VALUE-ADDED INFORMATION ON BABY DEVELOPMENT BY USING AUGMENTED REALITY TECHNOLOGY TO INCREASE KNOWLEDGE ON PREGNANCY

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JUDUL: VALUE-ADDED INFORMATION ON BABY DEVELOPMENT BY USING AUGMENTED REALITY TECHNOLOGY TO INCREASE KNOWLEDGE ON PREGNANCY

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VALUE-ADDED INFORMATION ON BABY DEVELOPMENT BY USING AUGMENTED REALITY TECHNOLOGY TO INCREASE KNOWLEDGE ON PREGNANCY

MOHD FAIRUZ BIN TAIB

This report is submitted in partial fulfillment of the requirements for the Bachelor of Computer Science (Interactive Media)

FACULTY OF INFORMATION AND COMMUNICATION TEKNOLOGY
UNIVERSITI TEKNIKAL MALAYSIA MELAKA
2016

DECLARATION

I hereby declare that this project report entitled

VALUE-ADDED INFORMATION ON BABY DEVELOPMENT BY USING AUGMENTED REALITY TECHNOLOGY TO INCREASE KNOWLEDGE ON PREGNANCY

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STUDENT : _____ Date: 26/08/2016
(MOHD FAIRUZ BIN TAIB)

I hereby declare that I have read this project report and found this project report is sufficient in term of the scope and quality for the award of Bachelor of Computer Science (Interactive Media) With Honours.

SUPERVISOR : _____ Date: 26/08/2016
(DR. MOHD HAFIZ BIN ZAKARIA)

DEDICATION

To my beloved parents, wife and children, thank you for your continuous supports with my studies. It is blissful to have you as my parents and family. Thank you for giving me a chance to improve myself through all my walks of life.

To my supervisor, Dr. Mohd Hafiz Bin Zakaria, thank you for guidance and encouragement during the project planning and development.

To my evaluator, Dr. Ahmad Naim Bin Che Pee, thank you for the valuable advices during presentation and evaluating my Final Year Project.

To all my friends who always support me and together we can pursue a broad knowledge.

ACKNOWLEDGEMENTS

This Final Year Project is the end of my journey in pursuing my degree in Universiti Teknikal Malaysia Melaka. This project has been completed on time with the support of numerous people including my supervisor, my friends and my family. As the project reached its final process, I would like to take this opportunity to thanks all the people who have lent their strengths and times for me during the development of the project.

First and foremost, I would like to express my deepest gratitude to my supervisor, Dr. Mohd Hafiz Bin Zakaria, who has giving me valuable advices and guidance throughout the progress of this Final Year Project with his patient and knowledge. It is an honour to have someone with lots of experience and skills to share his thoughts and carefully guided me along the way. The project will not be accomplished without his motivation and supports

Next, I would like to thanks my parents and family who have always supported and prayed for me, sharing my ups and downs throughout the project development. Without their support, I would not have the motivation to continue this journey.

Last but not least, I would also like to thanks all my friends. Thank you for listening, offering me advice, sharing their knowledge and skills as well as supporting me throughout this entire semester.

ABSTRACT

Nowadays, marriage at young age has become a common scene in our community. They are the generation that have been exposed to the computing and internet technology since they are very young. Hence, they prefer all the information to be easily accessed at the tip of their fingers and at the comfort of their home. These information need also to be presented in an attractive and interactive manner in order to keep them interested to read about it. These young married couples will eventually have their own babies in their young age too. Although they can get the information regarding pregnancy through books, brochures and online articles, they would find that reading through these materials is tedious and majority of them will not read the same materials again and again. Pregnancy Alpha-Omega, a marker-based mobile application that utilizes the Augmented Reality technology has been designed and developed to deliver the knowledge on pregnancy to the parents, especially the Gen-Y parents. Augmented Reality is an advanced technology that overlays a 3D information, which in these project, unborn babies models onto the real-life environment by scanning the respective markers. For this project, the markers are brochures that can also be read physically if the user does not have any smart devices. The AR technology aimed to deliver the knowledge regarding pregnancy to the young parents in an attractive way to make them interested to use it again and again. Current developed product has completed the month-to-month visualization of an unborn baby development inside the mother's womb. Future development may include fixing the known weaknesses as well as adding more contents and interactivity to the product.

ABSTRAK

Pada masa ini, perkahwinan pada usia muda telah menjadi sesuatu yang sangat biasa dalam masyarakat kita. Mereka adalah generasi yang telah didedahkan kepada teknologi komputer dan internet sejak dari awal usia mereka. Oleh itu, mereka lebih suka sekiranya semua maklumat boleh dicapai di hujung jari dan di keselesaan rumah mereka. Maklumat ini juga perlu dipersembahkan dengan cara yang menarik dan interaktif untuk memastikan mereka berminat untuk membaca mengenainya. Pasangan-pasangan muda ini juga bakal mendapat anak pada usia muda mereka juga. Walaupun mereka boleh mendapatkan maklumat mengenai kehamilan melalui buku-buku, risalah dan artikel dalam talian, mereka akan mendapati bahawa membaca bahan-bahan ini adalah membosankan dan majoriti daripada mereka tidak akan membaca bahan yang sama lagi dan lagi. *Pregnancy Alpha-Omega*, aplikasi mudah alih berdasarkan *marker* yang menggunakan teknologi *Augmented Reality* telah direka dan dibangunkan untuk menyampaikan pengetahuan tentang kehamilan kepada ibu bapa, terutamanya ibu bapa daripada golongan Gen-Y. *Augmented Reality* adalah teknologi maju yang melapisi maklumat 3D ke atas alam nyata dengan cara mengimbas penanda (*marker*) yang telah disediakan. Untuk projek ini, penanda adalah risalah yang juga boleh dibaca secara fizikal jika pengguna tidak mempunyai sebarang peranti pintar. Teknologi AR bertujuan untuk menyampaikan pengetahuan berkenaan kehamilan kepada ibu bapa muda dengan cara yang menarik, supaya mereka berminat untuk menggunakannya setiap kali mereka perlu mendapatkan maklumat. Produk yang telah dihasilkan telah menyediakan visualisasi lengkap perkembangan bulan-ke-bulan untuk bayi di dalam kandungan. Pembangunan masa akan datang mungkin termasuk menetapkan kelemahan-kelemahan yang telah dapat dikenal pasti disamping menambah lebih banyak kandungan dan interaktiviti untuk produk ini.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

3D	**-**	**Three-Dimensional**
AR	**-**	**Augmented Reality**
API	**-**	**Application Programming Interface**
SDK	**-**	**Software Development Kit**
VR	**-**	**Virtual Reality**
GPS	**-**	**Global Positioning System**
WWW	**-**	**World Wide Web**

LIST OF APPENDICES

CHAPTER I

INTRODUCTION

1.1 Project Background

Nowadays, there are many couples who have been married at a young age. This young couples are among the Generation-Y, where their daily lives are constantly exposed to the use of technology to greatly simplify their daily affairs. They always need a simple method to do something, for example, to get information on pregnancy.

Previous generations have more trust in information obtained from the elders, and they also depend solely on the doctors to find out what is happening during the rest of their pregnancies.

Although there are a lot of information regarding pregnancy can be found in books, magazines, brochures, web sites, blogs and so on, these young parents who are mostly IT-savvy, they would prefer to use something that is accessible in the palm of their hands.

By using Augmented Reality together with a booklet, the project aims to provide an added-value for these information, where we facilitate the understanding of the public, especially these young parents for the baby's month-to-month development. The usage of Augmented Reality helps the users to understand more about pregnancy process in an interesting way. Parents can imagine the progress of the babies in certain months by

scanning the markers and watching the animations or interacting with the interfaces, rather than just reading lines of text and looking at static pictures.

1.2 Problem Statements

According to McCarthy (2014), for years, doctors assumed that babies were born without any knowledge about the outside world. But recent research offering clues to what babies comprehend in utero, what they remember after they're born, and how that information prepares them for the world outside the womb. Many parents are unaware of this phenomenon and do not have any ideas on what to do on particular stages.

With the arising numbers of young marriage in Malaysia, there should be a way that can educate these young parents on how to keep up with and take care of their unborn babies' development. The introduction of Augmented Reality was aimed to attract their attentions since these young parents are mostly tech-savvy and aware of latest technologies.

There are a lot of static and uninteresting materials regarding pregnancy and unborn babies development in the market but learning through these materials are not quite effective in these era as people nowadays tend to find an easier but yet, informative way.

A gynaecologist might explain to the parents regarding babies' development but verbal information usually are not enough and sometimes may lead to misconceptions or wrong information.

1.3 Objectives

This project embarks on the following objectives:

i. To study the relevant contents that can assist and attract the users

ii. To develop a booklet with AR facilities to give a clear picture on what happen on certain stages of baby's growth

iii. To evaluate the effectiveness of AR application in delivering information regarding pregnancy to the parents

1.4 Project Scopes

The scopes in developing this project focus on Target User and the Contents. The explanations for each are as below:

a. Target User

This informative and interactive contents are focused on all parents-to-be, especially the younger ones.

b. Content

The contents are divided into 2 parts:

- Pre-pregnancy. This part will explain on how the pregnancy process started and preparation that should be taken.
- During pregnancy until delivery. For this part, the contents will be divided into month-to-month progress sub-contents. The babies growth will be illustrated using a 3D model for visualization purpose.

1.5 Project Significances

In this project, the user with limited knowledge or have any doubts about pregnancy will understand more about the process, because instead of just reading the book, they can also interact with the AR contents provided. The user will find that this new feature would make them interested to read the book as well as remember the contents because visualization impacts greatly to the memory.

1.6 Expected Outputs

a. Commercial value product - This product can be distributed to clinics, especially maternity clinincs, as well as being promoted under the Ministry of Women, Family and Community or the Health Ministry

b. Improvements or value-adding to the currently available products such as pamphlets or booklets

1.7 Conclusion

This chapter explains the overview about the project of an interactive AR contents on pregnancy, which facilitates the understanding of younger parents towards pregnancy.

In project background, explanation about what the project is about was presented, what the project will do and the benefits of the project. In problem statement, there are detail explanations about what the problem with current informative materials. From the problem statement, the objectives for this project are stated. Then in scope section, there are explanations about the target users and contents of this project. Furthermore, in the project significant section, there is an explanation on who will get benefits from this project. Lastly, the expected output is decided.

Discussion about literature review, area of study, current system or tools, comparison of existing systems and project methodology will be in detailed in Chapter II.

CHAPTER II

LITERATURE REVIEW AND PROJECT METHODOLOGY

2.1 Introduction

The literature review related to this project and type of methodology being used for the development will be detailed in this chapter. The literature review is an important part of the project as it let us to understand the topic selected. Through this process, we need to gather and analyze readings on related topics and projects that have been implemented before. Most of the reading sources for the literature review are from the internet; journals, articles and also from reference books. The literature review will be done by searching articles on the internet on how the previous project has been done, what did they focused for the development, the technology that has been implemented and what can I benefit or improve from the previous projects. In order to achieve learning experience, I need to compare a few projects in term of the domain of the project, technology implemented and techniques used to develop the product.

On the other hand, this chapter will also discussed the methodology that will be used in this project. A project methodology needs to be followed to make sure that the project moves on the right track and also as a framework to guide the developers what to be done for this project, and to manage the project from beginning to end of the project.

Furthermore, all the required software and hardware as well as their functions will be detailed in this chapter. The milestone of the project is also provided at the end of this chapter to demonstrate the whole progress of the project and duration of the task to be done.

2.2 Facts and Findings

The facts and findings for this research was conducted based on the domain and existing system. Domain explained on a study about Augmented Reality (AR) and how an implementation of AR to a normal issue, such as pregnancy can attract people to use the software as well as gives impacts to them in term of knowledge and understandings. For the existing system, a research has been made to several existing apps and projects, and the selected projects will be explained.

2.2.1 Domain

Vamien (2014) defined that Augmented Reality is a way of combining the real world with the virtual world by overlaying digital data on to the real world views. As it were, it's a live immediate or aberrant perspective of a physical, true environment whose components are “augmented” or "increased" by PC produced information, for example, sound, video, representation or GPS. Thusly, virtual data is overlaid on this present reality, yet Augmented Reality doesn't supplant this present reality with a reenacted one like virtual reality does; despite what might be expected, AR "supplements" the data on the encompassing true by making it intuitive.

State, Chen, Tector, Brandt, Ohbuchi, Bajura and Fuchs (1994) stated that augmented reality system displaying live ultrasound data in real time and properly registered in 3D space within a scanned subject would be a powerful and intuitive tool as it can be used for more advance purposes.

Deebika (2015) mentioned that Augmented Reality addresses problems of stationary images and traditional Scan pictures obtained from Ultrasound. It enable people

to take advantage of their existing skills in interacting with objects the everyday world while benefiting from the power of networked computing by superimposing scan images with from simple text to links with video and audio content. Herron (2016) stated that not only can augmented reality aid in student education, but it also can impact patient care through its ability to enhance medical training.

2.2.1.1 Categories of Augmented Reality

AR applications can essentially be divided into two classes: marker-based/image recognition and marker-less based applications. From one viewpoint, marker-based applications overlay the marker/picture with some substance or data. Keeping in mind the end goal to do as such, these applications utilize a camera to perceive a marker or a picture from the real world, and along these lines they compute its position and orientation to augment the reality. Markers perceive a specific example (for example, a code), when a camera focuses to it, and overlay a digital image by then on the screen.

Figure 2.1 A digital image is overlaid on the screen when the user scans the page (marker)

Then again, marker-less applications utilize the GPS devices in your gadget and utilize its position to discover pertinent information around your area, for example, eateries

close-by, maps, help you get locations or present you the name of stars and constellations in the sky.

2.2.1.2 Application of AR

The field in which we're most likely more used to see AR is in commercial sector, to incorporate print and video advertising: ordinary to an ever increasing extent, we discover a QR code that we can scan to access to extra substance, for example, a video or additional pictures of the item. AR can likewise upgrade item previews, for example, permitting clients to view what's inside an item's bundling without opening it.

Figure 2.2 A customer scans the marker on a Lego product to see how the real-product looks like

AR can be exceptionally amazing for education as well, since content, representation, video and sound can be superimposed into a student's real time environment.

