THE DEVELOPMENT OF FOOD WASTE AWARENESS CAMPAIGN USING AUGMENTED REALITY

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TEE PEI YA

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

FACULTY OF INFORMATION AND COMMUNICATION TECHNOLOGY
UNIVERSITI TEKNIKAL MALAYSIA MELAKA
2017

DECLARATION

I hereby declare that this project report entitled

THE DEVELOPMENT OF FOOD WASTE AWARENESS CAMPAIGN USING AUGMENTED REALITY

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DEDICATION

To my parents and family,
who always love and support me;

To all the lecturers,
who always point me to a right direction;

To my friends,
who always lend me their hand;

To all the human beings,
who always try their best to protect our planet.

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ABSTRACT

Food waste, a global issue that getting serious in the recent year. The Food and Agriculture Organization of the United Nations (FAO) estimates that in global, one-third (approximately 1.3 billion tonnes) of food produced for human consumption is lost or wasted per year. The purpose of this project is to study food waste and augmented reality. Then, propose a campaign about food waste using augmented reality. This project is carried out with the project methodology that refer to the writing guideline of final year project The expectation of this project is to successfully develop an effective and powerful advertising media. It can reduce food waste.

ABSTRAK

Pembaziran makanan merupakan satu isu global yang semakin serius pada tahun kebelakangan ini. Food and Agriculture Organization of the United Nations (FAO) menganggarkan bahawa di peringkat global, satu pertiga daripada makanan untuk kegunaan manusia dibuangkan atau dibazirkan 1.3 bilion tan setahun. Tujuan projek ini adalah untuk mengkaji pembaziran makanan dan realiti tertambah. Kemudian, mencadangkan satu kempen mengenai pembaziran makanan menggunakan realiti tertambah. Projek ini yang dijalankan dengan metodologi projek yang merujuk kepada panduan penulisan projek tahun akhir Jangkaan projek ini adalah untuk berjaya membangunkan pengiklanan yang berfungsi dan berkuasa. Kempen ini dapat mengurangkan pembaziran makanan.

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AR	-	Augmented Reality
FAO	-	Food and Agriculture Organization of the United Nations
SWCorp	-	The Solid Waste Management and Public Cleansing Corporation
SME	-	Subject Matter Expert
ADHD	-	Attention Deficit Hyperactivity Disorder
GUI		Graphical User Interface

CHAPTER I

INTRODUCTION

1.1 Introduction

According to Silva, Oliveira, & Giraldi (2003), Augmented Reality (AR) is a new technology that immerses computer graphics on the real world. People are interesting and attracted by new things. Since AR in advertising campaign is still a fangle to public, it is easily to grab people's attention. Develop advertising campaign using the new media can change people's perception and bring an unforgettable experience. Johnson, L., Levine, A., Smith, R., & Stone, S. (2010) stated, "AR has great potential to provide both powerful contextual, live learning experiences and serendipitous exploration and discovery of the connected nature of information in the real world."

Nowadays food waste is a global problem that is getting serious. There is one over three (roughly 1.3 billion tonnes) of the food produced for human get loss or wasted in a year. Therefore, more actions have to be taken to create awareness to public. Increased public awareness can help begin to shift strongly ingrained habits and mind-sets surrounding the value and consumption of food. New media in advertising aspect play an effective role to reduce the problem.

1.2 Problem Statements

The problem of food waste is getting serious and it becomes a global issue in the recent year. The Food and Agriculture Organization of the United Nations (FAO) estimates that 1/3 of food produced for human is gone or wasted globally, which amounts to about 1.3 billion tonnes in a year. A study conducted by The Solid Waste Management and Public Cleansing Corporation (SWCorp) shows that in 2016, 38,000 tonnes of solid waste was generated by Malaysians each day, of which 15,000 tonnes was food waste. Food waste is happen anytime, anywhere and it is maybe the person just beside us.

People are complaining that the prices of food keep rising, but they are wasting food in the other hand and giving variety of excuses. They do realise that food waste is a problem, but they do not care about it. Food waste is a problem and it can lead to many problems in different area, including economic, environmental and social. Emissions of methane, a green-house gas from rotting food, contribute to climate change. Food waste causes wasting of huge energy and resources that is used in agricultural production, and while transporting and preparing food. This causes to enormous amount of financial loss and economic loss. Distinctly, this issue should get widespread attention.

1.3 Objectives

i. **To investigate food waste and augmented reality technology.**
   To study one of the global issues, food waste and the new media: augmented reality technology.

ii. **To propose a campaign about food waste using augmented reality.**
   To apply the augmented reality technology in new campaign about food waste.

iii. **To test the effectiveness of the campaign towards target audience.**
   Since there is no food waste campaign using augmented reality yet, a lot of research and testing have to be done to obtain the data.

1.4 Scope

This project will be focused in restaurant since it is a place that people having meal and the possibility of food waste is higher. The target audience will be the customers or public in the age range of 12-25 who are acquainted with mobile device. Since they are good in operating mobile device, they will be easily understand augmented reality and get the message from the campaign. An augmented reality application will be applied and user can access the application using mobile apps (ENTiTi). Further discussion will be in Chapter IV-Design.

1.5 Project Significant

Developing a new campaign using augmented reality can attract people's attention and from that can raise public awareness. Therefore, people are concerning about this issue and the problem of food waste can be reduced. At the same time, the long-term impact such as economic, environmental and social impact can be mitigated. Using augmented reality, therefore, people are allowed to immerse their perception with digital content compared to conventional method such as static poster.

1.6 Conclusion

This chapter discuss about the current scenario and the long-term problems that food waste will result in. It also briefly introduces the new media, augmented reality and how augmented reality can help in developing a campaign.

Literature review and project methodology will be covered in the next chapter. It summarizes the main concerns of the project, study previous approaches and existing methods. Finally, come out with the opinion points.

CHAPTER II

LITERATURE REVIEW AND PROJECT METHODOLOGY

2.1 Introduction

This chapter will discuss about literature review, existing system and methodology that will be used in development of augmented reality food waste awareness campaign. Literature review is focus on new media, augmented reality and food waste issue.

2.2 Domain

New media refers to an information system which requires a machine interface to interpret the stored data (Ansari & Omid Yazdani, n.d., 1998). According to Understanding New Media (2010) by Robert Logan, new media is defined as “digital media that are interactive, comprise of two-way communication and contain some form of computing,” The meaning of new media keep changing as new media evolves and morphs continuously. Lev Manovich, professor and new media theorist, describes that new media as being innate to computers or relying on computers for distribution such as websites, computer games, human-computer interface, computer animation, virtual worlds, virtual reality, multimedia, digital video, special effects in

cinema and interactive computer installations. Augmented reality is a good example of new media.

According to Connolly & Chambers (2010), augmented reality (AR) is the combination of digital media within an existing actual environment. AR utilizes digital graphics to add an extra lay er of information for understanding and interaction with the physical world. This is commonly demonstrated through adding extra digital information or computer models, which are showed through visual output screen. The first developed conceptually in the early-1990s, recent progresses in technology have allowed AR to begin to touch, and it is potential, especially in a portable context. The first AR user applications developed for marketing purposes and run through static home computers. The applications range has begun to diffuse into other areas, such as education.

AR can be separated into two broad categories: marker-based, and markerless:

Marker-based Systems: This technology uses physical-world symbols as a reference point for computer graphics to be overlaid. For example, a 2-dimensional printed marker is placed in front of a webcam. The computer then interprets this symbol to overlay an on-screen graphic as if it were directly on top of the marker in the physical world. There have been several notable uses, most commonly in marketing.

Markerless system By contrast, this technological approach has given rise to ‘mobile augmented reality’, denoting use of the technology with devices such as smartphones and tablets. This method uses a combination of an electronic devices’ accelerometer, compass and location data (such as the Global Positioning System – GPS) to determine the position in the physical world, which way it is pointing and on which axis the device is operating. This location data can them be compared to a database to determine what the device is looking at, and thus allows computer data/graphics to be displayed on-screen.

AR is an interactive medium. As such, interaction plays an important role in the overall user experience. Interaction can be defined roughly as a mutual influence of one thing on another. (Alan B. Craig, 2013) Interactions in the virtual world can be boiled down to three primary categories:

1. Manipulation
2. Navigation
3. Communication

Manipulation is primarily how we interact with things in the virtual world. In order to manipulate something (virtual) in an AR experience, one must first make a selection (i.e., identify what it is he wants to take action on) and then perform an action. Mark Mine (Mine, 1995), a VR researcher, provides three ways that manipulation can be used in virtual reality applications and, by extension, in AR applications.

These are:

1. Direct user control-in which participants manipulate the virtual world in a manner that is directly analogous to how they do it in the physical world.
2. Physical control-where participants use a physical device that they can hold and touch, such as a tablet computer or a physic al push button.
3. Virtual control-where participants interact with virtual versions of a physical control, such as a (virtual) button, that they can press in the virtual world.

Sherman and Craig add a fourth category to this list:

4. Agent control-where participants issue commands to some agent in the virtual world to carry out the action on behalf of the participants.

Navigation is related to how we move through the world. Some people equate navigation specifically with the act of moving through the environment, but navigation actually has two components: (1) travel and (2) wayfinding. Travel is the actual physical act of locomotion through the world. Wayfinding is related to how we know where we are in the world, and what we need to do to get to the place we want to go.

Augmented reality developer Robert E. McGrath suggests that AR is especially suitable for multimodal communication and provides provocative

ideas that could exploit the affordances of augmented reality for the purposes of synchronous and/or asynchronous communication in an AR experience. One such suggestion is the idea of attaching a message (text, audio, or video) to a concrete object from either the real world or the virtual world. There is also the issue of a participant communicating with the AR application itself. Beyond the typical interactions of a changing point of view and interacting with buttons and other interface elements, it is sometimes necessary to communicate with the application about something other than the typical virtual world interactions. For example, one might need to indicate to the application that you want to load a different virtual world or change the content in some other way. This type of communication can take place via a traditional computer system keyboard, via commands entered directly on a smart tablet or phone, or issued in other ways from within the application virtual world.

