camera load clearly.		/
6.	Addition Page		
	Introduction button work well.		/
	Activity button work well.		/
	Back button work well.		/
	Camera load clearly.		/
7.	Subtraction Page		
	Introduction button work well.		/
	Activity button work well.		/
	Back button work well.		/
	Camera load clearly.		/
8.	Exit Page		
	Yes button work well.		/
	No button work well.		/
	Application close automatically.		/