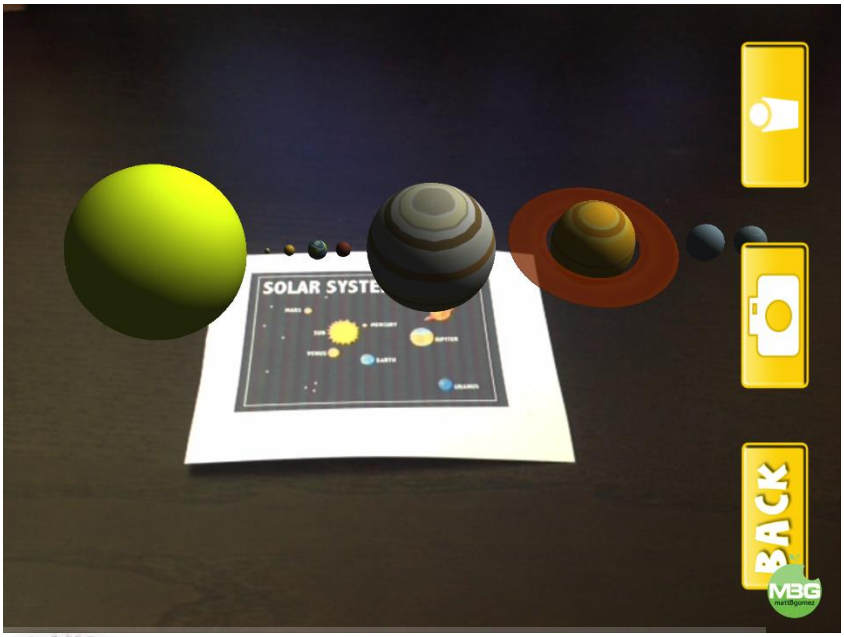


Figure 2.3 Students can visualize the size of the planets and their positions through AR

The absolute most momentous fields where AR can be connected are architecture, construction and archaeology: in the main case, PC produced images of a structure that can be superimposed into a real-life view before building the physical building.

In art, AR technology can help handicapped people to draw, by interpreting their eye developments (through eye following) into drawings on a screen.

2.2.1.3 AR approaches in pregnancy

In Malaysia, Friso has launched a campaign entitled “Belly Window” on 2011. For this campaign, they gave an AR t-shirt for expecting mothers. The mothers need to key-in their expected delivery date inside the apps, then, when the AR marker on the shirt is being scanned, an image of current baby will be displayed.

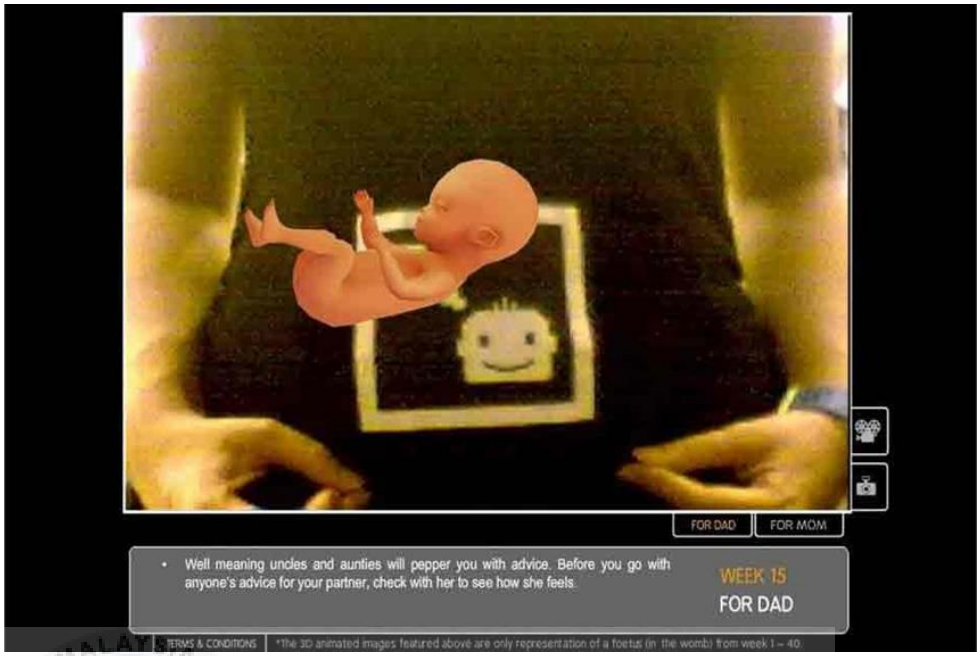


Figure 2.4 The virtual baby that grows along with the real one inside the mother's womb

2.2.3 Existing System

As progressing with the research, only small numbers of apps / interactive websites have been developed regarding pregnancy, and it was hard to find the ones with AR functionalities. These are the apps that have been researched:

2.2.3.1 Simubaby

Developed by Atlantis Virtual Reality, Simubaby acts as a simulator that will explain a lot of information regarding pregnancy, such as week-to-week baby's stage of growth. User need to order the starter kit online and this kit will be posted to their home. The kit consists of a belt, a virtual magnifying glass, a printed AR marker and the software. User need to fill the details of their pregnancy inside the software before using the app. They also need to wear the belt together with the AR marker and use the virtual magnifying

glass to scan the marker. The image of the baby in current-week stage will be displayed on the screen.

Figure 2.5 Using the Simubaby

Figure 2.6 Image of the baby will be displayed within the app

2.2.3.2 How Big Is The Baby?

This page can be accessed via the URL http://www.howbigisthebaby.com/ . As the name mentioned, it can show you how big is the unborn baby from month 1 until 9. In order to use the application, the marker need to be downloaded and printed. A PC with a working webcam are needed as the application needs to use it to scan the marker. After scanning the marker, user can choose from 1 to 9 in reflection to months of pregnancy. The image will be displayed on the screen after selecting the month.

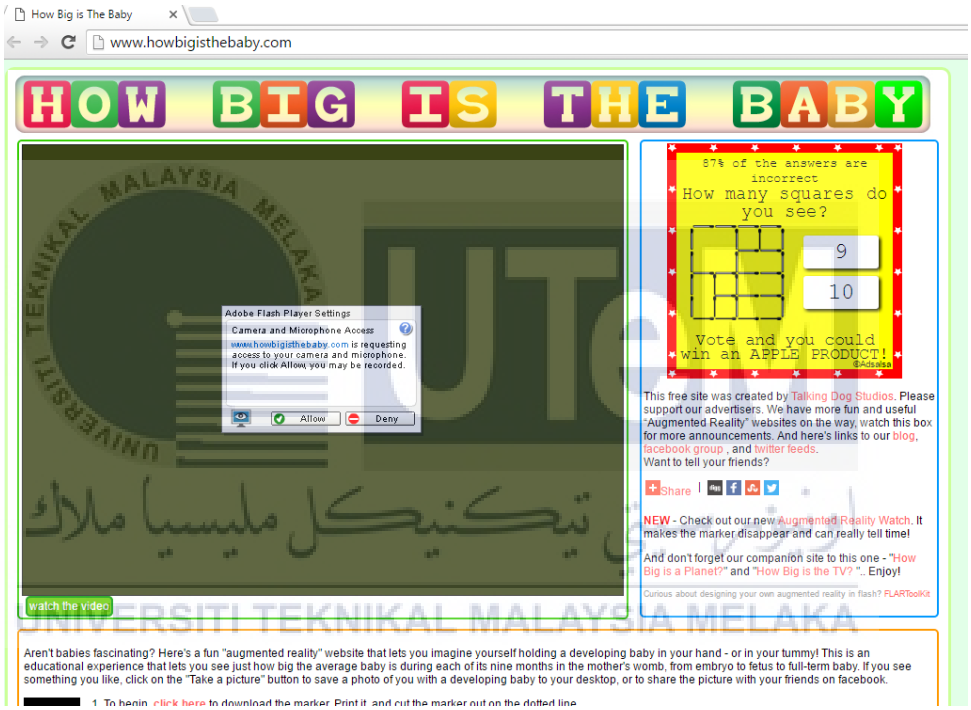


Figure 2.7 The interface of the 'How Big Is The Baby' website

2.2.3.3 The Little One Pregnancy Guide

Developed by EHD (The Endowment of Human Development), this app which primarily focused on iPad, can be downloaded via App Store or Google Play. Adapted from *The Biology of Prenatal Development*, a 42-minute science documentary, which presents normal human development from fertilization to birth, this app is a guide for a pregnant

mother complete with stunning graphics and videos as well as descriptions on month-to-month fetal development. Despite of lacking an AR functionality, it has won eleven video awards from five competitions. The app also comes in Spanish language.

Figure 2.8 The interface of the Little One Pregnancy Guide

2.2.4 Comparison of Existing Systems

Table 2.1 shows the comparison of the three applications that related to the pregnancy. Categories being compared among three existing mobile application are technology applied, tracking method, platform, content creation, goals, pros and cons.

Table 2.1 Comparisons between three applications on pregnancy

Categories	Simubaby	How Big is the Baby	Little One Pregnancy Guide
Technology applied	AR	AR	Mobile Apps
Tracking Method	Provided marker	Printed marker	None
Platform	Desktop	Desktop	IOS, Android
Content Creation	3D Modelling	Images, Text	3D Modelling, Images, Videos
Goals	Simulates baby growth stage in the womb	Visualizes how big a baby on each month stages	Guides a pregnant mother on the details during each stage of pregnancy together with pictures and videos
Pros	• The startup kits provides everything that are needed to use the software • Able to record videos or capture the image	• Free to use • No installation required	• Does not need internet connection to use • High quality videos and images give better experience to users
Cons	• Have to buy the starter kit • Delivery only limited to certain countries	• Requires internet connection • Need to have a webcam to use	• No AR functionality • Requires large amounts of

	• No more troubleshooting and updates		memories to install

From the comparison, it can be concluded that mobile AR app on pregnancy is still far from popularly developed. This may be due to many developers focused more on other sectors such as gaming and advertising and may also cause by lack of expertise and materials to develop this app.

2.3 Project Methodology

For this project, agile development has been chosen as project methodology. This method is based on traditional waterfall methodology but with better approaches such as:

- Allowing changing requirements
- Early and continuous delivery.

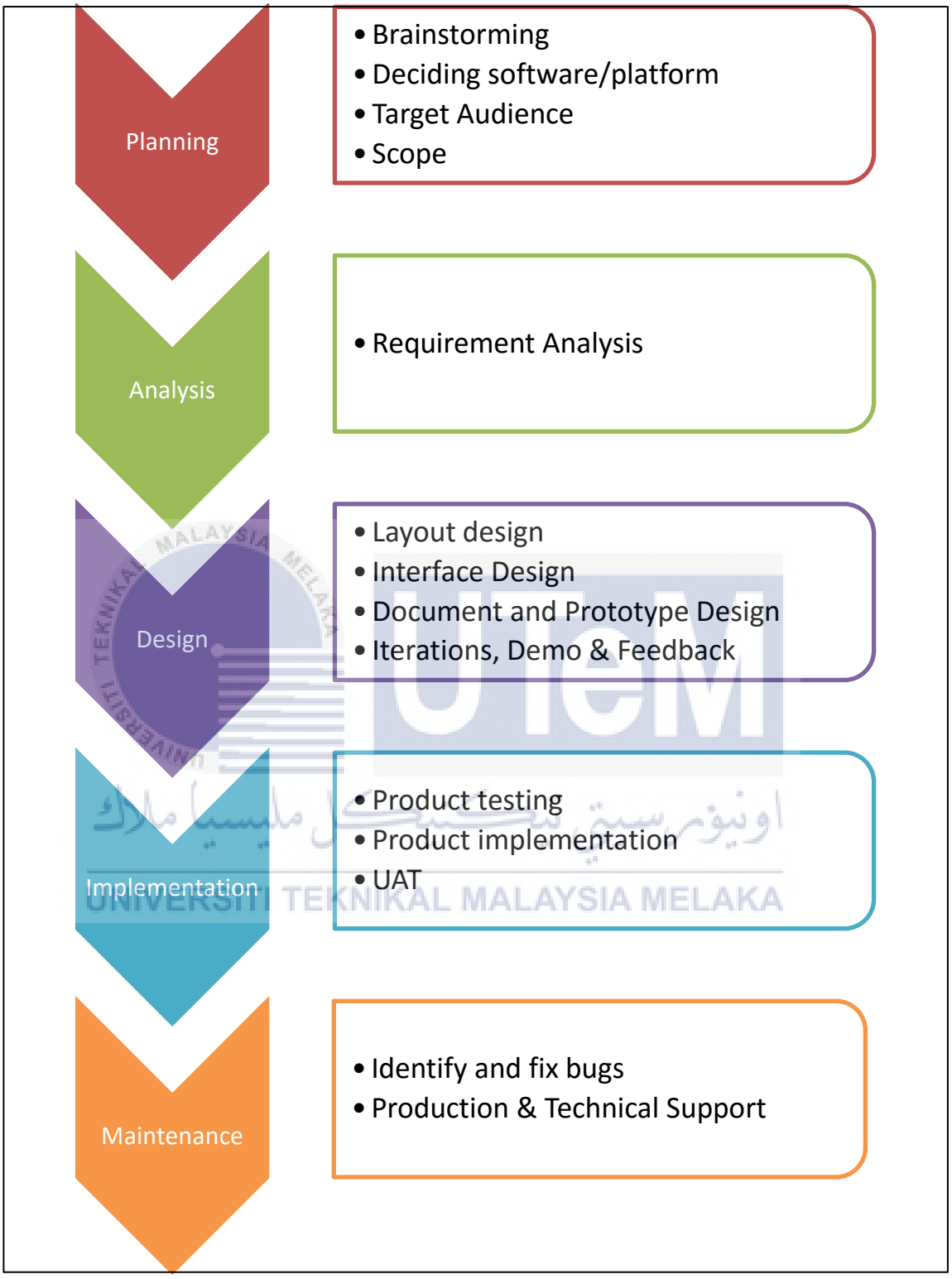


Figure 2.9 Agile Development Process

2.3.1 Planning Phase

This phase involves activities such as brainstorming, deciding software and hardware that are needed to develop the project, on what platform will the project be implemented, target audience and scope

2.3.2 Analysis Phase

Analysis phase involves gathering all the requirements for the project such as what the user need, what are the problems with the current system, what type of system to be built and how to build it, will the developed system meet its intended functions.

2.3.3 Design/Development Phase

For this phase, it involves all the design activities of the system including system architecture and flow chart. This phase also where activities such layout and interface design, document and prototype design, iterations, demo & feedback take place.

The development of the system also takes place in this stage. 3D modelling and animation, marker designs, sounds recording, uploading markers as database, coding and importing all of the contents to Unity 3D will be done in this phase.

2.3.4 Implementation Phase

This phase involved product implementation as well as product testing to check any errors or any parts that need to be updated, changed, removed or added. After the first level of testing, the software can be delivered to the user.

2.3.5 Maintenance Phase

Maintenance phase involved identifying any leftover bugs, or any flaws detected during the UAT as well as production and technical support.

2.4 Project Requirements

Project requirements detailed all the software and hardware required to develop the project.