Mobile augmented is a portable AR that can bring along everywhere. A smartphone is a good example of mobile device that can fits into pocket and is easy to operate. The advantages are related mostly to the fact that AR applications can be experienced at anywhere and at any time. The disadvantage is related to constraints that are imposed in exchange for mobility, although there are sometimes advantages to using a permanent or semi-permanent installation at a particular location. There are also other special considerations for those planning to create mobile augmented reality applications such as technological constrains and environmental constrain. Technological constraints on mobile augmented reality applications are that the resources on most devices are limited. These are manifested primarily as limited memory and limited computational capability, as well as limited graphics capability, limited input and output options, and, especially in the case of non-projection environments, limited screen real estate. Humidity, pressure, and magnetic fields may effect on mobile devices and consequently on mobile AR applications. If an AR application requires sound or voice as an input to the system, it is important to make sure that there are not extraneous sounds in the environment that might cover those signals.

Food waste can be defined as "…any food, and inedible parts of food, removed from the food supply chain to be recovered or disposed (including composted, crops ploughed in/not harvested, anaerobic digestion, bio-energy production, co-generation, incineration, disposal to sewer, landfill or discarded to sea) (Aschemann-Witzel, de Hooge, Amani, Bech-Larsen, & Oostindjer, 2015). Food waste are most usually refers to edible food products, which are proposed for the human consumption, but have instead been thrown away, lost, degraded or consumed by pests, and does not include the inedible or undesirable portions of foodstuffs. (Bond, M., Meacham, T., Bhunnoo, R. and Benton, 2013) Food waste includes any food items that were once edible and have been discarded to the landfill or composted rather than consumed (Schilt, 2014). There is no legal or universally accepted definition of "food waste". This means that different definitions and methodologies are often used when discussing, recording or reporting food waste. This results in varied estimates of food waste which cannot necessarily be directly compared with each other.

Wasted food can be categorized into three categories:

i. Avoidable: Food that can be easily prevented from going to waste. The reasons of waste include over preparation, inappropriate storage, or damage. Understanding the cause of waste is the key to preventing it. Example: An entire tray of food is left over every day at a buffet.

ii. Possibly avoidable: Food that may seem bad but can be used or repurposed. Example: Beet tops can be cooked similarly to spinach instead of discarded. Also, slightly stale bread can be used for croutons or bread crumbs.

iii. Unavoidable: Food that cannot be eaten by people and should be used for animal feed, fertilizer, or anaerobic digestion. Example: Fruits peels and pits.

The food supply chain includes five main stages: production, processing, distribution, food service and retail and consumption. Food waste in the food supply chain arises from over-production, over-purchasing,

inefficient and problematic technology, improper handling, storage, and transportation, as well as a general lack of coordination and communication between businesses in all of the stages (Schilt, K., 2014). Weather fluctuations as well as other factors can cause variations in consumer demand which processors, distributors, and retailers inadequately consider or communicate. The result is an excess supply of food that becomes wasted because the necessary supply adjustments are not made (Schilt, K., 2014).

Most people do not keep track of the amount of food they waste. WRAP had 300 people keep a diary of the food they wasted for one week and because they started to pay attention to how much they wasted, 2/3 of those people found they wasted more food than they originally thought.

During 2011, the global population exceeded seven billion people and is predicted to reach 9.3 billion by 2050. An increasing economic development allows people to consume more, leading to a probable increased food demand of 50-70% by mid-century. A significant part to play in increasing the availability of food in the future.is reducing global food waste. The challenge is to fulfil rising consumption demands through an environmentally, economically and socially sustainable approach that provides safe and healthy food for all. Growing food that is never eaten and ends up in the landfill contributes to an unnecessary usage of agricultural efforts, which, along with the emissions of methane and carbon dioxide gas from decomposing food, have major impacts on global climate change.

Wasted food is not only harmful to the environment but also charges consumers, businesses, and taxpayers substantial amounts of money. On the consumer level, an American family of four throws out an average $1,484 worth of edible food a year. It is estimated that all of the food wasted yearly costs $750 million per year in disposal fees and uses 4% of the total US oil consumption. Nationally, the cost associated with the disposal of food exceeds one billion dollars in local tax funds annually.

The social impact of food waste can relatively be explained using the concepts of food security and access to food. The definition of food security from the World Food Summit in 1996 is normally accepted today, which describes a situation where “all people, at all times, have physical, social, and economic access to sufficient, safe, and nutritious food to meet their dietary needs and food preferences for a healthy and active life.”

The daily energy amounts essential for the balanced nutrition of a person, is average about 2,700 kcal. Although the data concerning the supply shows that there is sufficient food to fulfil the global population’s energy requirements, there continues to be malnutrition in the world. These problems can be traced back to difficulties in access to the supply of food caused, for example, by the high levels of poverty or the presence of conflict in a particular country or region. There is indeed a strong correlation between areas with a high percentage of malnourished populations and areas with high percentages of extremely poor people, indicating how poverty can prohibit people from being either able to produce or buy enough food for adequate health. In societies where availability is abundant and access to food is guaranteed, we see the increase of food waste from overeating.

AR contributes to the improvement of the way information is delivered and received in the context of the Media and Publishing ecosystem.

2.3 Existing System

2.3.1 Anti-domestic Violence Campaign

In 2010, brand.david, a German agency, has launched an AR campaign for the "Frauennotruf Munchen", which is a local non-profit organization that against domestic violence.

Figure 2.1: "Frauennotruf Munchen" Campaign

Female victims typically live in two parallel worlds: while the print campaign suggests a perfect world, the augmented reality leads us into the terrible abyss of the women's fate. The objective of this campaign is to bring the topic of domestic violence to light and to decrease victim-hostile prejudices. The campaign is a good example of how augmented reality in combination with the precise idea can make a valuable contribution to social.

2.3.2 Virtual Blood Donation Campaign

In May 2016, NHS Blood and Transplant is using augmented reality in out-of-home ads that allow the public to give virtual blood donations via an iPhone. The campaign, “Virtual blood donation” created by 23red, was a winner in the annual competition run by Ocean Outdoor and Campaign, which rewards the most creative ideas that can then be brought to life on Ocean’s out-of-home digital screens. The campaign is running at Westfield in west London and in Birmingham New Street, backed by experiential and social activity.

Figure 2.2: “Virtual blood donation” Campaign

Ian Trenholm, the chief executive of NHS Blood and Transplant, said: "We need to find new ways to show people the importance of blood donation." The virtual experience gives an insight into the personal reward and satisfaction loyal donors feel when they give blood and know they are saving lives. Each unit of blood donated can benefit up to three people which save or improve their lives.

This campaign has received over 77000 online views and there is 583 new donors signed up across the 5 days.

2.3.3 Recycling Campaign

In August 2016, The Canadian Beverage Container Recycling Association (CBCRA) has launched a mobile application to make recycling rewarding and more enjoyable. The app, called Recycling Starts Here, is an augmented-reality application with which users have a chance to win prizes during a month long contest, aimed to get people out and about to take pride in recycling.

Figure 2.3: "Recycling Starts Here" Campaign

2.3.4 Comparison of Existing System

Table 2.1: Comparison between Existing System

Topic	Frauennotruf Munchen	Virtual blood donation	Recycling Starts Here
Aim	To call attention to domestic violence against women and girls	To highlight the life-saving power of blood donation Encourage people who have never given blood before to register to donate blood for the first time.	To make recycling rewarding and more enjoyable. To curb poor recycling behaviours
Award	No	Winning idea for the Ocean Outdoor new technology competition	No
Device	Smartphone/Tablet (IOS, Android)	- Digital big screen - Smartphone(iPhone only)	Smartphone/Tablet (IOS, Android)
Marker	Poster in magazine	Sticker	Sticker on Blue recycle bin
Interaction	Normal	Very interactive	Interactive
Type of visualisation	2D	2D	2D

Table 2.1 shows that the comparison of three existing approaches. Three of the existing systems provide interaction to public. The augmented reality applications successfully grab public's attention engage with them.

However, the Frauennotruf Munchen campaign only can be found in the magazine which provides a lower chance to be discovered by public compared to another two campaign which Virtual blood donation and Recycling Starts Here campaign are outdoor campaigns that open to public.

Virtual Blood Donation is very successful in interaction and conveying message. It brought surprises when people try to see the result through the big screen in the public place. The campaign is successful although it only held in few days. However, it is more expensive compared to the other two campaigns as it requires a big digital screen.

Recycling Starts Here is an outdoor activity that allowed people to explore the augmented reality application. This campaign does not require only mobile device to experience the augmented reality. It is cheaper compared to Virtual Blood Donation campaign. Besides, it also encourages people to walk around to find the recycle bin.