2.4.1 Software Requirement

Software requirements can be divided into two categories which are the development tools and documentation tools

2.4.1.1 Development Tools

i. Unity3D 5.3.4f1

Unity3D is mainly used for developing games, but it can also serves as a platform to integrate resources to build an AR application.

ii. Vuforia 5.5.9

Vuforia is needed to create a database that contains all the markers needed for the AR application.

iii. Android SDK

Android SDK allows developers to build a mobile application for Android platform. Android SDK incorporates a debugger, emulator, documentation, development tools, and supported libraries.

iv. Autodesk Maya 2013

Create 3D model with textures and animations

v. Adobe Photoshop and Adobe Illustrator CS6

Used to edit images, image tracing, creating design templates, create vector graphics

2.4.1.2 Documentation Tools

i. Microsoft Office Word 2013

Used to prepare the documentation of proposal, report, questionnaire, and information required for brochure.

ii. Microsoft Project 2013

Used to prepare the Gantt-Chart for the project in proposal and report.

iii. Microsoft Office PowerPoint 2013

Used to prepare the presentation slide for presentation.

2.4.2 Hardware Requirement

i. Laptop

To install all the software required for project development, to develop all the contents and resources for the AR app and as a platform to connect with a tablet.

ii. Android Smartphone

To install and test the application

2.5 Project Schedule and Milestones

Table 2.1: Schedule of the project

Week	Activity	Note / Action
1 22-26 Feb	Proposal PSM : Submission & Presentation	Deliverable – **Proposal** Action – Student
		Deliverable – **Proposal Presentation (PP)** Action – Student
	Proposal assessment and verification	Action – Supervisor, Evaluator
2 29 Feb -4 Mar	Proposal Correction/Improvement Chapter 1	Action – Student
	List of supervisor/title	Action – AJK PSM/PD
3 7-11 Mar	Chapter 1 (System Development Begins)	Deliverable – **Chapter 1** Action – Student, Supervisor
4 14-18 Mar	Chapter 1 & Chapter 2	Action – Student
5 21 - 25 Mar	Chapter 2	Action – Student
6 28 Mar -1 April	Chapter 2 Chapter 3	Deliverable – **Chapter 2** **Progress Presentation 1 (Pembentangan Kemajuan(PK 1))** Action – Student, Supervisor
	Student Status	Action – AJK PSM/PD, Supervisor Warning Letter 1

7 4-8 April	Project Demo & Chapter 3 Chapter 4	Action – Student
8	**MID SEMESTER BREAK**	
9 18-22 April	Project Demo & Chapter 4	Deliverable – **Chapter 3** Action – Student, Supervisor
10 25 - 29 April	Project Demo & Chapter 4	Deliverable – **Progress Presentation 2 (Pembentangan Kemajuan ,(PK) 2)** Action – Student, Supervisor
	Student Status	Action – AJK PSM/PD, Supervisor Warning Letter 2
11 2 - 6 May	Project Demo	Action – Student
	Determination of student status(Continue/Withdraw)	Action –PSM/PD Committee, Supervisor(submit student status to AJK)
12 9 – 13 May	Project Demo & PSM Report	Action – Student, Supervisor, Evaluator
13 16 - 20 May	Project Demo & PSM Report	Action – Student, Supervisor, Evaluator
	Presentation Schedule	AJK PSM/PD
14 23 - 27 May	Project Demo & PSM Report	Deliverable – **PSM Report** Action – Student, Supervisor
15 30 May -3 June	**FINAL PRESENTATION (PA)**	Action – Student, Supervisor, Evaluator
16 6 - 10 June	**REVISION WEEK** Correction draft report based on supervisor's and evaluator's comments during the final presentation session. Submission overall marks to PSM/PD committee.	Action – Student, Supervisor, Evaluator. PSM/PD committee.

For further understanding of the project progress, please refer to the Gantt chart in Appendix A.

2.6 Conclusion

This chapter focused on the literature review and methodology that have been chosen for this project. The literature review is done by gathering and analyzing the technology and techniques that have been used by other developer for making fetal stage development looked more interesting and easier to be understood. From the research, it is obvious to say that there were very small numbers of commercial apps have been developed to cater for this purpose.

Agile Development has been chosen as the project methodology as it is able to provide fast and continuous delivery. All activities involved have been divided into five main phases. On the other hand, all the required software and hardware have been explained in details in this chapter as well as project milestone and schedule.

The next chapter will explain on Analysis activity, where all the data in this chapter will be analysed, extracted and concluded to better understand how to design the product for this project.

CHAPTER III

ANALYSIS

3.1 Introduction

This chapter will analyse the system by identifying the requirements and how it will be accomplished. Through the analysis phase, we could be able to solve the flaws and problems with existing system. There are two parts of analysis phase which are the current scenario analysis and requirement analysis.

Current scenario analysis focused on generic flow of existing system and information gathered to help us to determine the problem raised. While the requirement analysis will detailed out the problems of existing system as well as determined the functional requirements to be included in the current system.

3.2 Current Scenario Analysis

Current scenario analysis identifies the flow chart and architecture of the existing application that have been mentioned in the previous chapter.

3.2.1 Analysis of Simubaby

Atlantis Virtual Reality developed the Simubaby on their own as they are a company that has specialties on VR/AR. The Simubaby utilizes AI technology to simulate baby movements on different growth stage. As the baby in the mother's womb grows, the simubaby will also show some changes everyday. A newer version of Simubaby was recreated to support iOS and intendedly to be used on an iPad. The newer version needed the user to download and print the tracker from their website.

There are 4 options provided in the Simubaby apps. Table 3.1 explains the functions of each option while Figure 3.1 explained the flow of the system.

Table 3.1 Functions of each option in the menu

Option	Description
Simulation mode	Scan the tracker by using the camera on the iPad. The simulated 3D model of the baby will appear on the screen
Camera mode	Take photo together with the AR baby
Information/Setting	Information on how to use the app. User can also set the date of deliver. The app will sync with your current month of pregnancy
Sound	Adjust the sound/volume

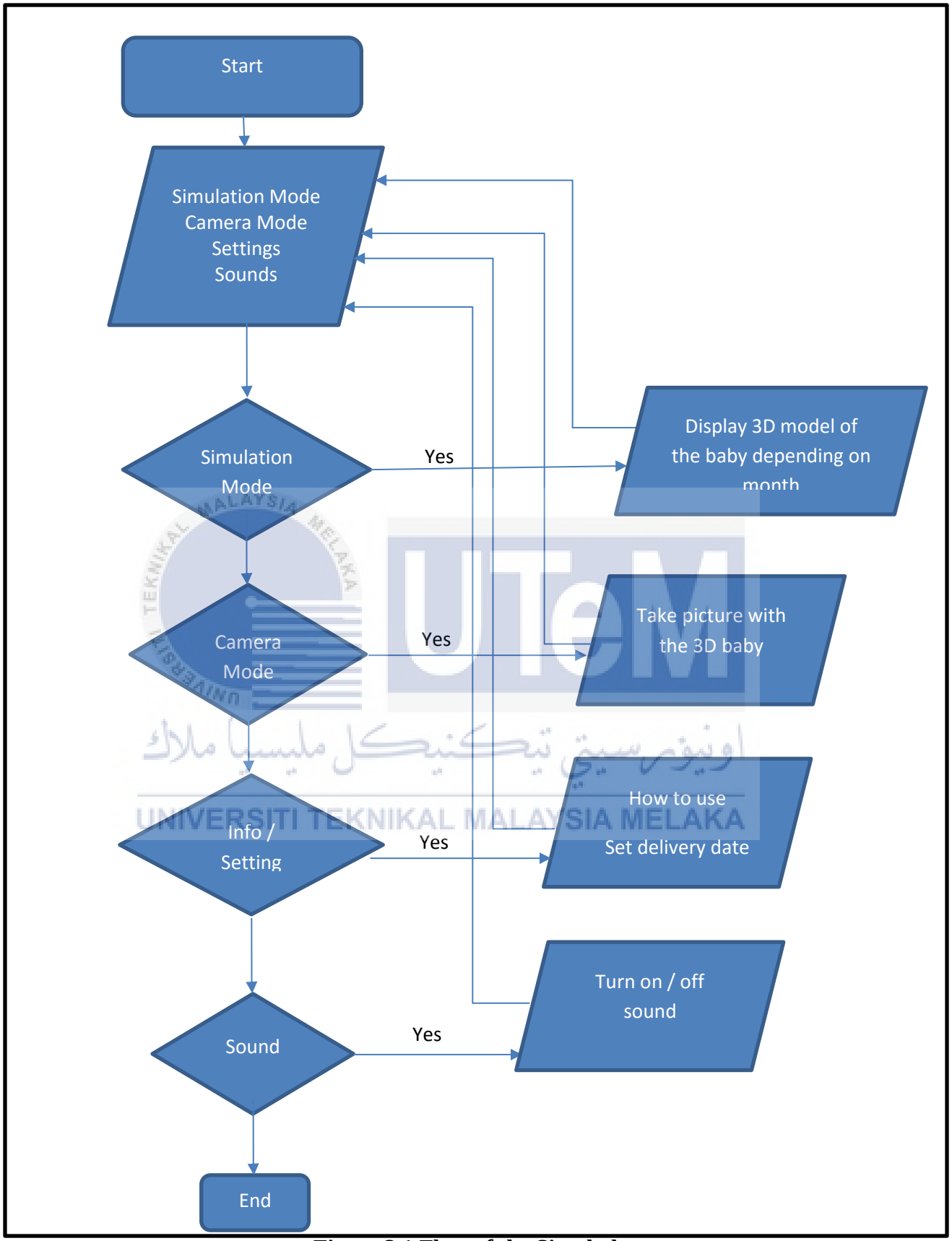


Figure 3.1 Flow of the Simubaby system

3.2.2 Analysis of the How Big Is The Baby?

"How Big Is The Baby" was developed by Talking Dog Studios. The application was built by using FLARToolKit. It allows user to scan the printed marker by using their webcam. The AR baby model will be displayed on the application window. User can press number 1 to 9 on their keyboard in order to change to the corresponding month.

There are no on-screen menu provided. Users just need to flash the marker to the webcam.

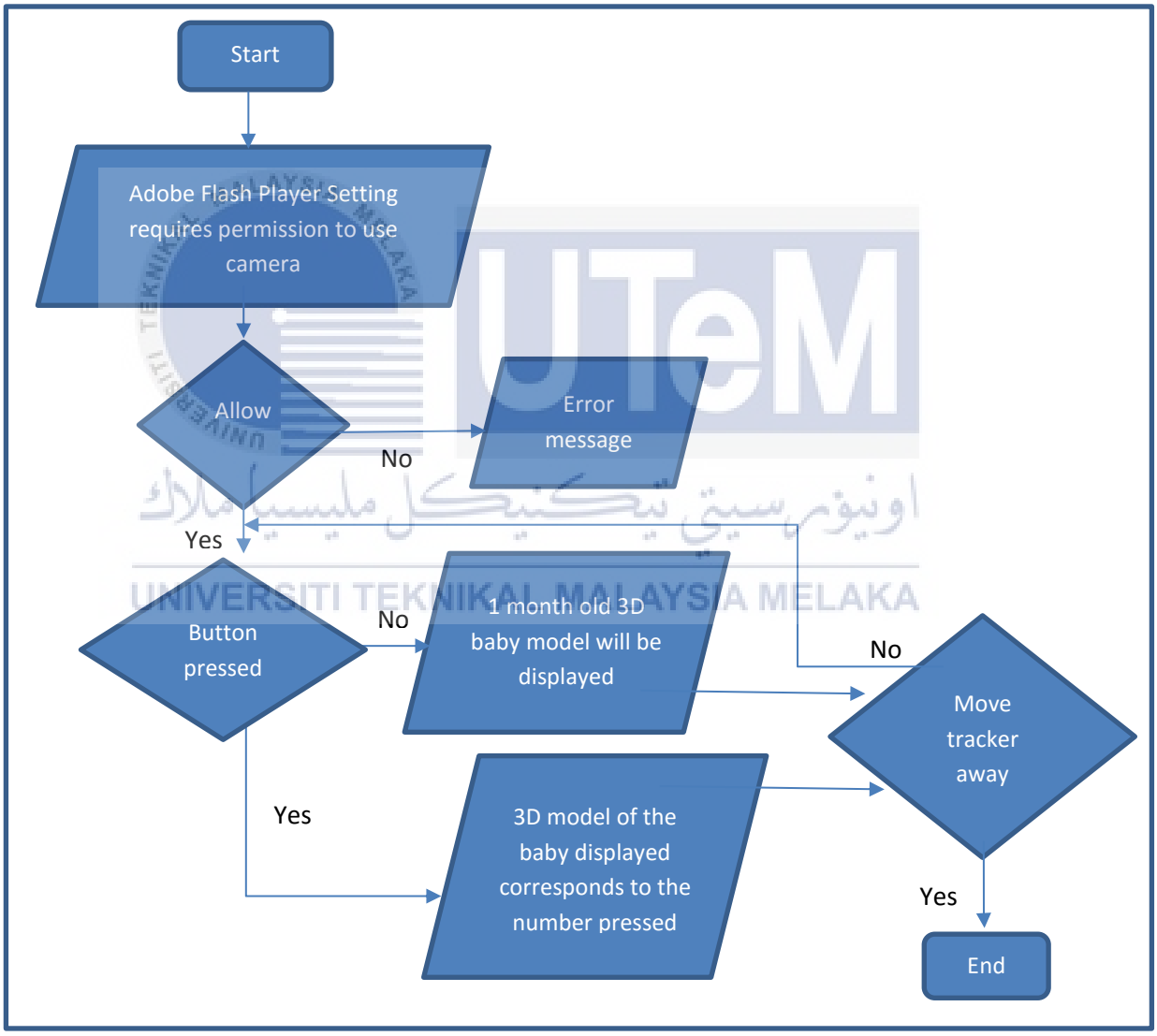


Figure 3.2 Flow of How Big Is The Baby? system

3.3 Requirement Analysis

Requirement analysis can be divided into need analysis, user analysis, technical analysis, resource analysis and requirement gathering.

3.3.1 Project Analysis

Project analysis is an analysis that had been made to determine what elements that should be included into the project. Table 3.3 listed the problem with the existing system.

Table 3.2 Problems with the existing system

Existing System	Problems
Simubaby	• Have to buy the starter kit • Delivery only limited to certain countries • No more troubleshooting and updates • Updated marker need to be colour-printed • Not fully translated to English
How Big Is The Baby	• Lack of customization or option for users • Requires webcam and need to allow the adobe flash player • Limited to desktop only
Little One Pregnancy Guide	• No AR functionality

With those deficiencies of the existing AR application, current system is targeted to overcome these problems.

3.3.1.1 Need Analysis

As there are very limited amount of AR application about pregnancy and fetal development on the market, this project was planned to overcome this problem. This project was intended to accompany a physical book on pregnancy. And at the same time, the pamphlet and the app can work alone as a summary to the book. This is due to the price of the book is quite high on the market and it is tedious to look through lines of text and static image. The introduction of AR let the user appreciate more on the contents as they will be able to see the baby come alive on their screen.

3.3.1.2 User Analysis

The project was targeted to young parents (Generation-Y) as nowadays, a lot of young couple has decided to marry. These couples sometimes have little knowledge on pregnancy, and at the same time they have less interest in reading a book or pamphlets with lines of texts and static images. Living as IT-savvy individuals, they prefer all the information are easily accessible at the end of their fingertips. Moreover, they tend to remember and appreciate information that is presented in exciting and interactive way.

The project was also developed for Android platform. Due to the popularity of Android OS and devices, a lot of users chose Android over other platforms. Furthermore, these generations preferred using smartphones rather than desktop PC. From these findings, we can conclude that this project might be able to attract younger parents to use it.

3.3.1.3 Technical Analysis

The technical analysis part outlines all the devices and tools that were used to build the application. It is an essential process in order to establish baseline technical capabilities as well as estimating costs, efforts and impacts of the app.

For this project, Autodesk Maya 2013 was used to do 3D modelling and animations. These models can be imported to be used as assets in Unity. I chose to use marker-based AR and my markers are pages of the booklets. These markers are uploaded to Vuforia database. All of the resources will be combined in Unity to develop the AR mobile application. Android SDK was used to build the application into Android package. I have to reinstall my some of the tools to 32-bit version as it had a problem during building the package.

3.3.1.4 Resource Analysis

There are nine 3D models that have been included in the AR mobile application. These models were based on the real picture or drawings of embryo, foetus and unborn babies from the internet and books. Each of the model was distinguished by their changes from one month to another.

3.3.1.5 Requirement Gathering

In the data collection phases, online surveys have been conducted to several correspondents.

A. Research Tool and Data Collection

The online survey (refer to Appendix B) consists of 11 questions and was separated into two sections. The first section is regarding the details of the participant together with their experience in AR. The second part covers the pregnancy information.

The link of online survey was distributed randomly to 55 correspondents from different age level, ethnicity, marital status and education background.

From the questionnaire, the result was analysed and represented in pie-chart and table form.

Table 3.3 shows the details of the correspondents. From the 55 correspondents, 21% of them aged 31-35 years old (earlier Y-Generation), while 18% of them aged 26-30 years old and 4% between 20-25 years old (later Y-Generation). From these group, 60% of them are married, indicating the trend of young marriage.

Table 3.3 Details of the correspondents

	Gender		Ethnicity				Marital Status	
Age	**Male**	**Female**	**Malay**	**Chinese**	**Indian**	**Others**	**Single**	**Married**
20-25	0	2	1	1	0	0	2	0
26-30	6	4	8	1	1	0	4	6
31-35	5	6	11	0	0	0	2	9
36-40	14	12	26	0	0	0	3	23
40+	2	4	5	0	0	1	0	6

The next questions are more related to mobile applications.

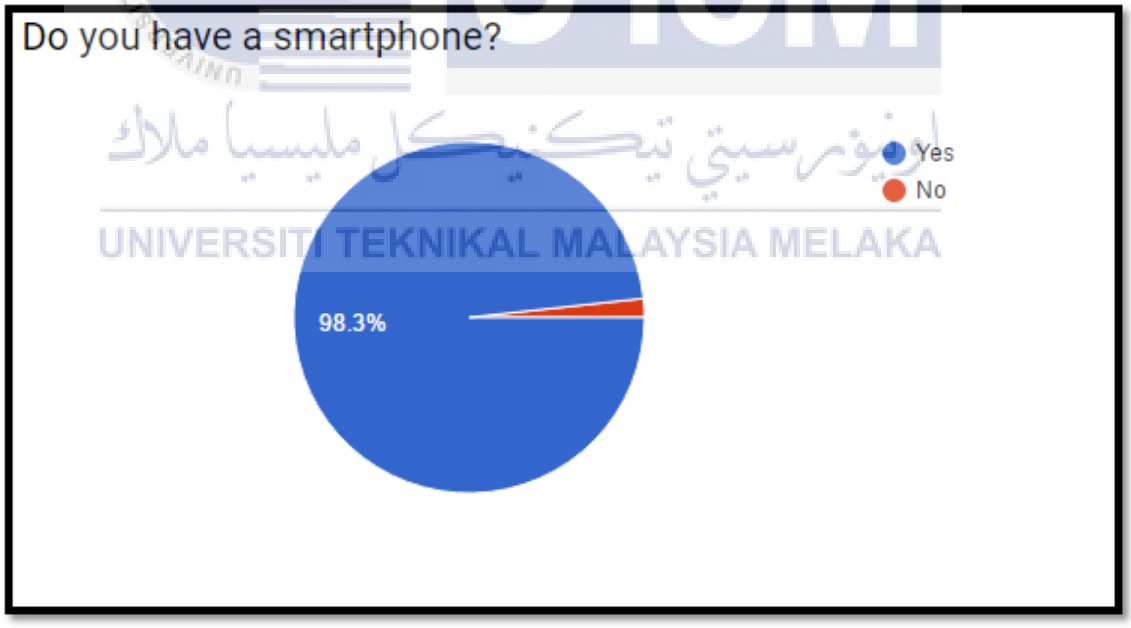


Figure 3.3 Statistic of correspondents that owned a smartphone

From Figure 3.3, only 1 person (1.7%) did not own a smartphone. This is rather obvious since the mobile technology is at its peak now and some smartphones with decent specifications can be obtained at a reasonable price.

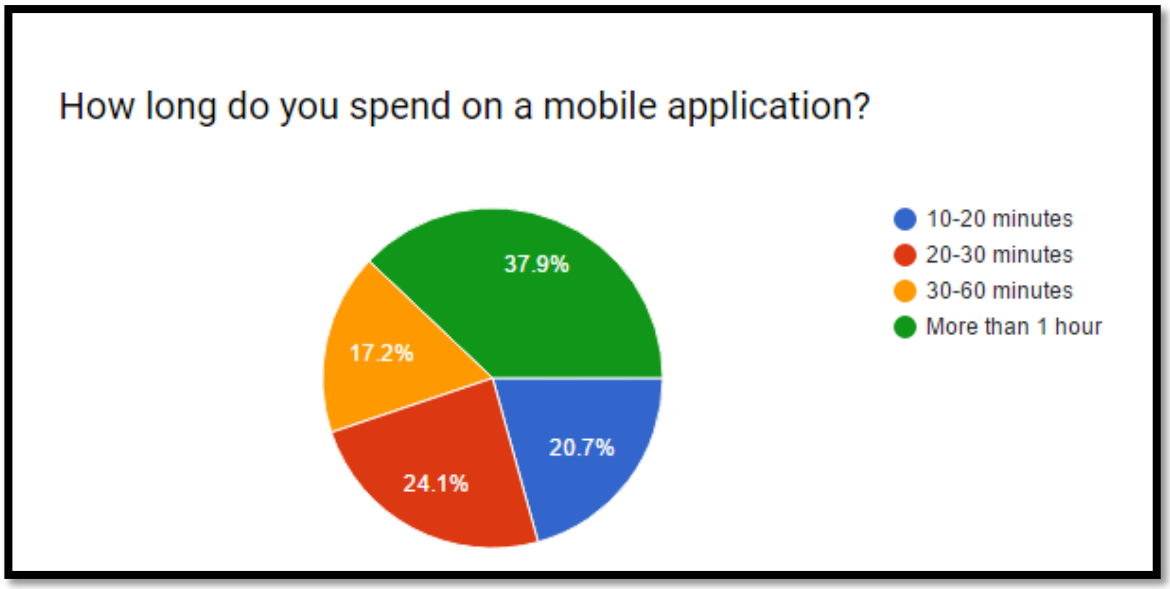


Figure 3.4 Statistic of time spent on a mobile application among the respondents

Based from Figure 3.4, 37.9% of the correspondents spent more than 1 hour on a mobile application. From this, we can conclude that a lot of people are feeling comfortable using a mobile application for a long period of times and the decision on developing a mobile application is a smart choice.

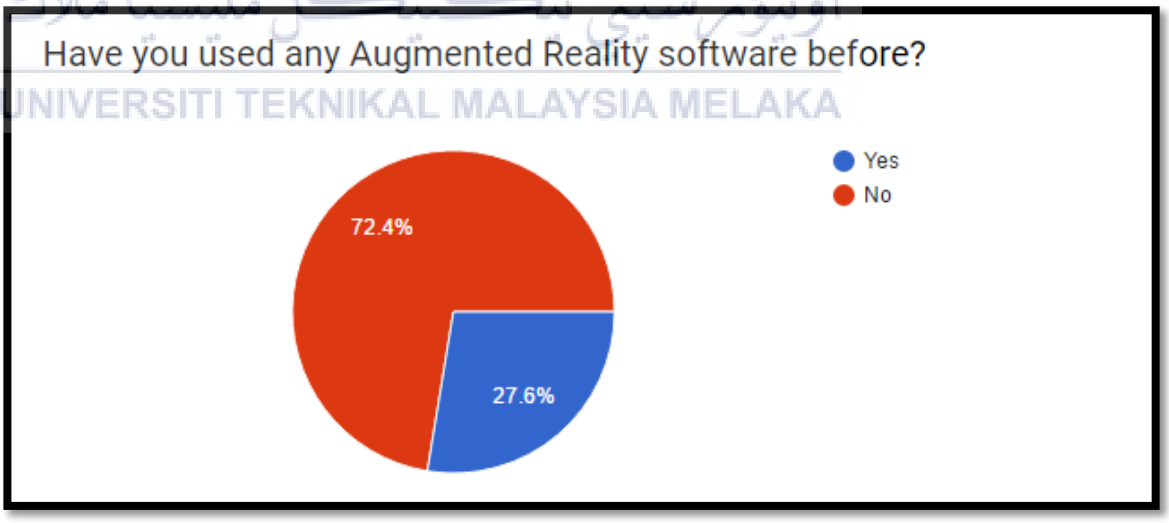


Figure 3.5 Statistic of AR usage

Figure 3.5 shows that 72.4% of the correspondents never used an AR application before. Although they have been explained on what is an AR application, most of them do not aware of this technology. Some of them ever heard about AR, but they never tried this technology before. Developing an AR mobile application is a bit risky decision, but if we let the app easy to be downloaded and used, more people will likely choose to use it.

B. Findings

The aim of this project is to determine issues that raised about searching information on pregnancy.

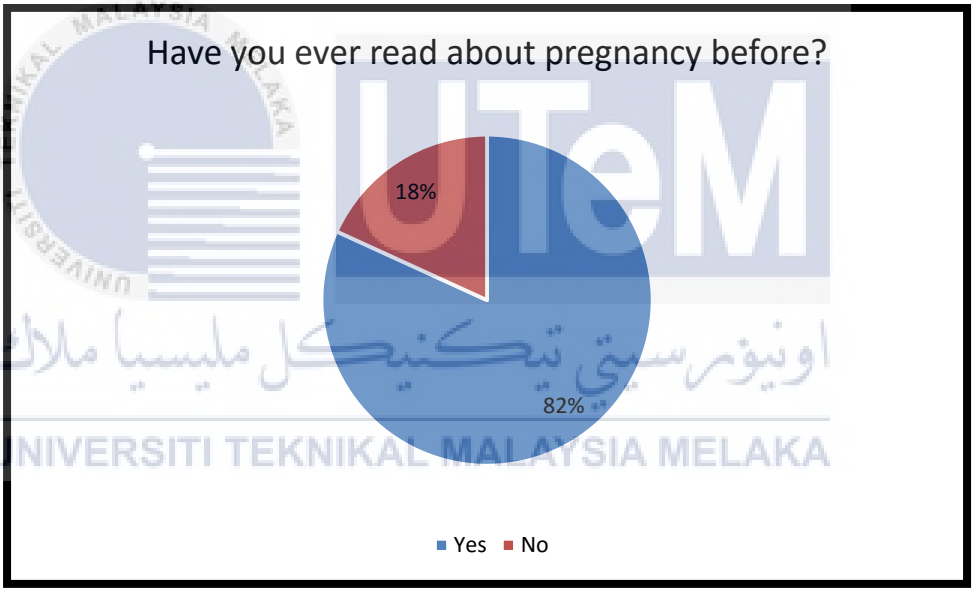


Figure 3.6 Statistic on whether they have ever read about pregnancy before

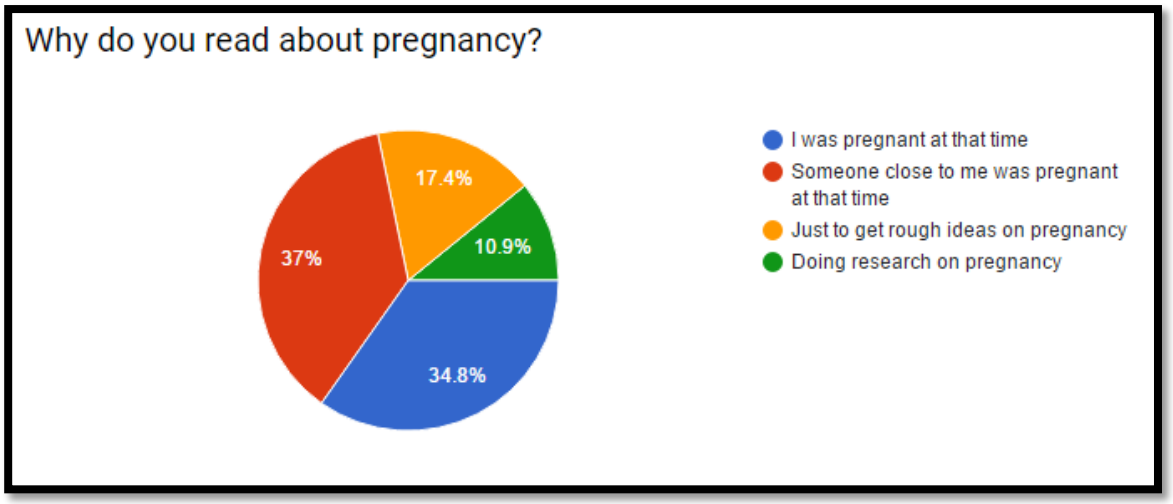


Figure 3.7 Why the correspondence read about pregnancy

Figure 3.6 shows that 82% of the correspondence ever read about pregnancy and fetal development before. If we narrow down the result to the next question, on Figure 3.7, 37% of them read about pregnancy because someone close to them was pregnant at that time while 34.8% of them read about pregnancy because they were pregnant at that time. If we look on the other reason, only 10% read about pregnancy because they are doing a research on it while 17.4% of them read about pregnancy just because they want to get a rough ideas on pregnancy. From these findings, we can tell that a lot of people read about pregnancy because they or someone close with them are pregnant. This project aimed to attract more people to know about pregnancy as their additional knowledge.