2.4 Project Methodology

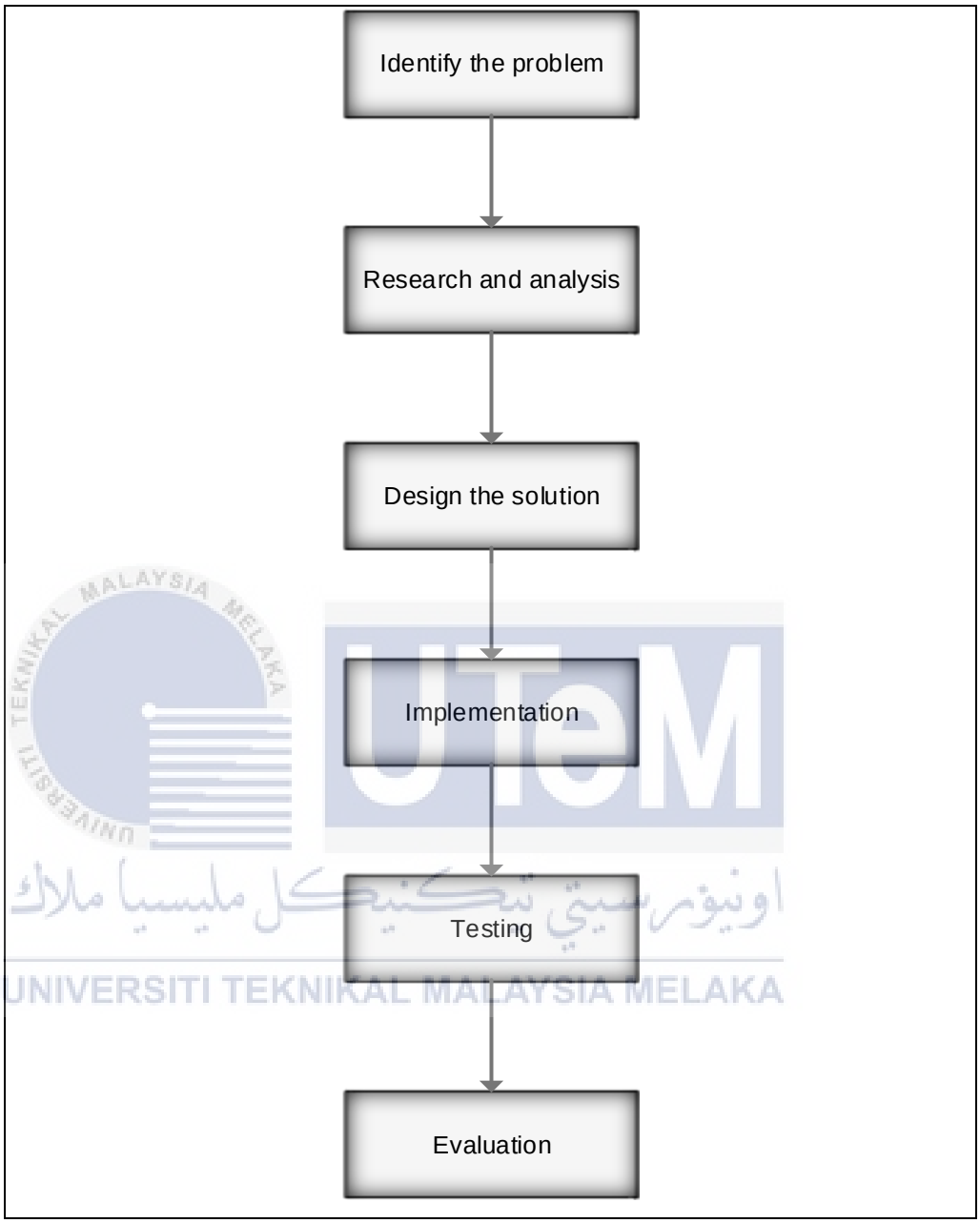


Figure 2.4: Project Development Methodology (UTeM, 2015)

This project development methodology is referred to the chapter guideline from *Buku Panduan Penulisan PSM*. Basically, it is divided into six phases, which are identifying the problem, research and analysis, design the solution, implementation, testing and evaluation.

First, identify the problems and define the objectives and scope of project. Then, understand how to reduce the problem using the tools that been chosen.

During the research and analysis phase, research in literature review has to be carried out. Since understanding the problem domain is critical, hence a lot of data researches and knowledge need to be analysed and done. By studying different AR application, it is possible to get a feel for, and even to predict to a certain degree, what types of hardware, software, interaction mechanisms, and so on will be most suitable for a new application.

After that, defines the results of the analysis of the preliminary design and the result of the detailed design. The rough idea about the AR content is draft in interactive storyboard which also includes the character and the target images.

Based on the design, develop the application with the best solution. Alpha testing is carried out to potential testers such as “friends and family” to discover the issues. Observe the testers and note problems. Most identified critical issues are fixed; some features may change or be added because of early feedback.

During the testing phase, the effectiveness of this application is tested in the “real world” with “real users” by collect the data or feedback.

Last, evaluate the data obtained from testing stage and make conclusion and recommendations

2.5 Project Requirement

2.3.1 Software Requirement

i. ENTiTi Creator
ii. ENTiTi Mobile Application
iii. Autodesk Maya 2016
iv. Autodesk FBX Review
v. Adobe Illustrator CS6
vi. Adobe Photoshop CS6
vii. Adobe After Effect CS6
viii. Audacity
ix. Microsoft Word
x. Microsoft Power Point 2010

2.3.2 Hardware Requirement

i. Laptop / Desktop
ii. Mobile Device
iii. Mobile Device
iv. Printer/Scanner

2.6 Conclusion

In this chapter, literature review, existing system and methodology is done. A deeper knowledge about augmented reality will help to develop a better solution for the food waste issue.

Next chapter will discuss about the present scenario and project requirement analysis. Action plan will be explained to from the start until the end of the project according to the project schedule and milestones.

CHAPTER III

ANALYSIS

3.1 Current Scenario Analysis

In cooperation with Augmented Reality (AR) specialist Metaio, the campaign “"Frauennotruf Munchen e.V", have been enriched with multimedia content that can be discovered by anyone using a smartphone. It requires smartphone to download the app and scan the woman’s photo in the magazine. After scanning the target image, there is a video showing that the woman being beaten and the hotline for help.

Figure 3.1 Photo of “Frauennotruf Munchen" Campaign on Magazine

Figure 3.2: Photo of "Frauennotruf Munchen" Campaign on Magazine

"Virtual blood donation" utilise an AR app that is connected to an image of a sick patient and an empty blood bag on a large format digital screen. Visual recognition detects the sticker on a participant's arm which then overlays an AR needle, plaster and tube onto their arm. This then triggers the blood bag to fill and the sick patient to be transformed to looking well. Finally, a thank you to the named donor appears on screen. The patients featured in the ads have had their lives saved because of blood donations.

Figure 3.3: Photo of "Virtual Blood Donation" Campaign

"The Recycling Starts Here contest app is part of our mission to find new and interesting ways to encourage Manitobans of all ages to recycle all

their empty beverage containers," Director of the CBCRA Ken Friesen said in a news release. This app's strategy to help meet that goal is to make recycling exciting. Scanning away, users have to find the four branded bins in order to get a chance at winning the grand prize. Then, for tagging other unmarked recycling bins through the app, users can also nab instant prizes.

Figure 3.4: Photo of "Recycling Starts Here" Campaign

3.2 Requirement analysis

This sub-chapter will discuss about the project requirement, software and hardware requirement and other requirement that need to develop this campaign.

3.2.1 Project Requirement

The project functionality is to interactively bring out the message of how to avoid food waste. User can interact with the augmented reality by touching the screen of mobile device such as smart phone, tablet. Touching the virtual object through the screen, the system will direct user to a website. Therefore, user can get more information about how to reduce food waste.

This project is presented using different types of content format such as picture, animation, sound, text and interactive content. All the media creation is original or online free resources. Technology of augmented reality is set up using ENTiTi Creator, a cloud-based platform application to create virtual and augmented reality. ENTiTi Creator is used to set up the environment and the multimedia interaction. Augmented reality technology help to improve the user experience.

3.2.2 Software Requirement

3.2.2.1 Development Software

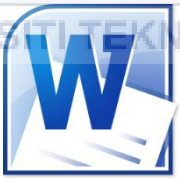
Table 3.1: Development Software Requirement

ENTiTi Creator 	To create interactive augmented reality
ENTiTi Mobile Application 	To access the augmented reality
Autodesk Maya 2016 	To create 3D object and 3D animation
Autodesk FBX Review 	To review 3D assets and animation
Adobe Illustrator CS6 	To design the graphics for animation and the target images

Adobe Photoshop CS6 	To edit the images
Adobe After Effect CS6 	To create motion graphic animation
Audacity 	To edit the audio clip

3.2.2.2 Management Software

Table 3.2: Management Software Requirement

Microsoft Word 2010 	To create or edit document
Microsoft Power Point 2010 	To create or edit document

3.2.3 Hardware Requirement

Table 3.3: Hardware Requirement

Laptop 	To install and operate the software that required for project development.
Mouse 	To help in controlling computer action To help in 3D object animation modelling and graphic production
Mobile Device 	To install ENTiTi Mobile Application To access and view the augmented reality through camera
Printer/Scanner 	To print the documents To print the target images

3.3 Project Schedule and Milestones

Figure 3.5 shows the overall flow of the project. During the 15 weeks, the problem identify phase until development phase is carried out. First, the problem is identified. The appropriate solution is designed to reduce the food waste problem effectively. A lot of studies will be carried out to improve the knowledge and broaden the view. Therefore, there is an optimal capital to expertise for advertisement aspect. Then, the project is designed and developed.