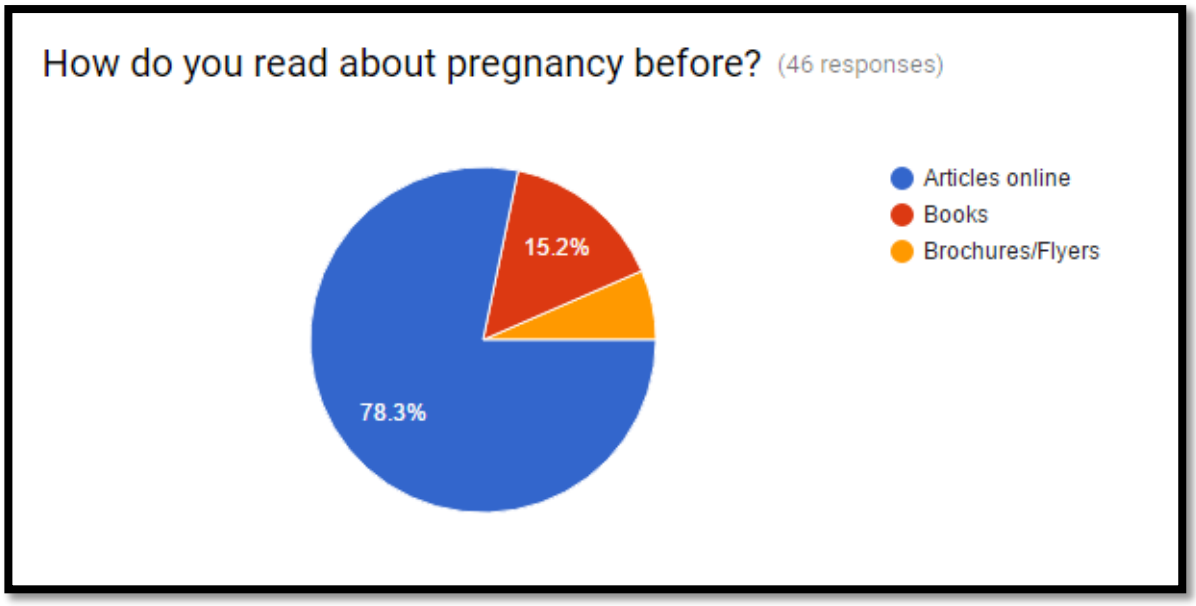


Figure 3.8 How the correspondence read about pregnancy before

Based from Figure 3.8, 78.3% of the correspondence read online articles regarding pregnancy. This is due to the information are free and available to be read at any times.

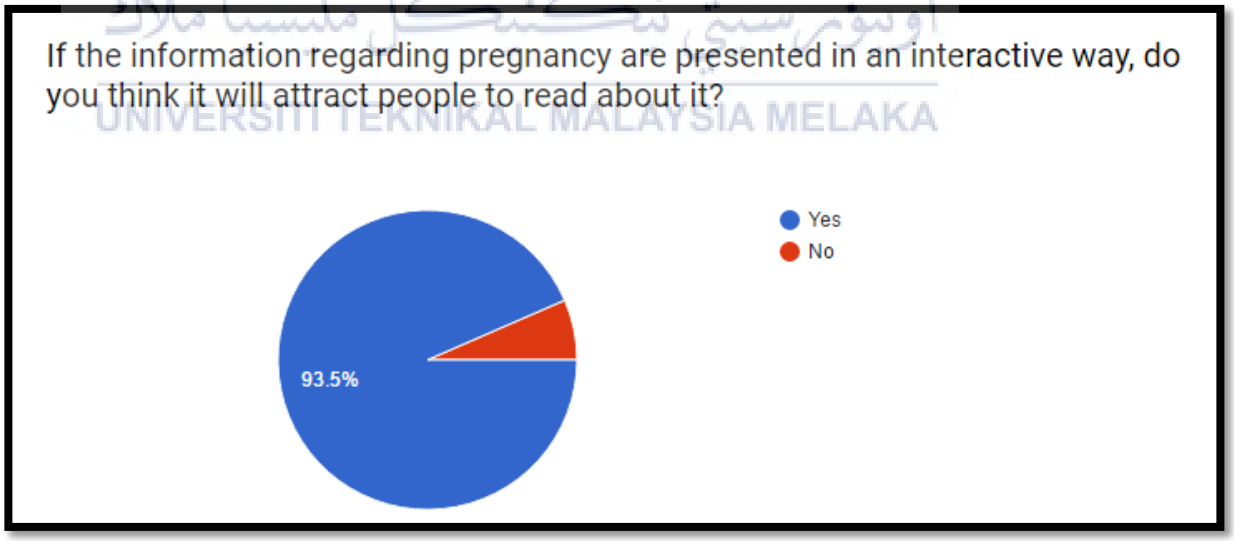


Figure 3.9 Correspondence opinion on interactive contents may attract more people

While most of them prefer to read from online articles, in Figure 3.9, 93.5% of the correspondence agreed that information that are presented in an interactive way may attract more people to read it.

C. Summary

As a summary, the survey provides a lot of useful information for developers. From the results, we can tell that many people prefer easier way to search for information (using smartphones to read online materials or use apps) and at the same time they prefer something that is more exciting than the traditional way. Another important information is that most of them never used or even know about AR. Therefore, AR mobile application is the most suited system to be developed.

3.4 Conclusion

As a conclusion, this chapter consists of two main parts as discussed before, which are the current scenario analysis and requirement analysis. The current scenario analysis analysed existing systems; Simubaby, How Big Is The Baby and Little One Pregnancy Guide with the intention to gather requirements from them, as well as well overcome the issues with the existing

The requirement analysis analyses the requirements of the system that need to be developed. The functional requirements are gathered from the survey and from this findings, it is concluded that AR is a promising technology and it is able to attract more people to use it.

The design phase will be discussed in the next chapter. Activities involved in the design phase are the architecture and flow of the system as well as layout and interface designs.

CHAPTER IV

DESIGN

4.1 Introduction

In this chapter, all the outcomes from the previous chapter will be identified. System architecture, preliminary design and user interface design will be the main focus in this chapter.

4.2 System Architecture

System architecture is the conceptual design that defines the structure of the software being developed. For this project, Unity3D is being used as the main platform to develop an AR application. As the software was targeted for Android devices, Android SDK has been used for building the software package. Vuforia is used as the database for the markers.

The system developed uses standalone architecture, which means that the system does not require any network connection to be used. Network connection only needed to download the application and/or the markers for the system

This AR application is a marker-based application. Every pages in the booklet serves as a marker for fetal development in every month. The marker can be downloaded from the website or obtained from distributors.

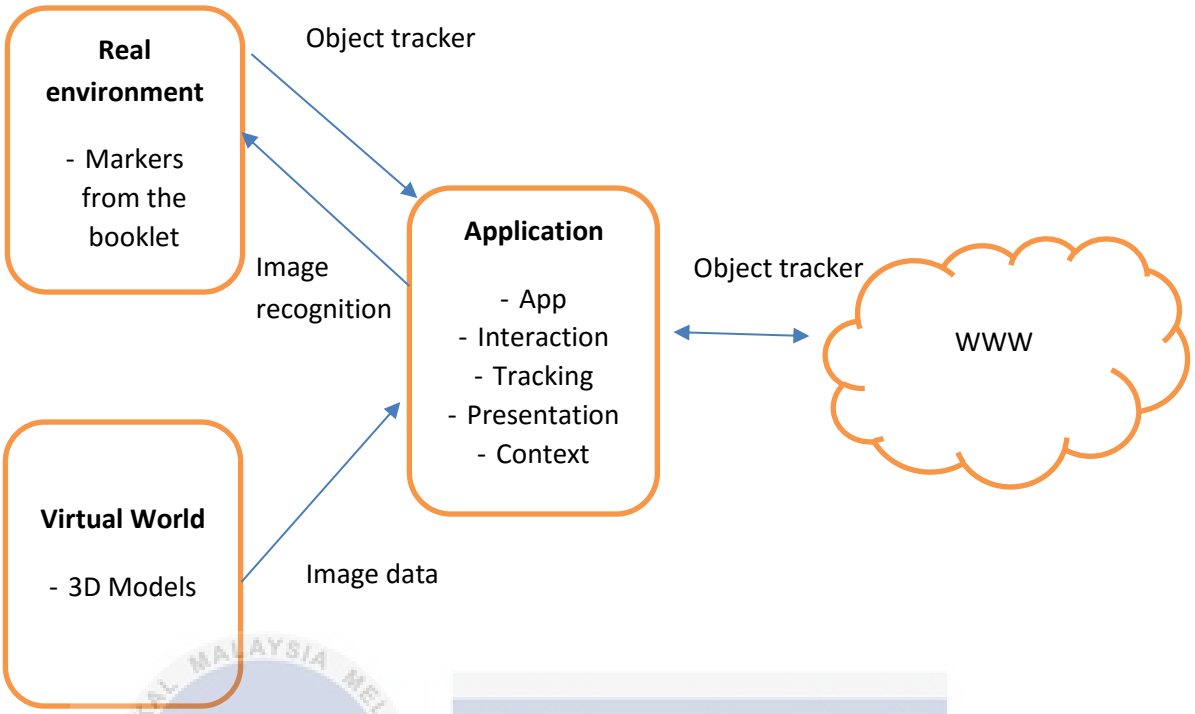


Figure 4.1 System architecture

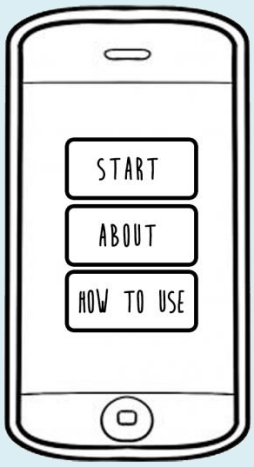
4.3 Preliminary Design

Preliminary design is an early sketch or rough ideas on how the system works. It is rather important in order for developers to understand the ideas of the system as well as working along the track that has been planned.

4.3.1 Storyboard Design

Storyboard design is a graphical representation of the system's flow. Images or illustrations are displayed in sequence to give visualization on how the real system will be developed.

Table 4.1 Storyboard Design

Scene	Description
	Scene 1: The interface of the AR mobile app Action: 1. Click START and navigate to Scene 4 2. Click ABOUT and navigate to Scene 2 3. Click HOW TO USE and navigate to Scene 3
	Scene 2: The About page explains about Fetal Development Action: 1. Click BACK to navigate to Scene 1 2. Click DOWNLOAD to download the tracker
	Scene 3: The How To Use page explains on how to use the app Action: 1. Click BACK to navigate to Scene 1

	Scene 4: Point the camera to the page (marker) Action: 1. Click BACK to navigate to Scene 1
	Scene 5: AR object will be displayed on the screen together with the narrations. User can zoom/pinch the image as well as rotate it.

4.3.2 Flow Chart

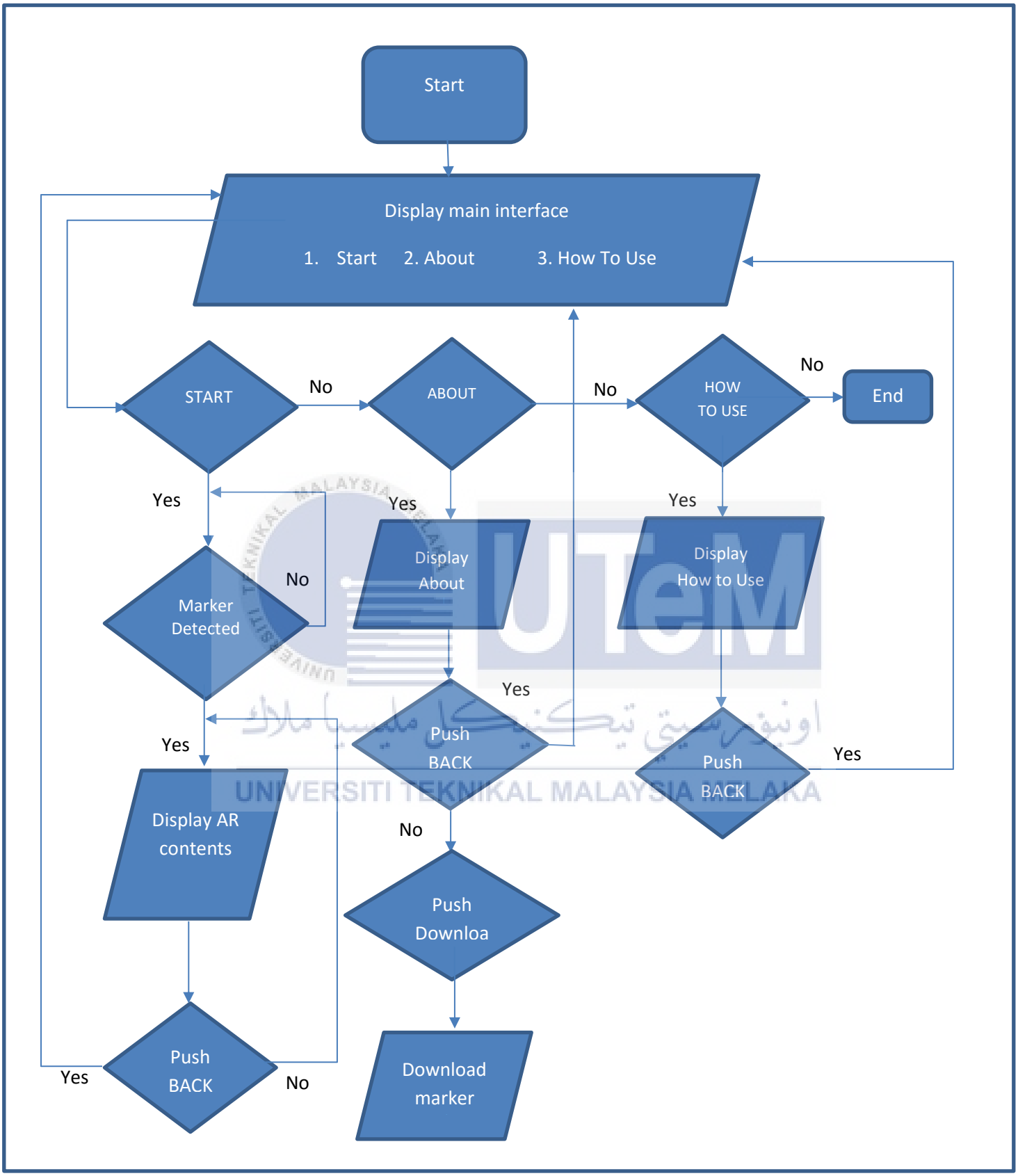


Figure 4.2 Flow Chart of the system

4.4 User Interface Design

4.4.1 Brochure Design

The brochure have been designed by using Adobe Photoshop CS6 and Adobe Illustrator CS6. If, without the app, the brochure can still be used physically as a summarized representation of a normal pregnancy. It can also accompany a pregnancy book or website. Every page of the brochure is a marker.

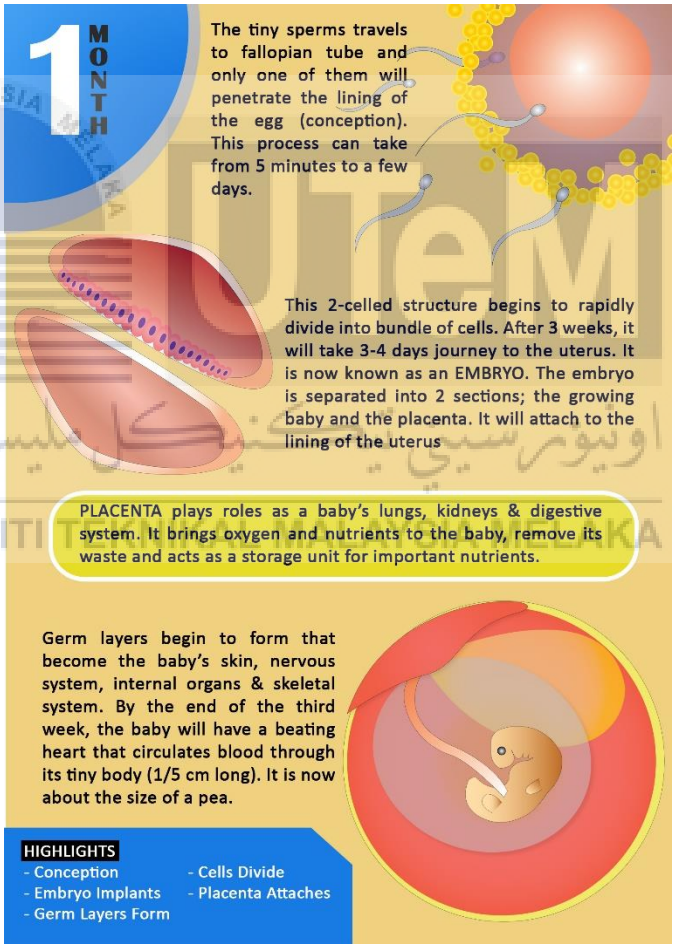


Figure 4.3 Sample brochure design

4.4.2 Navigation Design

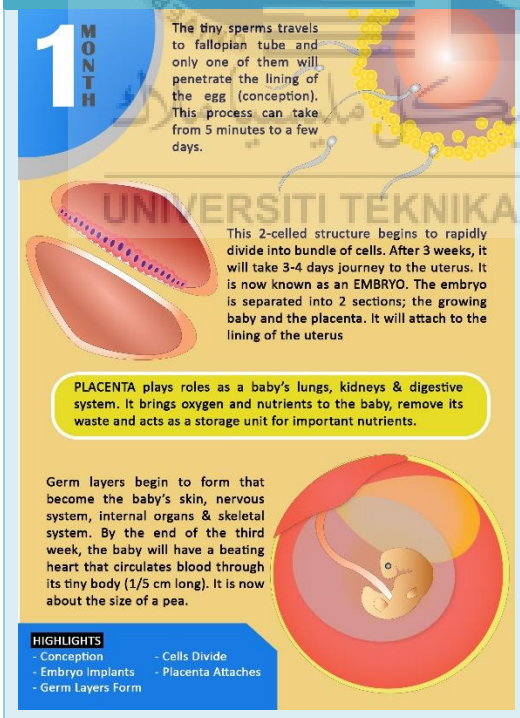
Navigation design is the logical flow design of the system. For this project, the navigation design is basically the same as the flow chart design.

4.4.4 Input and Output Design

For this project, the input design is the marker. Every page of the booklet has been set as a marker for every month fetal development.

The output design of the application is the 3D models of the foetus.

Table 4.2: Input and output design

Input design	Output Design
 Information on unborn baby during the first month	 3D models of the embryo

4.5 Conclusion

This chapter basically explained all the design activities involved during the design / development phase which are the system architecture, flow chart design, brochure design, user interface design, navigation design, input and output design.

Next chapter will focus on the implementation phase and all the activities involved; product implementation as well as product testing to check any errors or any parts that need to be updated, changed, removed or added. After the first level of testing, the software can be delivered to the user.

CHAPTER V

IMPLEMENTATION

5.1 Introduction

The implementation phase outlines the issues with the quality of the media creation. The activities that will be included in this chapter are the media creation, media integration, product configuration management as well as the implementation status. Media creation is all about the content creation for the system while media integration details out the process of integrating the created content. The product configuration management will discuss about the configuration setup of the system and lastly describe the progress of the development status of the system.

5.2 Media Creation

Media creation mainly focuses on the production of text, graphics, audio and animation.

5.2.1 Production of Text

Text plays an important roles in developing this application as it helps the user to understand all the information in the brochure (markers). A set of fonts with suitable colors and sizes has been picked in order to allow the user to read through the texts comfortably. Table 5.1 details out the process of text production

Table 5.1 Productions of text

Materials	Types of Text	Color
Brochure (marker) • Main texts • Headings	 Sans serif: Calibri Sans serif: Britannic Bold	 Black, White
Labels for 3D Models	Sans serif: Calibri	White
Application User Interface • Main page • Buttons • Other text	 Sans serif: Century Gothic Sans serif: Candara Sans serif: Calibri	 White Yellow Black

5.2.2 Production of Graphic

Graphic plays important roles in this application as graphic lets the user to better understand the topics. There are two types of graphics have been used in this project; bitmap and vector.

Vector images were created and traced by using Adobe Illustrator CS6. The 2D images of the unborn babies are vector images, and these images were saved in PNG format as transparent images are needed in order to produce interesting designs. The overall designs of the brochures have been created in AI, and then transferred to the Adobe Photoshop CS6 for the purposes of combining with bitmap images and using the effects in Photoshop.

The 3D models of the unborn babies were created by using Autodesk Maya 2013. These models need to be converted to FBX formats in order to allow Unity3D to recognize them. FBX is a universal format for 3D models and can be used with various software. The models have been modelled, textured and animated inside Maya and when converted to FBX formats, these settings will still applied to the model. These models

also have been rendered to PNG format and being used inside the application and brochure.

Figure 5.1 3D Model of the baby

Figure 5.2 Modelling of 3D images process

5.2.3 Production of Audio

The audio that has been used in the application is voice narration. The narration explains important information in each month of the unborn babies. The voice has been recorded inside a room by using a recorder, then the recorded sound have been enhanced and edited using Audacity. The sound later on being imported to Unity3D and some tweaking need to be done in order for the sound to be fully-functioned.

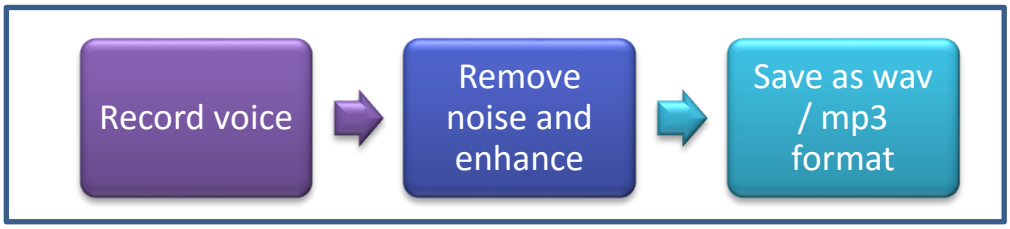


Figure 5.3 Production of audio process

5.2.4 Production of Animation

The 3D models that have been created and textured need to be animated in order to simulate the movements of unborn babies inside its mother's womb. These movements were simulated from some videos of real-life babies which is available from YouTube. Animated models will be exported into FBX format and later on imported to Unity3D. Some settings need to be done in Unity3D in order to activate the animation for the 3D models.

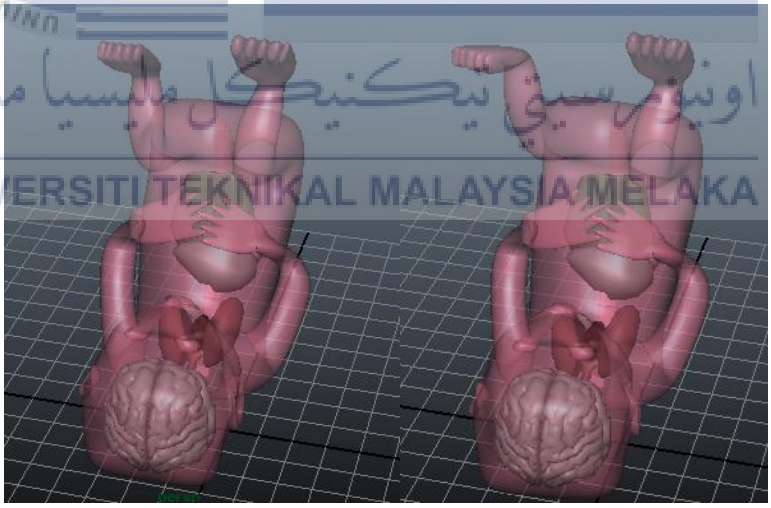


Figure 5.4 The animation of the baby's left leg movement

5.3 Media Integration

Media integration is the integration process for all the media that have been created (texts, graphics, audio and animation). The application has been developed by using Unity3D while the implementation of AR has been made by using Vuforia SDK.

The integration process started after all the needed media have been produced. All these media will be imported, carefully arranged and scripted inside Unity3D. The main menu and the other scenes were created later and will be linked during the packaging process. Android SDK is needed to package the application into an APK package.

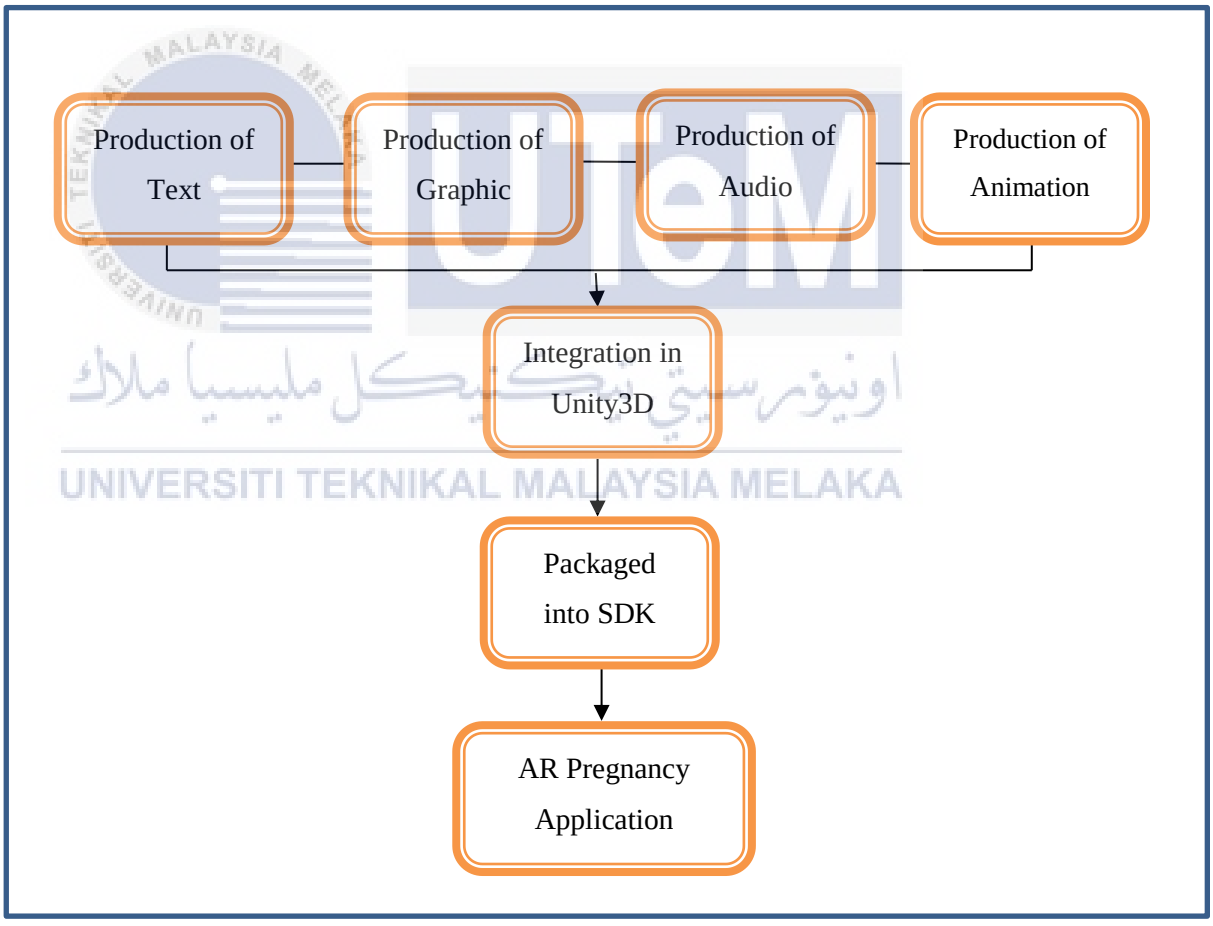


Figure 5.5 Process of integration

The first stage of the integration is to import all the media into Unity. Texts, graphics, audio, animation and marker database, after being imported are now known as Assets and have been placed in the Assets folder of Unity. Developer need to name the asset into meaningful name and the names follows the format that is known to all team members.

Then, each asset is carefully placed and arranged into the scene. All the needed scripting will be done in order for each element to be functional. The main interface and other scenes will be designed later and these scenes will be linked by buttons.

The final stage is to package the application into an installer package for Android (apk).

5.4 Product Configuration Management

This section will explains the configuration environment. Configuration environment setup explains on how the developer configures the required software.

5.4.1 Configuration Environment Setup

There were many development tools have been used in order to develop this application. However, there were two important tools will be discussed in this section. These tools are Vuforia and Unity.

5.4.1.1 Vuforia

All the markers need to be uploaded into Vuforia website in order for the creation of AR marker database.

a. Register for Vuforia account at their developer portal
b. After registered, we need to create a license key for our application.
c. Copy the license key into the application

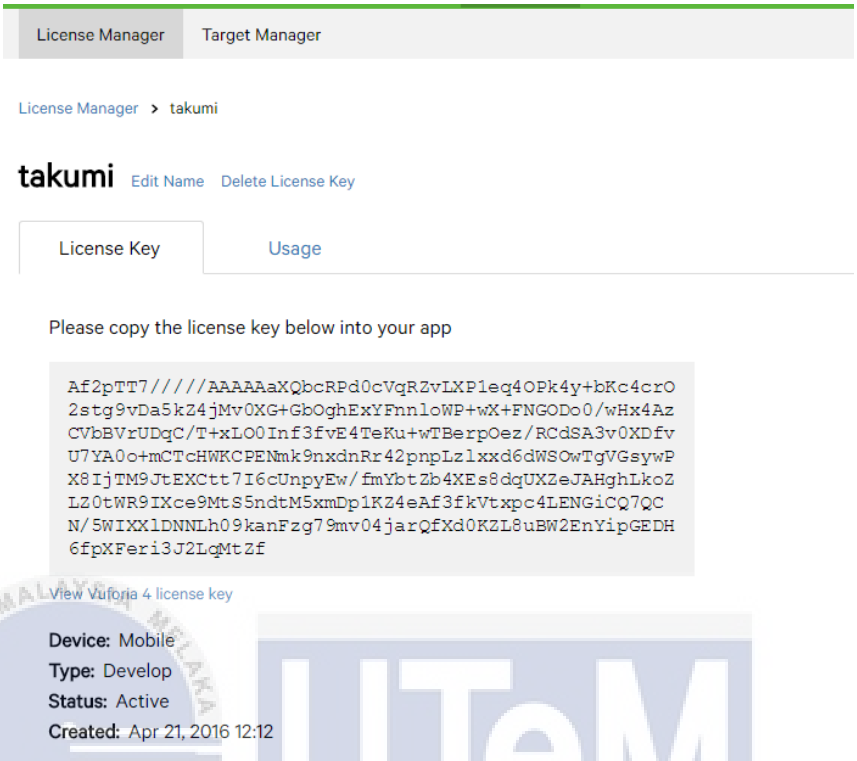


Figure 5.6 License Manager in Vuforia

a. Under target manager, create a database for the sets of markers
b. Click Add target button to upload the marker. After completed the upload process, click Download Database button to download the AR marker database.