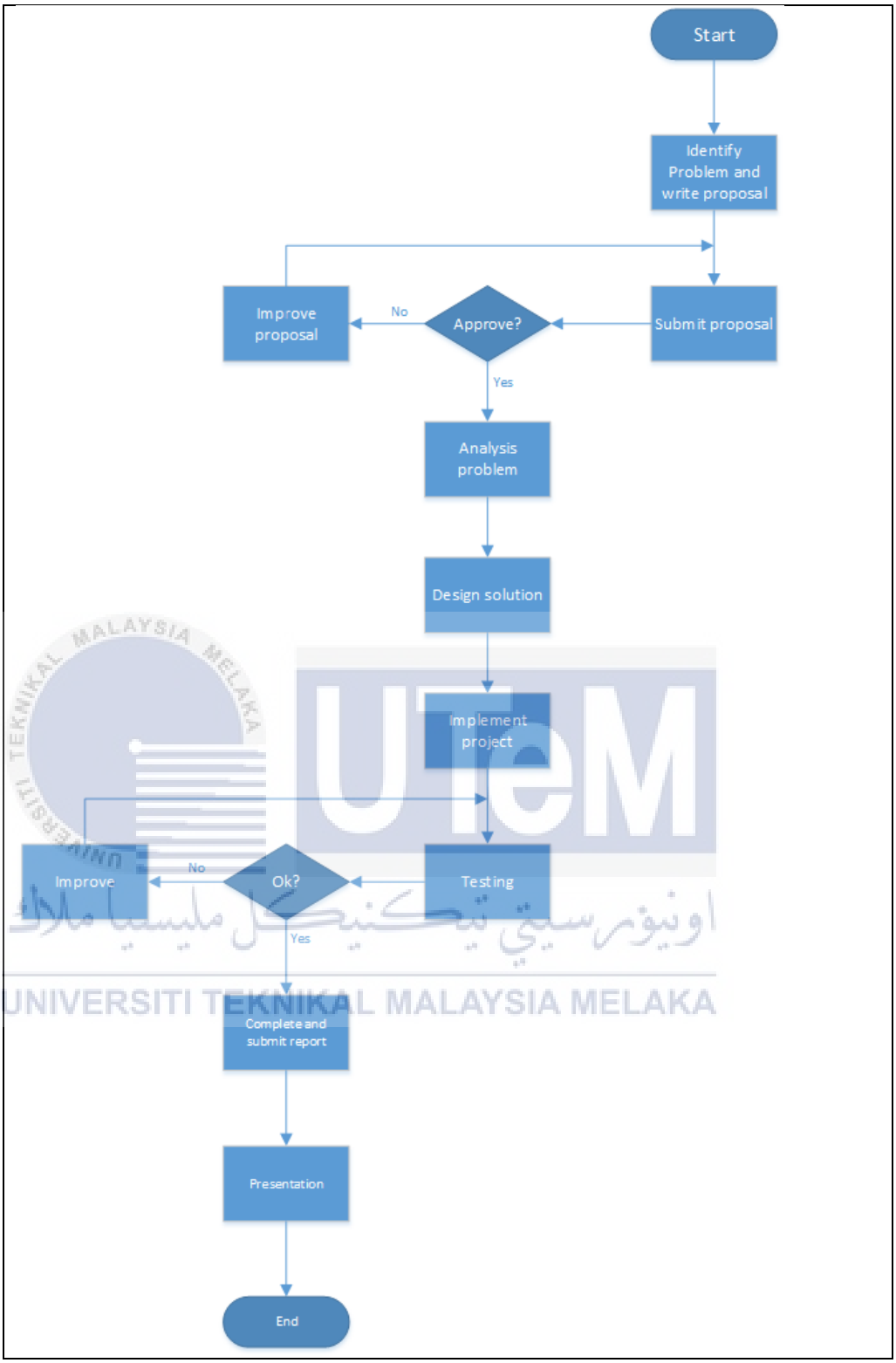


Figure 3.5: Flow chart of Project Activity

Table 3.4 Gantt Chart for Project Development

No	Task	Week														
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	Revise project plan and finalize proposal.															
2	Analysis of problem															
3	Complete literature review															
4	Design of solution															
5	Project implementation															
6	Project testing and improving															
7	Submission of final report															
8	Presentation &Showcase															

3.4 Conclusion

In this chapter, the analysis of current scenario and project requirement which include software and hardware requirement are completed. Project schedule and milestones are project guideline which discusses about the activity stages in this project. Project management is very important.

Next chapter will discuss about the design of the application such as system architecture and preliminary design.

CHAPTER IV

DESIGN

4.1 Introduction

This chapter will goes into the design phase. The design process that involved in this project will be explained which is system architecture, preliminary design and user interface. The idea is transform to rough sketching before development. It gives a clear image for development phase.

4.2 System Architecture

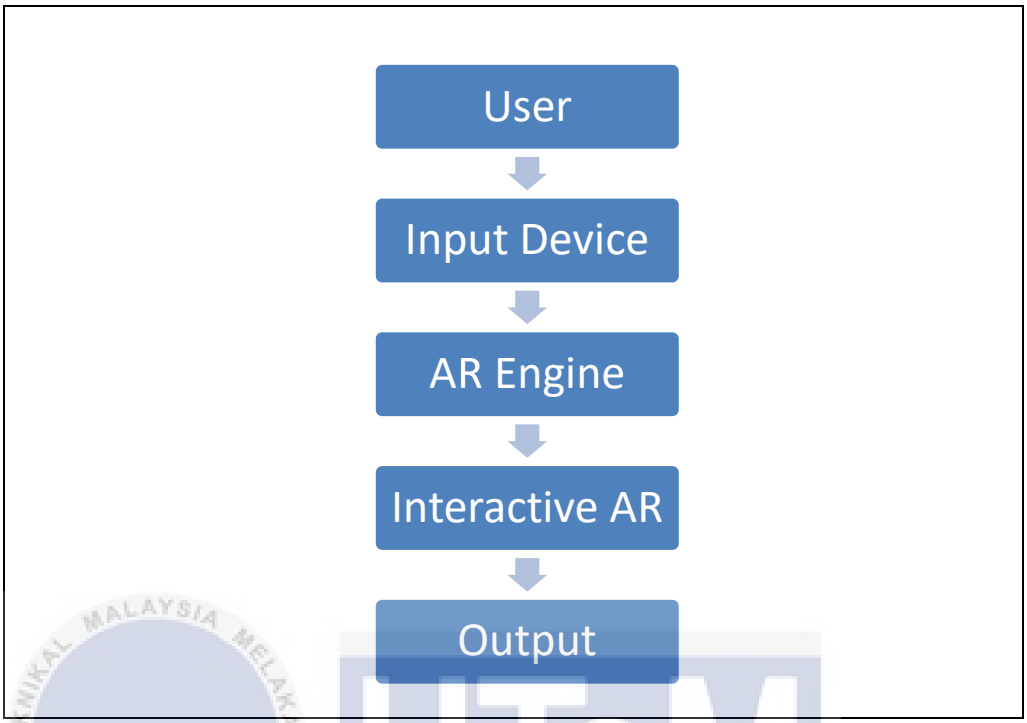


Figure 4.1 Flow of System Architecture

When user scan to the target image, the AR content will be display in the mobile device (input device) through the camera. User can interact with the content through the screen. ENTiTi Creator (AR engine), that operate the interactive control by logic. The application consists of many functions that can step by step set and restrict the activities function such as on start, play video. Therefore, people are able to interact with the content without flow error. The output is display on the screen through the camera.

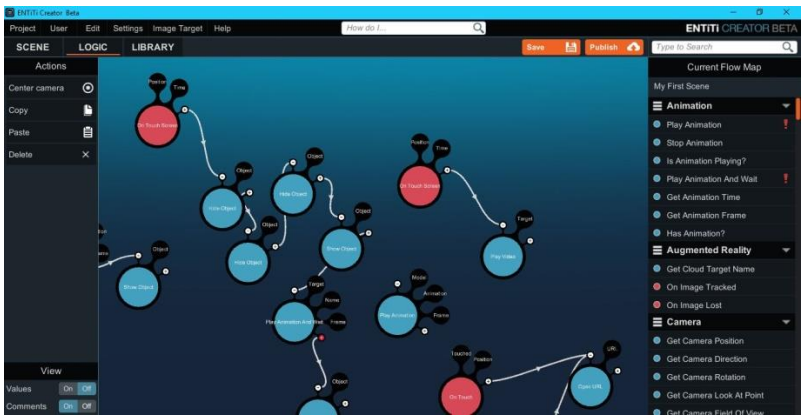


Figure 4.2 Screenshot of Logic in ENTiTi Creator

4.3 Preliminary Design

4.4.1 Interactive Storyboard

Table 4.1: Interactive storyboard of first content

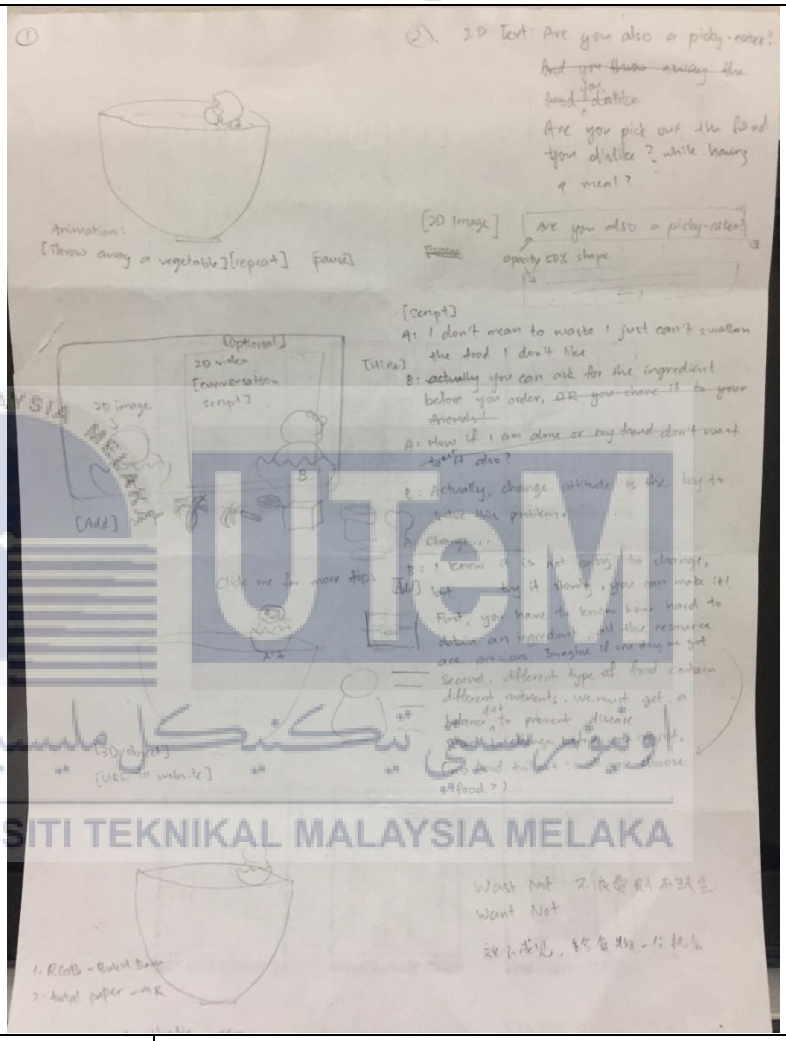
FoodARmour_Tomato	
	
Media Type:	3D animation
Frame:	650
Script:	*You can ask for ingredients before ordering.* *Actually, changing attitude is the key solution.* *First, we need a balance diet to prevent diseases.* *Second, every ingredient has not come easily, produce, process, serve, every resource is precious.* *Imagine that, if you have no food to eat, will you choose it?* *Start to change before regret!*
Sound:	Create using online free resource (http://www.fromtexttospeech.com/)
Action:	Click the character to go to website