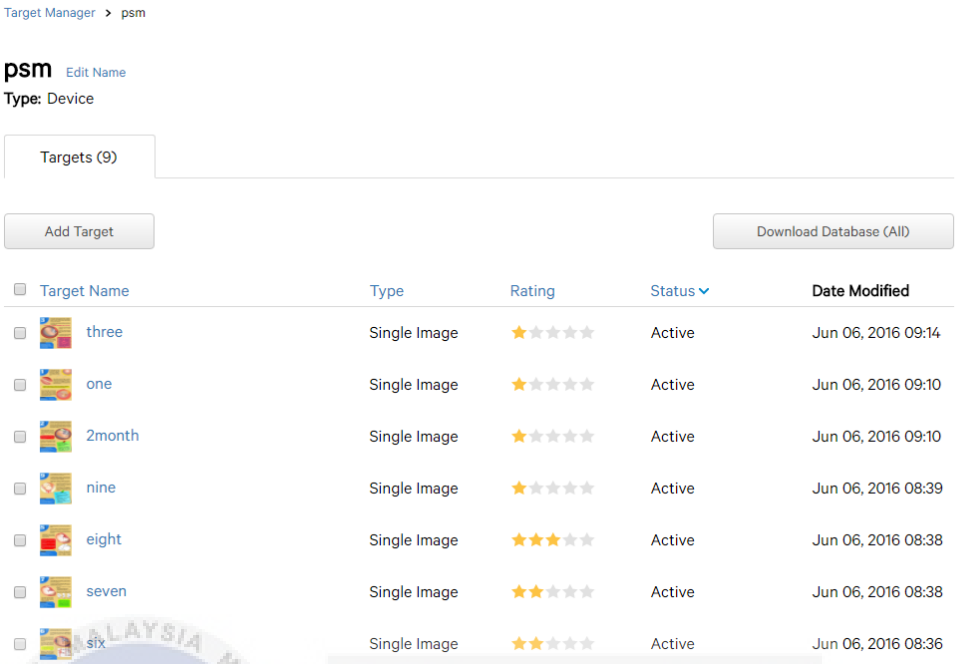


Figure 5.7 List of markers to be included into the marker library

c. Import the database into Unity as new asset

5.4.1.2 Unity3D

After integrating all the media into Unity3D, we will build the application into an Android package file (apk).

a. Choose build setting and put the all the scenes in their respective orders

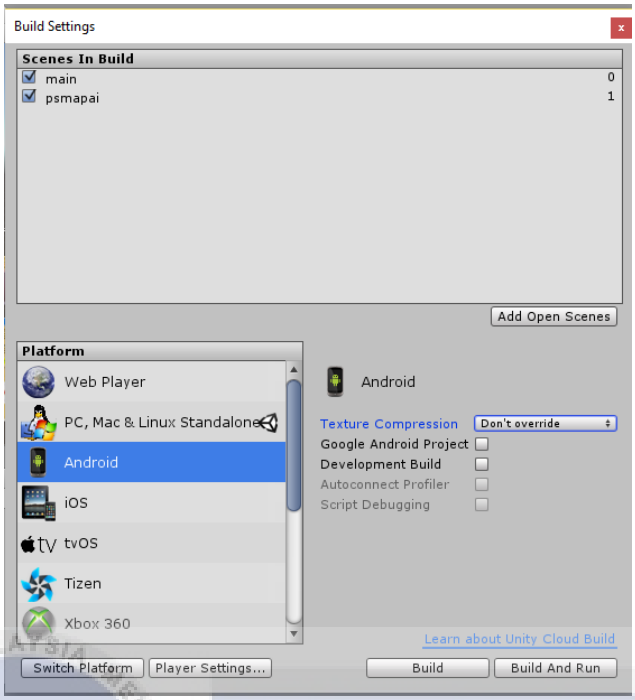


Figure 5.8 Build Setting for Android package in Unity

b. Choose **Android** as the target platform.

c. Choose **Build** to create an APK file or **Build and Run** to create an APK that will be transferred and run on an android device.

5.5 Implementation Status

This section detailed out the progress of the project development

Table 5.2 Implementation status

Tasks	Description	Status
Pre-production • Analysis Phase	• Proposal preparation and submission • Collecting information • AR analysis	On Time On Time On Time

• Design Phase	• Analysis of existing systems • Define methodology, target user, scope • Verify software and hardware required • Define user requirement, functional requirement and non-functional requirement • Design flow chart • Design user-interface • Design brochure (markers)	On Time On Time On Time On Time On Time Delayed Delayed
Production • Development Phase	• 3D modelling, texturing and animating • Installing and setting up required hardware and software	Delayed On Time
• Implementation Phase	• Import media into Unity • Scripting • Debugging • Installation to Android device	Delayed Delayed On Time On Time

5.6 Conclusion

The implementation phase is the most crucial part of the development as during this phase, all the main components of the application have been integrated into a single application. This stage explains all the needed steps to develop the AR application. The implementation phase also outlines the implementation status of the project whether they are on the right track or slightly delayed.

CHAPTER VI

TESTING

6.1 Introduction

This phase marks the final phase of the project development. Testing was conducted in order to define how far the project has been successfully achieved its intended objectives and whether the product is ready to be delivered to the user. The testing process must be conducted towards the target user.

Test plan, test environments, test schedule, test strategy, test implementation process and analysis will be explained in this section. The collected results will be analysed to determine whether the project has achieved the target.

6.2 Test Plan

Before the testing process being conducted, proper planning are required so that this activity can be done smoothly. Hence, the test plan will be the first part of the testing process. The test plan is vital because it outlines all the strategies that need to be taken to assure that the application meets its intended objectives.

6.2.1 Test Organization

The purpose of the test organization is to decide the personnel that are involved in the testing phase of the application. For this project, two types of testers were involved.

- Developer or Expert side

  Persons involved as testers in this project came from the same side of the organization. The selected personnel is a developer and is currently on the multimedia field. This type of user will perform functionality testing.

- User side

10 users are required for the testing process and they are carefully identified and selected based on the criteria of the target user that has been set before. Several users are married and been pregnant before. While the others are single woman and a few man. All of them aged less than 35.

6.2.2 Test Environment

Test environment focused on all the setting and location for the testing process to take place. The selected location must be convenient, thus allowing the testing process to be smoothly and comfortably conducted. The users have been given a basic instruction on how to use the application before the testing being conducted. Some observations have been made to evaluate their interests on the application.

On the other hand, all the required hardware and software for the testing were also mentioned in Table 6.1.

Table 6.1 Test environment

Environment	• Office lobby with good lighting • Tables and chairs are available to let the users feel comfortable to do the testing
Location	• Pusat Komputer, UTeM
Hardware	• 1 tablet with Android platform • 1 laptop computer
Others	• Brochure (markers)

6.2.3 Test Schedule

Test schedule control the timing and duration for the testing process to be conducted. This is crucial as a proper test schedule allow the testing process to be run smoothly and timely. Testing was done for the developer side first before being finally tested to the user.

Table 6.2 Test schedule for Developer

Profession	Multimedia Developer
Total of participants	2
Date	03 August 2016
Duration per session (minutes)	15
Number of participants per session	1
Total time spent (minutes)	30

Table 6.3 Test Schedule for User

Profession	Various fields
Total of participants	10
Date	06 – 07 August 2016
Duration per session (minutes)	15
Number of participants per session	2
Total time spent (minutes)	180

6.3 Test Strategy

Test strategy allows the testers to try and discover the application. The testers will be provided with a set of questionnaires regarding the effectiveness of the product. The testers have been given 5 minutes to get used with the user interface and the AR functions first before answering the questionnaires.

There were 12 testers involved in this test. The test is regarding the contents of the product, its functionality, interface, learnability, effectiveness, ease of use and how much they are related to the objectives.

- **Developer / Expert testing session**

The testing session for the experts was conducted earlier because the developer of the application would be able to correct any errors and problems detected by the experts before the application being tested to the user. This session allows for detection of any missing parts or problems with the contents, links and interface.

- **User testing session**

After fixing all the problems detected from the expert testing, the product was tested prior to the final release. The selected users came from different fields and never involved in the production of multimedia products. The purpose of selecting people who are the real end users because they have different view on the application rather than a developer's view.

Figure 6.1 Some of the users involved in the testing process

6.4 Test Results and Analysis

This section will overview the outcome of the evaluation testing. All the graph analysis from the questionnaire will be presented in this section.

There were two parts in the questionnaire. Section A is regarding the testers' general information while Section B has been divided into three sub-sections which are the Interface and Design, Learnability and Effectiveness (usability).

Figure 6.2 shows the bar chart for the interface and designs result tested by the testers. Based from the chart, the average scale of the attractive designs and interface is 4.0 where 3 people choose average and 3 people strongly agreed on the statement. The average scale for easily navigable menu is 4.2, slightly higher from the first statement which 5 people strongly agree with the statement and 4 people agree.

The chart also shows that the average scale for suitable colour schemes and graphic as well as the multimedia elements complement the design is 4.2. For the suitable colour schemes and graphics, 3 people strongly agree with the statement while only 1 choose average. On the other hand, for the multimedia elements complement the designs, 5 people strongly agree with the statement and 2 people choose average.

Hence, based from the result on the Design and Interface, it can be concluded that the design and interface of the application suitable for the target users.

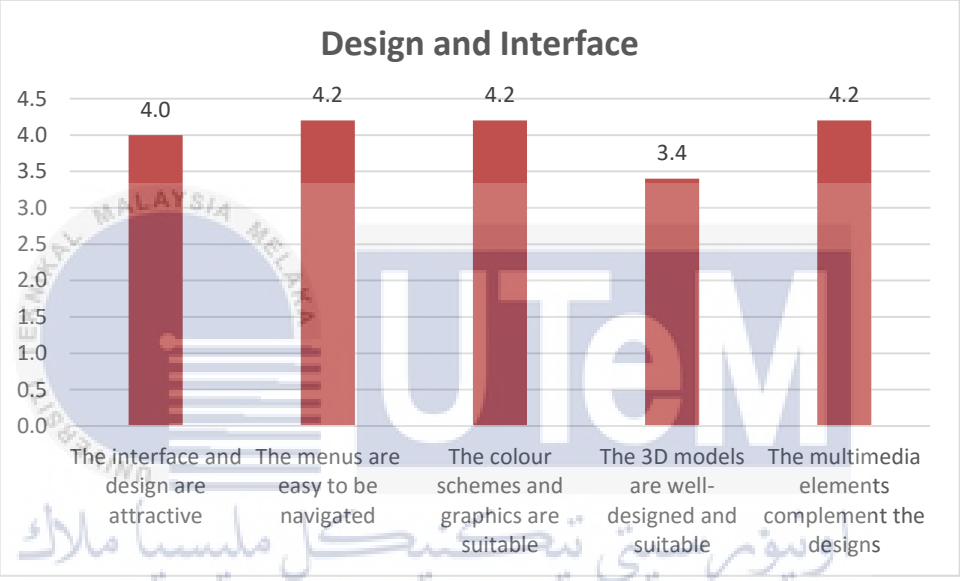


Figure 6.2 Bar chart on the average scale for the Design and Interface section of the application

Figure 6.3 shows the bar chart for the Learnability elements tested. From the chart, the AR elements provided a clear perspective on the topic shows an average scale of 4.1 with 3 people strongly agree with the statement while 7 choose agree and 2 others choose average. The application is easy to understand and simple to use marks the highest average scale of 4.3 with 5 people strongly agree with the statement, 6 people agree and only 1 people choose average. Furthermore, the lowest scale of 3.8 recorded for the audio helps me to understand the topic with only 1 strongly agree with the statement and 3 people choose average.

The bar chart also shows that all the multimedia elements provided are related to the topic had an average scale of 4.1 with 3 people strongly agree with the statement and 7 people choose agree while the other 2 choose average.

From the findings for the Learnability element of the test, it can be concluded that this application with all the included media is able to improve the learnability level of its user.

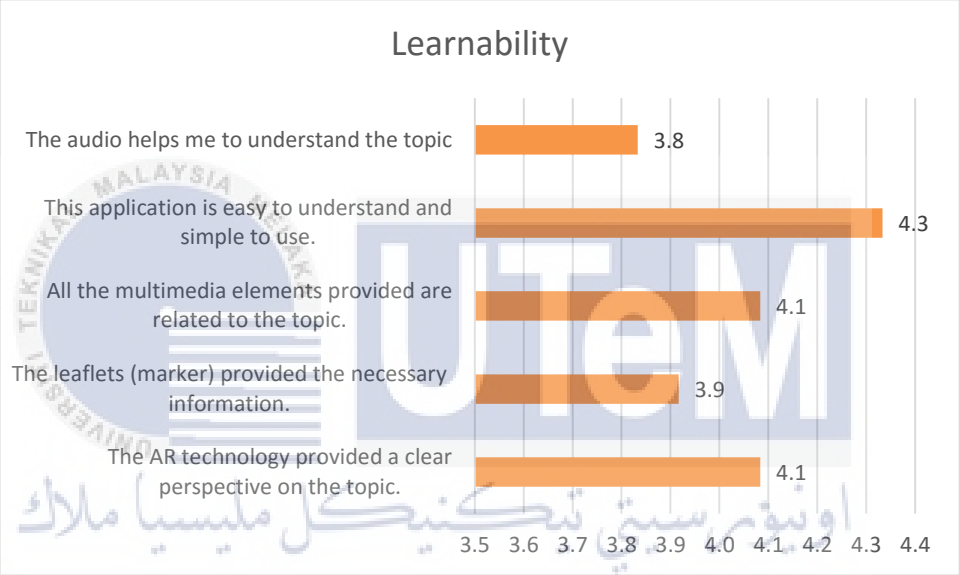


Figure 6.3 Bar chart on the average scale for the Learnability elements of the application

The next element being focused on the test is Effectiveness. Figure 6.4 shows that 'the AR technology attracts me to use the application' had an average scale of 4.0 with 2 people strongly agree with the statement, 8 people choose agree and 2 people choose average. Based from the observation made during the test, most of the participants impressed with the capabilities of AR in giving another dimension on learning. The highest average scale recorded is 4.2 for the statement 'I will use this application as an essential reference' with 4 people strongly agree with the statement and 6 people choose agree and only 2 choose average.