Table 4.2: Interactive storyboard of second content

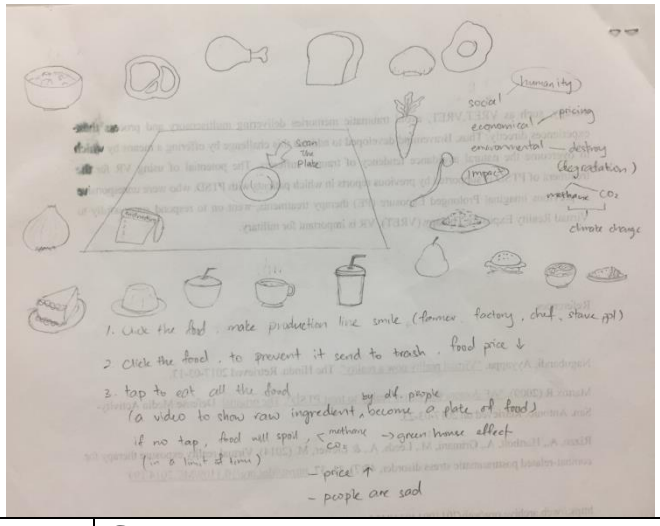
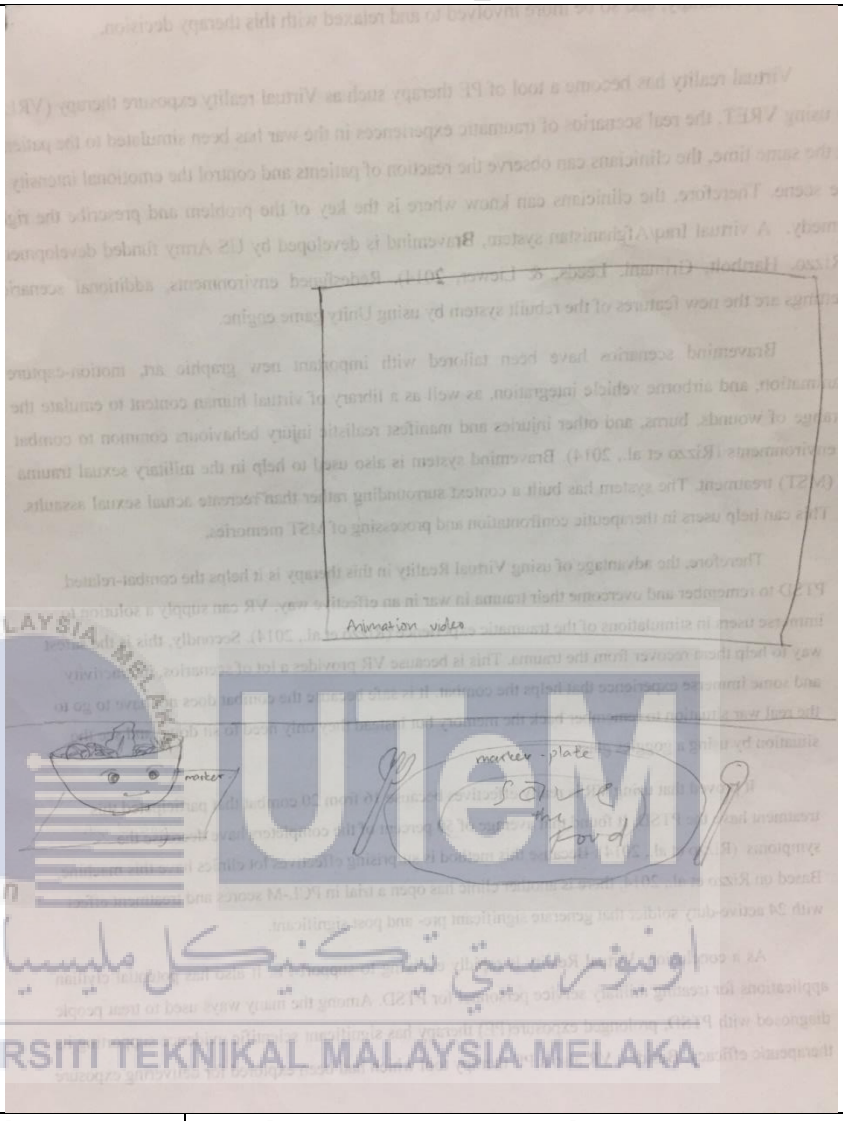
FoodARmour_Carrot	
	
Media Type:	Game
Genre:	Simple casual game
Button:	Start button Website button
Action:	Tap the food within the limited time, the tips for how to reduce food waste will display in 2D image. If user did not finish the task in the limited time, the game over and the message of "Eat food before it spoil" will display. If user finishes the task, praising message will display "Well done, you save the food. We should eat food before it spoils". Click the button to go website.

Table 4.3: Interactive storyboard of third content

FoodARmour_Fish	
	
Media Type:	3D Character + Motion Graphic
Length:	00:00:24
Script:	*Food nourishing life.* *However, human waste 1.3 billion tonnes of food in 2016.* *If the statistic keep increasing, food price will also increase* *People are suffered in starvation and malnutrition!* *The emission of methane gas is leading to global warming!* *You can stop it by now!*
Sound:	Shella Sarah Daud
Action:	Click the character to go to website

4.3.1.1 Character Profile

Table 4.4 and Table 4.5 showing the sketching of character and the stickers that will be used as target images. Chicken is chosen as the character because it is easy to model and animate.

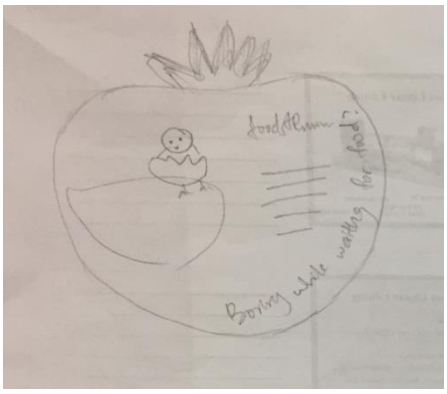
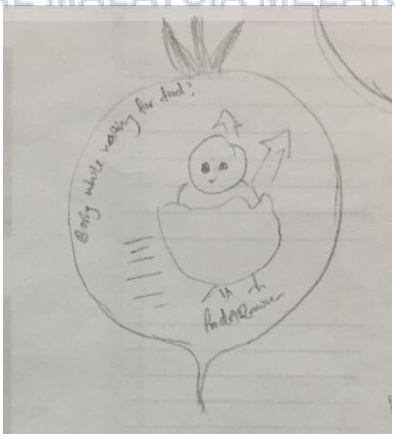
Based on the research by Food and Agriculture Organization, roots and tubers as well as vegetables and fruits have the highest wastage rate which is approximately 40-50%. Then the second highest wastage is fish, then cereals and then oil seeds, meat and dairy which are 35%, 30% and 20% respectively. Therefore, the sticker shape chosen is tomato (fruits or vegetable), carrot (root crops) and fish.

Table 4.4: Sketching of character

Character	**Character Description**
	Name: Chika Age: 7 days Gender: Female Physical Attitude: Born to protect food (Food Amour Hero)

4.3.1.2 Sticker Layout

Table 4.5: Sketching of stickers layout

Sticker
Sticker: Tomato 
Sticker: Fish 
Sticker: Root Vegetable (Carot) 

4.4 User Interface Design

4.4.1 Navigation Design

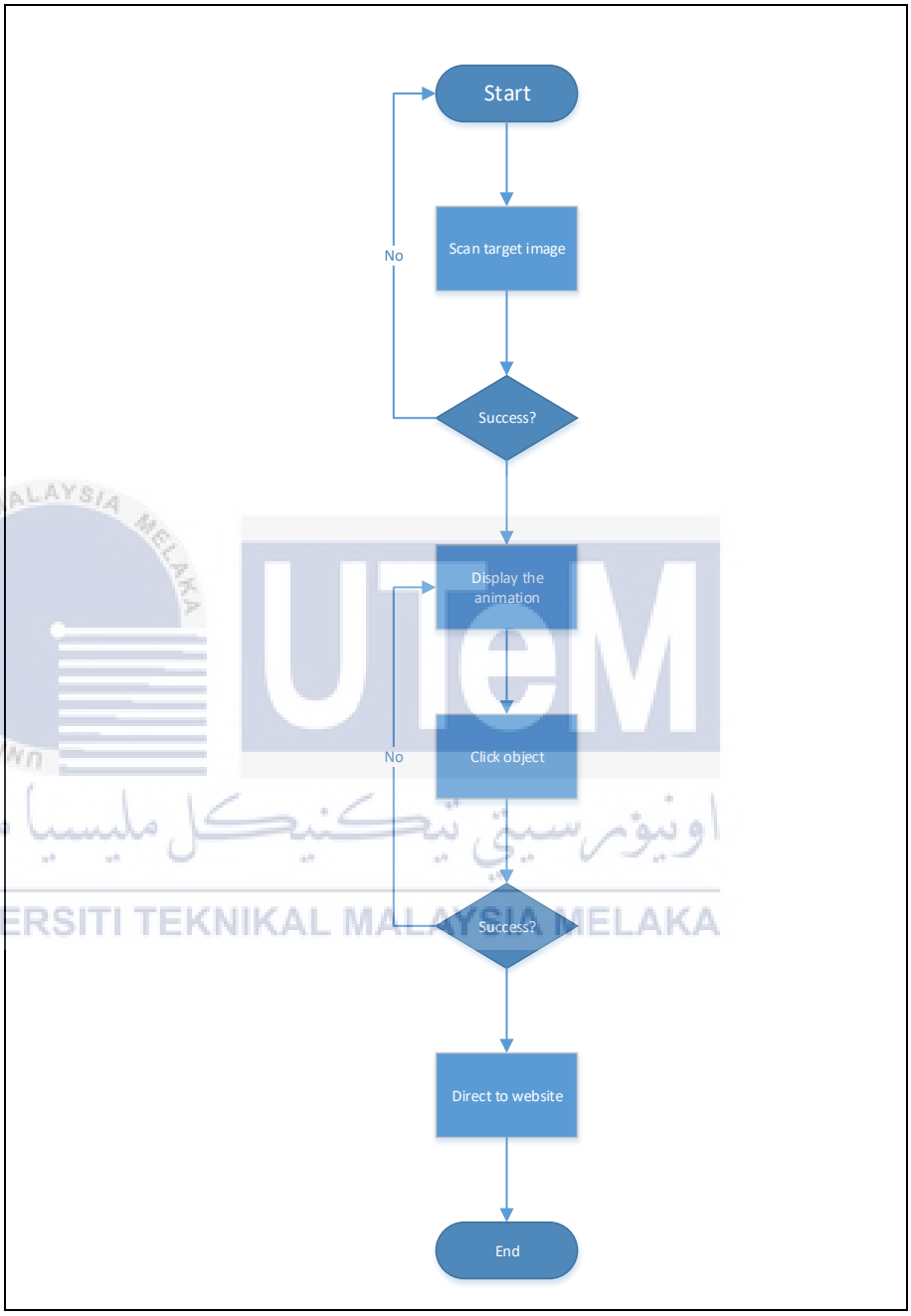


Figure 4.3 Navigation Flow

Navigation flow shows that the flow of how user interact with the augmented reality. Developers should consider the probability of error while user using the application. Therefore, the navigation design should be planned and designed well.