The chart also shows that the statement 'I will suggest this application to my family members and friends' marks as the second highest average scale with 3 people strongly agree with the statement and 7 people choose agree.

Based from these findings, it is clearly visible that Augmented Reality application gave an impact on learning and if it is smartly applied to a normal daily topic, it will be able to attract younger generations' attention to that issue.

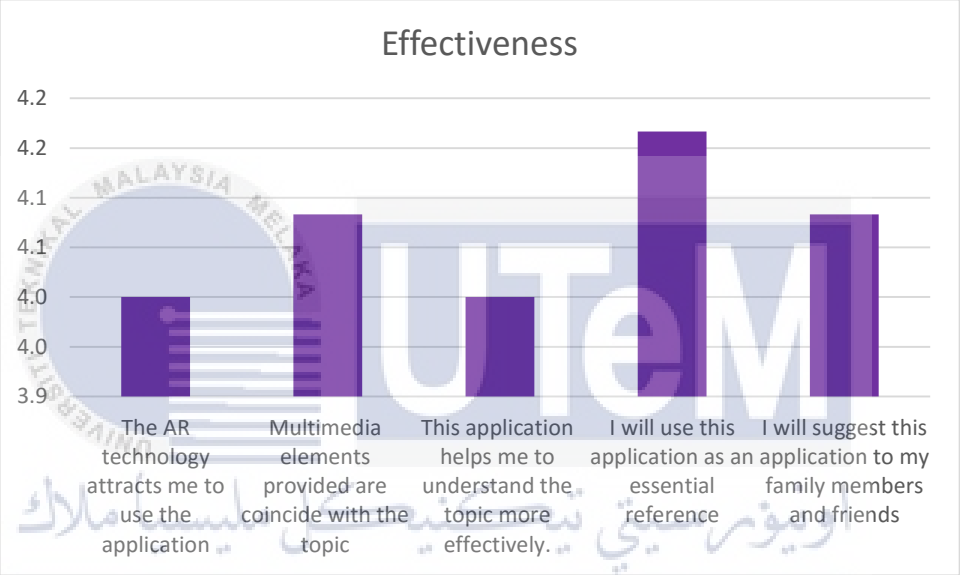


Figure 6.4 Bar chart on the average scale for the Effectiveness elements of the application

6.5 Overall Analysis Test

Based from all the data that have been collected and analysed, it is fair to say that this project gave a positive result. The overall analysis test shows that younger generation prefers a new and interesting way on assimilating knowledge. Although a few user stated that installing a new app to their device and utilising their camera for getting information are rather tedious, majority of the testers agree that AR is a promising platform if they were properly planned and designed. The graphics and

interface of the application as well as the interactivity elements are well-accepted by the user.

6.6 Conclusion

This chapter explained in details all the steps involved in the testing phase and analysis made from the testing data that have been collected. The analysis of the testing data proved that using the AR technology improve the learnability and effectiveness of learning process especially for the younger generations.

Further testing and improvement still need to be done in the future, although the project is able to give a positive results now. This is to establish better functionality and usability of the product.

CHAPTER VII

PROJECT CONCLUSION

7.0 Introduction

In this section, the results of this project and everything that have been done will be discussed. This chapter also summarize all the findings and thoughts from the surveys as well as any improvements that need to be planned and take action in the future.

7.1 Observation on Strengths and Weaknesses

Pregnancy Alpha-Omega was built using Unity. Unity is a software mainly for developing games, but it also serves as a platform for non-gaming developer to create an Augmented Reality application. This application, although having some strengths points, is undeniably still having some weaknesses that can be improved in the future.

7.1.1 Strengths

The strengths of this application are:

i. Usage of AR technology to attract attentions

AR technology has been applied to the application in order to attract the user, especially younger parents to read and learn about pregnancy. This product has dual-function; a normal brochure that summaries the fetal development.

On the other hand, if the user has an android device and the application, they can experience the AR functions to give better understanding on the topic.

ii. One of the earliest AR application on pregnancy being developed

As currently there are very small quantity of application on pregnancy with AR technology being developed, as well as the AR/VR technology now being talked about by everyone, this application can be considered as blooming on the right time.

iii. Tool for delivering knowledge

This application compiled all the main important information on stages of pregnancy in one package and by installing and using the software, a user will have a quick access to this valuable knowledge. 3D models of the baby let the user imagines how an unborn babies looks like in the womb.

iv. Time and cost saving

As this application was built on Android platform, thousands of device can be installed with it. The users can easily access the information on the tip of their fingers without having to visit a clinic or even lift a book to read.

7.1.2 Weaknesses

Albeit some of the promising strengths of the application, it is undeniably having some weaknesses that can be improved in the future.

i. A good lighting is an essential

A location with a low light source make it a bit hard for the AR to function as the application needs sufficient light in order for the camera to detect the marker.

ii. Application only limited to Android users

The application currently limited to Android users only.

iii. Requires a headphone to hear the narration if using the application in a noisy place

iv. Less realistic looks and movements of the unborn babies models

7.2 Proposition for Improvement

Referring to the abovementioned strengths and weaknesses, some improvements need to be done to this application.

First of all, the less-realistic looks and movements of the 3D baby model can be improved by applying a better texture or perhaps remodelled and reanimate them. The skills on developing 3D media using Maya can be improved by learning more on the software.

Next, the application need to be developed for iOS users as currently it is only available to Android users.

Lastly, developer need to work on the main application as currently the application delays during loading and changing scene.

7.3 Contribution

This project will certainly benefits the younger parents who want to have a better understanding on their month-to-month unborn baby development in the wombs. As IT-savvy people, younger parents prefer every information to be accessed by using the tip of their fingers without having to open a book or read a brochure solely.

The developer can work out with clinics, hospitals and the Ministry of Women, Family and Community Development to distribute or market this product for parents

and families. Pregnant mothers might find this application useful to assist them during this 9-months journey.

This application can also being promoted during Science and Biology lessons in secondary schools. This will help the students to better understands the topic as learning through textbooks only do not provide them with enough information.

7.4 Conclusion

After months of development, the Pregnancy Alpha-Omega has evolved from just a simple idea into a promising application. Although there are quite a numbers of improvements need to be done, it is fair to say that it already achieved its intended objectives which have been mentioned in the earlier chapter.

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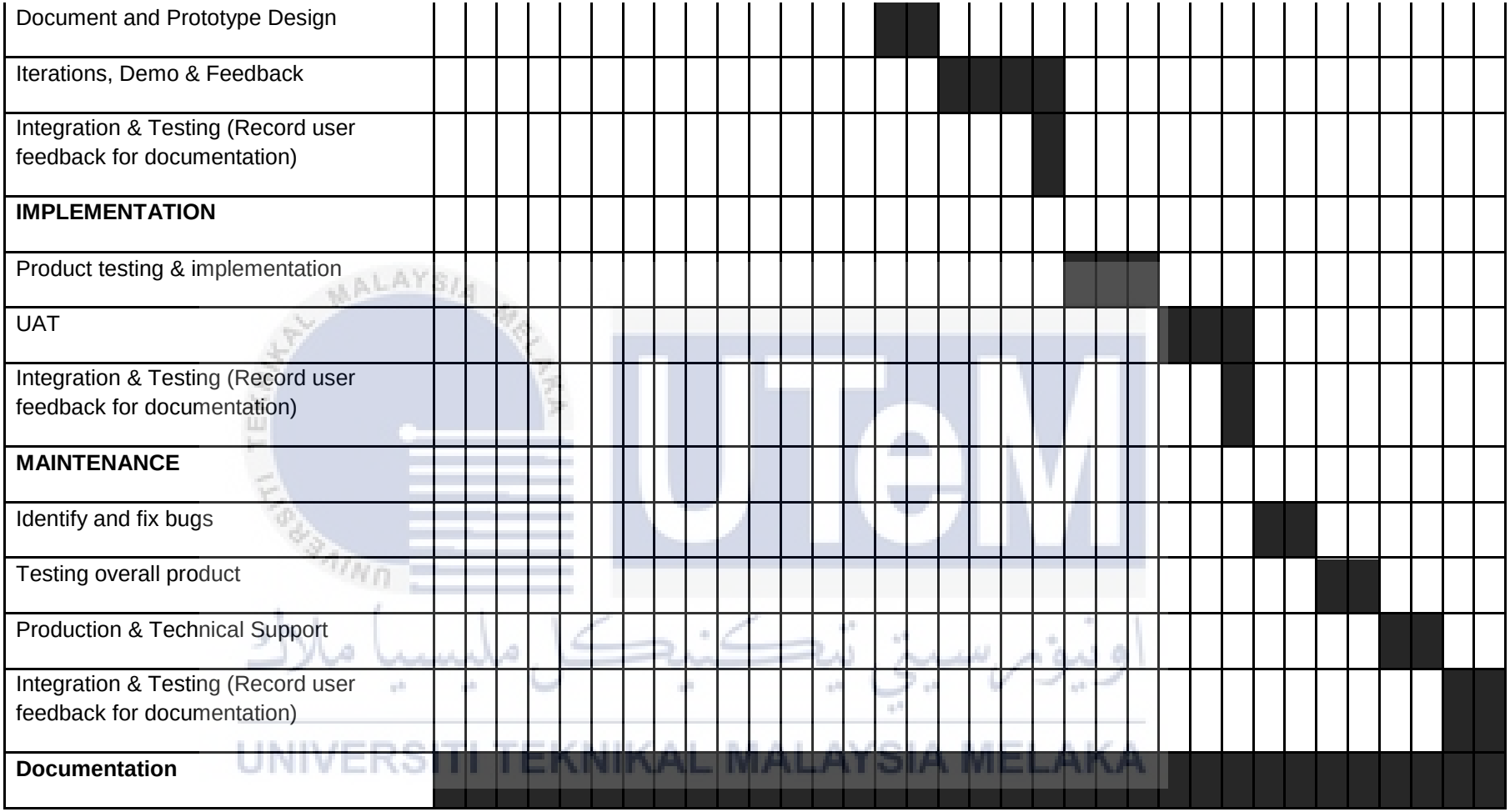
APPENDICES

APPENDIX A: MILESTONES

	Minggu																	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	
PLANNING																		
Brainstorming																		
Deciding software and platforms																		
Preparing proposal																		
Testing and Integration (Record user feedback for documentation)																		
ANALYSIS																		
Requirement Analysis																		
Testing and Integration (Record user feedback for documentation)																		
DESIGN																		
Layout design																		
Interface Design																		
Discuss with Client																		



APPENDIX B: QUESTIONNAIRE

Value-Added Information on Baby Development by Using Augmented Reality Technology to Increase Knowledge on Pregnancy

SECTION A

1. Gender
   - ☐ Male
   - ☐ Female

2. Age
   - ☐ 20 - 25
   - ☐ 25 - 30
   - ☐ 30 -35
   - ☐ 35-40
   - ☐ More than 40

3. Marital Status
   - ☐ Single
   - ☐ Married

4. Ethnic
   - ☐ Malay
   - ☐ Chinese
   - ☐ Indian
   - ☐ Others

5. Do you have a smartphone?
   - ☐ Yes
   - ☐ No

6. How long do you spend on a mobile application?
   - ☐ 10-20 minutes
   - ☐ 20-30 minutes
   - ☐ 30-60 minutes
   - ☐ More than 1 hour

7. Have you ever used any Augmented Reality software before?
   - ☐ Yes
   - ☐ No
8. Have you ever read about pregnancy before?
   - ☐ Yes
   - ☐ No

SECTION B

1. Why do you read about pregnancy?
   - ☐ I was pregnant at that time
   - ☐ Someone close to me was pregnant at that time
   - ☐ Just to get rough ideas on pregnancy
   - ☐ Doing research on pregnancy

2. How do you read about pregnancy before?
   - ☐ Articles online
   - ☐ Books
   - ☐ Brochures/Flyers

3. If the information regarding pregnancy are presented in an interactive way, do you think it will attract people to read about it?
   - ☐ Yes
   - ☐ No

APPENDIX C: QUESTIONNAIRES FOR USER ACCEPTANCE TESTING

VALUE-ADDING INFORMATION ON BABY DEVELOPMENT BY USING AUGMENTED REALITY TECHNOLOGY TO INCREASE KNOWLEDGE ON PREGNANCY

This survey is conducted to gather information on how augmented reality can improve the knowledge and understanding of the community towards pregnancy.

SECTION A: PERSONAL PARTICULARS

Please tick at the corresponding boxes

1. Gender
   - ☐ Male
   - ☐ Female

2. Age Category
   - ☐ 20 – 25
   - ☐ 26 – 30
   - ☐ 31 – 35
   - ☐ 36 – 40

3. Marital status
   - ☐ Single
   - ☐ Married

4. Do you have a smartphone / tablet?
   - ☐ Yes
   - ☐ No

5. Which is the MOST effective way for you to get an information?
   - ☐ Books

- ☐ Pamphlets / brochures
- ☐ Searching the internet
- ☐ Interactive mobile apps

6. Have you used or heard about Augmented Reality before?
   - ☐ Yes
   - ☐ No

SECTION B: AR APPLICATION

Please rate the following statements on a scale of 5 (Strongly agree) to 1 (Strongly disagree)

I. Design and Interface

No.	Statements	1	2	3	4	5
1.	The interface and design are attractive.					
2.	The menus are easy to be navigated.					
3.	The colour schemes and graphics are suitable.					
4.	The 3D models are well-designed and suitable.					
5.	The multimedia elements complement the designs.					

II. Learnability

No.	Statements	1	2	3	4	5
1.	The AR technology provided a clear perspective on the topic.					
2.	The leaflets (marker) provided the necessary information.					
3.	All the multimedia elements provided are related to the topic.					
4.	This application is easy to understand and simple to use.					
5.	The audio helps me to understand the topic					

III. Effectiveness

No.	Question	1	2	3	4	5
1.	The AR technology attracts me to use the application					
2.	Multimedia elements provided are coincide with the topic					
3.	This application helps me to understand the topic more effectively.					
4.	I will use this application as an essential reference					
5.	I will suggest this application to my family members and friends					

APPENDIX D: USER MANUAL

1. Copy package file “alphaomega.apk” into Android Smartphone by using a USB cable
2. Use File Explorer to search for the apk file inside Android directory and tap on it.
3. When an installation dialog box appear, choose “Install” to proceed.
4. After the application has been successfully installed on your device, the icon will appear on your screen. Tap the icon to start the application

Note:

1. Please ensure that your phone setting is configured to install of non-market applications.
   a. Navigate to Setting > Applications.
   b. Check the box for “Unknown sources – Allow install of non-market applications”