4.4.2 Input Design

Table 4.6: Input Design

Input Design	Function
Mobile device / Camera	To scan the target image, then user are able to experience the contents
Screen	Touch the screen to continue to next activity
3D object	Touch the object for more tips (picture)
3D object	Touch the object to go a certain website (url)

4.4.3 Output Design

Table 4.7: Output Design

Output Design	Function
Screen	Display the content including 3D animation, image, website

4.4.4 Metaphor

The sticker is design using the dynamic graphic design technique. Dynamic composition uses many diagonal lines. Diagonals are somewhat unsettling, which results in a sense of movement, energy, excitement that generates from a dynamic composition.

Complementary color scheme is applied in the sticker design. Complementary colors have opposite hues. When mixed together equally they create a neutral color (gray, black or white). They are best used for creating contrast which adds vibrancy, energy and visibility to a design.

The principle of animation is applied to the 3D animation in the content. For example, anticipating, staging, secondary action and appeal, these principles are to make the action or the animation more

real and interesting. The animation is also applied to the motion graphic video to create real-world motion graphic elements.

4.5 Conclusion

In this chapter, the design phase is discussed. The general workflow of augmented reality interaction is depicted in the system architecture and the content is covered in preliminary design and user interface design.

Next, the development chapter is going to discuss about how to generate the media creation and develop the augmented reality interaction.

CHAPTER V

IMPLEMENTATION

5.1 Introduction

This chapter is discussing the implementation process which explains how the media is created and integrated. Besides, the product configuration management and implementation status will be included in this chapter.

5.2 Media Creation

Media creation is discussing about how the multimedia elements such as texts, graphics, video and animation are created.

5.2.1. Production of Texts

Text is one of the important multimedia elements to convey message or information. Therefore, the decision for type of font is important. Serif and San-serif fonts were used in the different part of the design; for the part that mainly to bring out the message, san-serif fonts were chosen while for the part that need for attraction, serif fonts

were chosen. The typefaces were downloaded from a website called Dafont (www.dafont.com) and created in Adobe Illustrator. A curve was drawn using Pen Tool then the curved text was produced using Type on a Path Tool. Figure 5.3 shows the tomato shape sticker and Table 5.1shows the production of text in tomato shape sticker.

Figure 5.1: Tomato Sticker

Table 5.1: Production of Text in Tomato Sticker

Text	Font	Font Type	Colour	Font Size
Boring while waiting? 	Champion Shipmate	Italic	Red C-0 M-90 Y-85 K-0	83.58pt
Find out more in Augmented Reality 	Biko	Regular	Yellow C-0 M-2 Y-80 K-0	15.67pt
(Instruction) 	Biko	Regular	Yellow C-0 M-2 Y-80 K-0	26.12pt

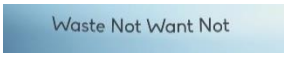
FoodARmour 	Acryle Script	Regular	Yellow C-0 M-0 Y-0 K-20	58.52pt
Waste Not Want Not 	Biko	Regular	Grey C-0 M-0 Y-0 K-90	12.83pt

Figure 5.3 shows the fish shape sticker and Table 5.2 shows the production of text in the fish shape sticker.

Figure 5.2: Fish Sticker

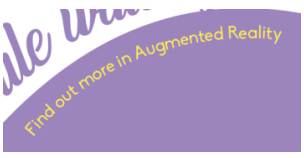
Table 5.2: Production of Text in Fish Sticker

Text	Font	Font Type	Colour	Font Size
Boring while waiting? 	Champion Shipmate	Italic	Green C-79.08 M-4.56 Y-65.26 K-0	94.51pt
Find out more in Augmented Reality 	Biko	Regular	Yellow C-0 M-2 Y-80 K-0	19.69pt
(Instruction) 	Biko	Regular	Blue C-57 M-31 Y-0 K-22	23.14pt
FoodARmour 	Acryle Script	Regular	Yellow C-0 M-0 Y-0 K-20	59.09pt
Waste Not Want Not 	Myriad Pro	Regular	Black C-0 M-0 Y-0 K-100	12pt

Figure 5.3 shows the carrot shape sticker and Table 5.3 shows the production of text in the carrot shape sticker.

Figure 5.3: Carrot Sticker

Table 5.2: Production of Text in Carrot Sticker

Text	Font	Font Type	Colour	Font Size
Boring while waiting? 	Champion Shipmate	Italic	Purple C-40.65 M-50.81 Y-0 K-0	81.6pt
Find out more in Augmented Reality 	Biko	Regular	Yellow C-0 M-0 Y-0 K-20	14.07 pt

(Instruction) 	Biko	Regular	Yellow C-0 M-0 Y-0 K-20	23.45 pt
FoodARmour 	Acryle Script	Regular	Yellow C-0 M-0 Y-0 K-20	48.81 pt
Waste Not Want Not 	Myriad Pro	Regular	Black C-0 M-0 Y-0 K-100	8.44pt

Figure 5.4 shows the design in the AR content and Table 5.4 shows the production of text in the AR content.

Figure 5.4: Newspaper Design in AR Content

Table 5.4: Production of Text in Newspaper Design

Text	Font	Font Type	Colour	Font Size
① FoodARmour	Old London Alternate	Regular	Black	80pt
② Vol CL No 134 BREAKING NEWS Wednesday May 24, 2017	Georgia	Regular	Black	17pt
③ WASTE NOT WANT NOT	Bebas Neue	Regular	Black	92pt
④ FOOD WASTE SHOULD NOT HAPPEN ANYMORE IN THIS WORLD	Bebas Neue	Regular	Black	42pt
⑤	Californian FB	Regular	Black	14pt

Figure 5.5 shows the GUI design in the AR content and Table 5.5 shows the production of text in the GUI design content.

Figure 5.5: GUI design in AR Content

Table 5.5: Production of Text in GUI design

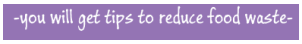
Text	Font	Font Type	Colour	Font Size
FoodARmour 	Buxton Sketch	Regular	White	106pt
[Tap all the food] 	Buxton Sketch	Regular	White	48pt
-you will get tips to reduce food waste- 	Buxton Sketch	Regular	White	26pt
Start 	Buxton Sketch	Regular	Black	50pt

Figure 5.6 shows the GUI design in the AR content and Table 5.6 shows the production of text in the GUI design content. There was 6 GUI for the tips information, each of the GUI was using the same font and font type, only the font size is different.

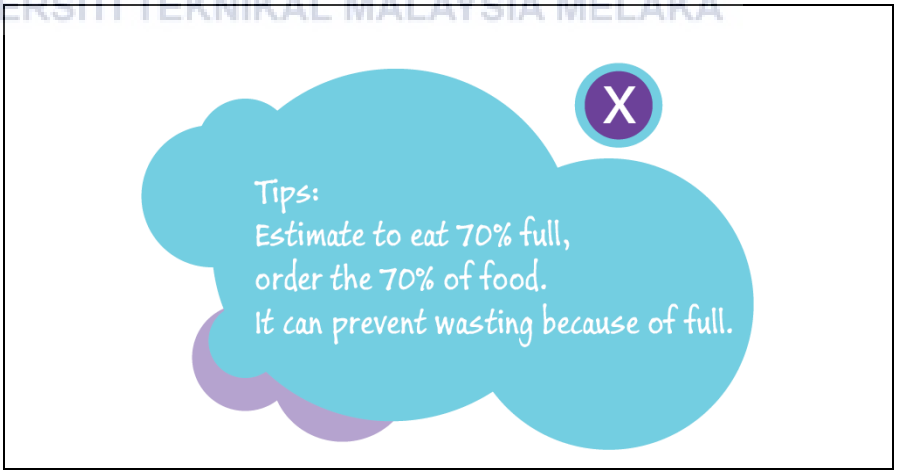


Figure 5.6: GUI design in AR Content

Table 5.6: Production of Text in GUI Design

Text	Font	Font Type	Colour	Font Size
[Tips] 	Buxton Sketch	Regular	White	41.52 pt

5.2.2. Production of Graphics

The stickers combine 2D and 3D graphic. The 2D graphics were produced using Adobe Illustrator and 3D graphics were produced using Autodesk Maya. 2D graphics, a vector images which were traced by tracing tools and the shapes in Adobe Illustrator. Figure 5.7 and Figure 5.8 show the 2D graphic produced by tracing tool. Figure 5.9 is the 2D graphic produced using the shape of rectangle and circle.

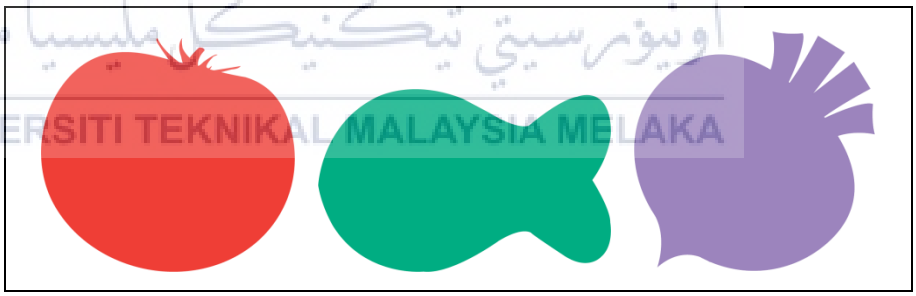


Figure 5.7: 2D Vegetable Shape of Stickers

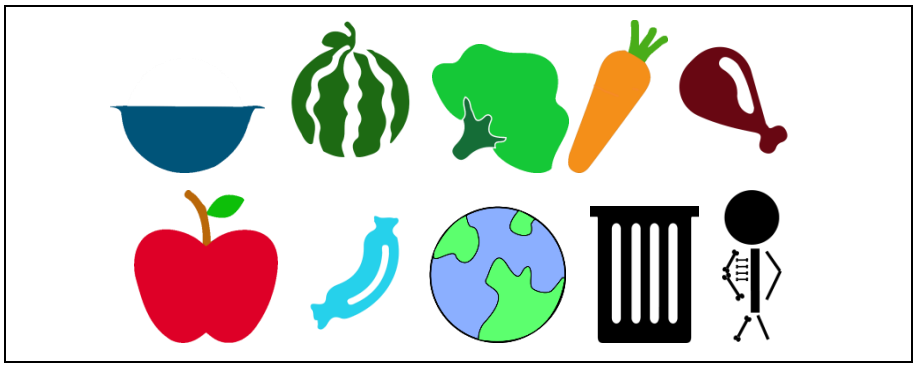


Figure 5.8: 2D Vegetable graphic in AR content

Figure 5.9: 2D GUI in AR content

3D graphic was produced by modifying primitive shape and adding texture or colour to it. Figure 5.10 shows that the 3D character design that added shadow using Brush Tools in Adobe Photoshop. Figure 5.11 shows the 3D graphic design in AR content.

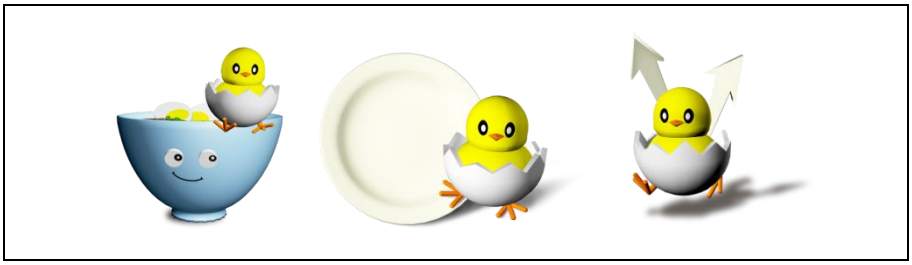


Figure 5.10: 3D Character Design in Stickers and AR Content

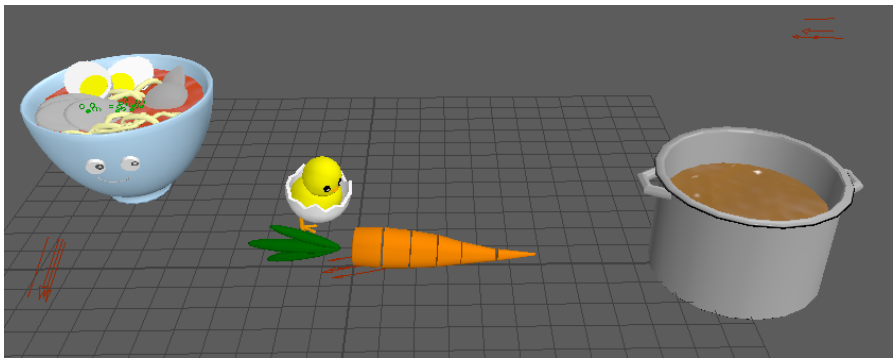


Figure 5.11: 3D Graphic Design AR Content

5.2.3. Production of Audio

There was two ways to generate audio source (narrator voice). One of the audio was recorded using smart phone by a friend and transfer to laptop. Another audio was converted through text to speech service from a website (fromtexttospeech.com). The audio clip was exported into mp3 format.

5.2.4. Production of Animation

There was 2D animation and 3D animation in different content. The 2D animation (Motion Graphic) was mainly to bring out the consequences of food waste. The effects were applied to the graphic. To make sure the animation is smooth and attractive; the motion was adjusted according to the tempo of narrator. Figure 5.12 shows the production of motion graphic using Adobe After Effect.

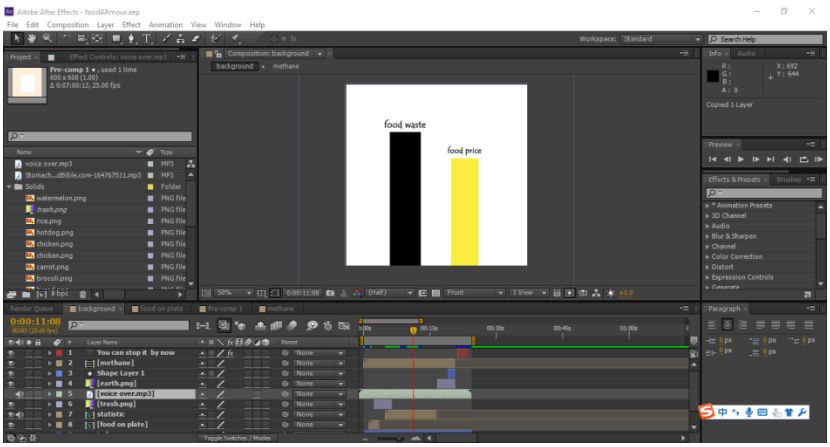


Figure 5.12: Production of Motion Graphic

The 3D animation was produced using Autodesk Maya. By setting key to the timeline, every position or posts was adjusted according to the speed of the voiceover, the animation was produced. Figure 5.13 shows the production of 3D animation in Autodesk Maya.

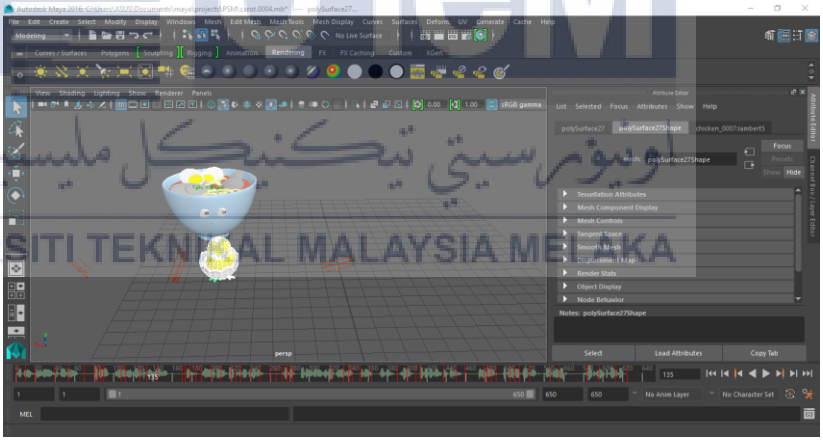


Figure 5.13: Production of 3D Animation

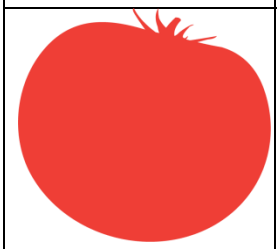
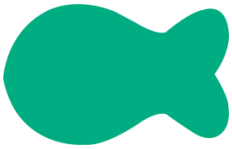
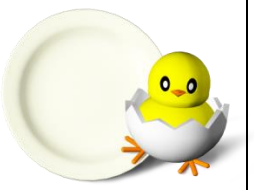
5.3 Media Integration

5.3.1. Sticker

The 3D character design was added to the 2D graphics (vegetable shape). The position was adjusted irregularly to bring out 3D visual effect; therefore it was distinct and attracts people. The text was arranged on the empty space in the sticker. Complementary colour scheme was applied to 2D graphic and text. Figure 5.14 and Table 5.7 are showing the integration of sticker.

Figure 5.14: Integration of Sticker

Table 5.7: Sticker Integration

2D Graphic	3D graphic	Text
		
		
		

5.3.2. Content

All the created media elements were combined in EnTiTi Creator. The AR content was controlled by adding the logic to the element in EnTiTi Creator. The final AR content was published to the EnTiTi cloud, user can view it through the EnTiTi mobile application. Figure 5.15 shows the process of media integration and Figure 5.16 shows the creation of logic in EnTiTi Creator.

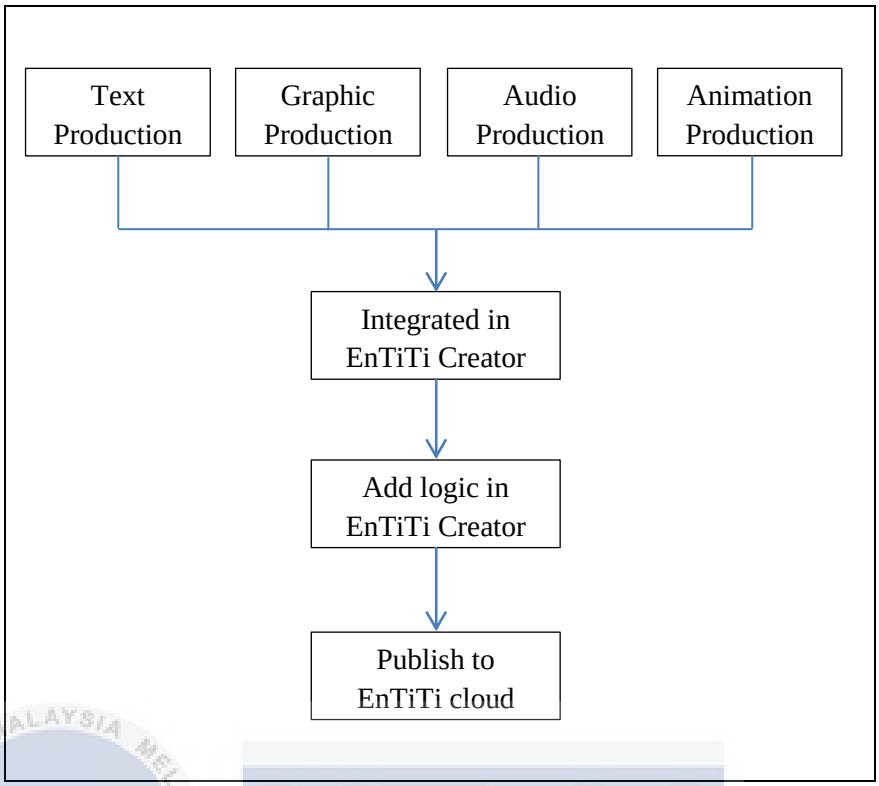


Figure 5.15: Process of Media Integration

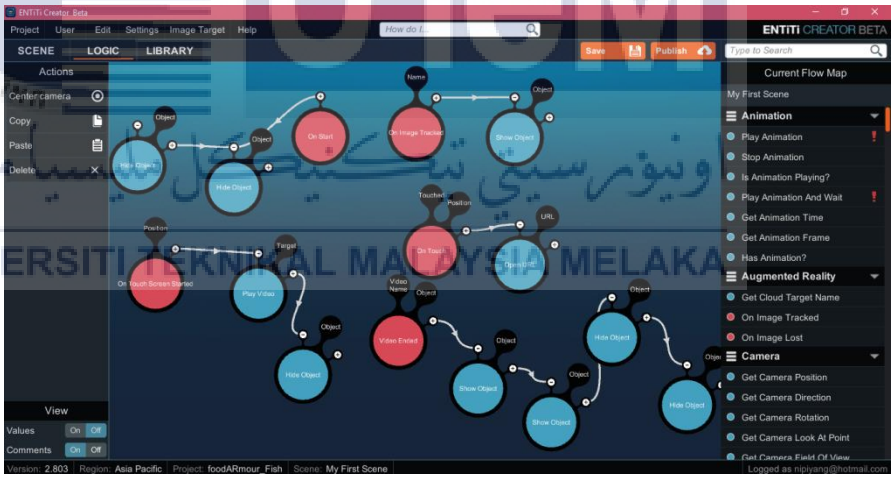


Figure 5.16: The Creation of Logic in EnTiTi Creator

5.4 Product Configuration Management

Produce configuration management will discuss about how the configuration environment is designed and setup.

5.4.1. Configuration Environment Setup

Setting up an appropriate environment is very important for this project to launch smoothly. General Setting is a setting before a project start, it is important to get a right product. If there is any setting error, it can slow down the progress since it needs to be adjusted back to proper setting. Render setting and export setting are to make sure the quality is good for presenting or printing. Table 5.8 shows the configuration environment setup for this project.

Table 5.8: Configuration Environment Setup

Software	Configuration
Adobe After Effect	General Setting Size: 600 x 600 px Frame Rate: 25fps Resolution: Full Render Setting Quality: Best Format: AVI
Adobe Illustrator	General Setting Size: A3 (4961 x 3508 pixels) Colour Model: CMYK Export Setting File Format: JPEG Colour Model: CMYK Quality: 12 Resolution: High (300 dpi)
Adobe Photoshop	Export Setting File Format: PNG Compression: Smallest / Slow Interlace: None
Autodesk Maya	Export Setting Video format: FBX (.fbx) Render Setting Image format: PSD (.psd)

5.5 Implementation Status

Implementation status will discuss about the development of each progress of component. Table 5.9 shows the schedule of implementation status of this project.

Table 5.9: Schedule of Implementation Status

Component	Description	Duration to complete	Status
Design	Design each of the content, including the storyboard, character design and sticker design.	2 weeks	On time
Tracing	Trace all the 2D vector images needed for sticker and content in Adobe Illustrator.	3 days	On time
Modelling	Model the character in different post for the use of sticker by using Autodesk Maya.	3 days	On time
Audio recording	Record the voiceover.	1 days	On time
Animating	Make 2D and 3D animation, including the addition of audio part.	3 weeks	On time
Integrating	Integrate all the multimedia elements to EnTiTi Creator and set the logic.	2 week	Delay

5.6 Conclusion

This chapter discussed about the details of implementation phase. This chapter includes the process to create the multimedia elements and the integration of each element to become a complete product. It also describes the setup configuration and the implementation status. Product testing and data analysing will be discussed in the next chapter.

CHAPTER VI

TESTING

6.1. Introduction

In this chapter, the testing phase will be discussed. Test plan, test strategy, test implementation, test result and analysis of data will be covered in this chapter.

6.2. Test Plan

There are three methods of testing which are questionnaire, observation and interview. At the beginning of testing, a short introduction about this campaign, how the testing will be carried out and the privacy issues (the whole process will be recorded, only for the purpose this project) will be introduced to candidates. Then, candidates will start to experience the campaign using the prepared phone. At the same time, observation will be carried out. After that, candidates will be given questionnaire. Some of the candidates will be chosen to carry through interview.

For the testing by multimedia expert, the testing session will be carried out in two ways: online interview or a Face-to-Face meeting. First, a short introduction will be explained to multimedia expert. After

experiencing the campaign, an interview session will be carried out to get the feedback and suggestions.

6.2.1. Test User

There are total of 20 people respondents and 1 expert will be involved in this testing. Among the 20 respondent, 5 people will be chosen as observation respondent and 2 people will be chosen as interview respondent. Expert will only involve in interview section. The question of observation will not be answer by respondents; it is only guidance for inspector. Same interview question will be distributed to respondents as well as expert.

The testing section will involve two categories of target user:

i. Customers in restaurant who are in the 12-25 years age group and acquainted with mobile device.
ii. Expert who have experience around 5 years in UX/UI area or in multimedia area.

6.2.2. Test Environment

The testing section will be conducted in restaurants. The questionnaire will be distributed in a restaurant, to the target user in the 12-25 years age group. A phone will be set up before testing. Candidates will use the phone to carry out testing section so that candidates no need to spend time for application installation and project download.

For multimedia expert, he or she has to set up the environment by themselves following the given instruction.

6.2.3. Test Schedule

The testing is planned before carried out the testing section. Each of the respondents will consume 30 minutes. There is much time consumed, therefore the testing for target user is separate to two days, in two different restaurants. Table 6.1 shows the test schedule for multimedia expert while Table 6.2 shows the test schedule for target user.

Table 6.1： Test Schedule for Multimedia Expert

Section	Duration
Interview	30 minutes
Notes: Number of respondents: 1 Date:14th August 2018 Method: Online Interview	

Table 6.2 Test Schedule for Target User

Section	Duration
Questionnaire	20 minutes
Observation	20 minutes
Interview	10 minutes
Notes: Number of respondents: 20 Date: 12nd – 13rd August 2018 Venue: i. Kedai Makanan & Minuman Jaya Corner ii. The Windmill Station	

6.3. Test Strategy

There are three methods for effectiveness testing being carried out which are questionnaire, observation and interview. The test strategy for questionnaire is separated into two parts; demography and effectiveness testing. When the survey is start, observation is conducted at the same time. Observation is to observe user's behaviour and the interaction with this campaign. The interview is a structured interview; the purpose is to explore the information from respondent.

The questionnaire is using linear scale to lead user to indicate how strong they agree to the statements. For the interview section, few questions will be asked and the feedback or suggestions is being recorded. Table 6.3 shows the linear scale for questionnaire.

Table 6.3 Linear Scale for Questionnaire

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	2	3	4	5

The question for effectiveness testing is set by including different category which is learnability, speed of use, ease of use, ease of communication, error-free use and subjective satisfaction. These parameters are refer from Joshi, Sarda, & Tripathi, 2010. Table 6.4 shows the questions and the objectives for each question in questionnaire. Table 6.5 shows the questions and the objectives for each question in interview. Table 6.6 shows the questions and the objectives for each question in observation.

Table 6.4 Questions and Objectives for Questionnaire

Learnability	
Question	**Objective**
1. I know the consequence of wasting food.	To determine whether user know the consequence of waste food.
2. I know the tips to save food.	To determine whether user know the tips to save food.
3. This campaign enhances my knowledge about food waste.	To know whether user gain knowledge about food waste.
Speed of Use	
Question	**Objective**
1. Tracking the images are quick and easy.	To know whether user can track the images easily.
2. I can navigate quickly and easily.	To know whether user can navigate quickly and easily.
Ease of Use	
Question	**Objective**
1. The elements of interface design (position, text, button, and colour) are visible and easy to find.	To know whether the interface design elements are legible and easy to find.
2. It is easy to operate the application.	To know whether the elements help to interact with the content.

Ease of Communication	
Question	**Objective**
1. The instruction is clear and easy to understand.	To know whether the instruction is guiding user.
Error-free Use	
Question	**Objective**
1. The navigation is smooth and without lagging.	To know whether the navigation is smooth and without lagging.
2. The button is working without error.	To know whether the button is working appropriately.
Subjective Satisfaction	
Question	**Objective**
1. This campaign is attractive and I am enjoying experiencing it.	To whether user feel in control of this campaign.
2. I would like to experience it again.	To know whether user engage with this campaign.

Table 6.5: Questions and Objectives for Interview

Question	Objective
1. Regarding the campaign you just experienced, please express your view towards the food waste issue in our county.	To test whether user understand the message from the content.
2. Do you think AR is suitable for awareness campaign? Why?	To test the acceptance of user for awareness campaign using AR.
3. Will you recommend to your friends and family about this AR awareness campaign? Why?	To test the degree of acceptance of user.
4. Do you experience any limitation during the usage of AR campaign? State the problem.	To know whether user face any problem.

5. Leave your comment to this campaign (Best and worst experience).	To know the strength and weakness of this campaign. To collect opinion from participants.

Table 6.6: Questions and Objectives for Observation

Question	Objective
1. Did user finish experiencing the content?	To know whether user finish experience the campaign.
2. How long user spends with the content?	To know the degree of ease of use for this application.
2. Are user facing problem while using the apps? If yes, please state the problem.	To know the weakness or problem of this application.

6.4. Test Implementation

Test implementation will discuss about the test description and test data. The raw data will be recorded in the table form.

6.4.1. Test Description

The question of effectiveness testing in questionnaire is separated into two parts; demography and effectiveness testing. The questions for interview for expert and target user are the same. Please refer to Appendix A for the question form.

6.4.2. Test Data

Test Data is discussing about the data collected from questionnaire, observation and interview. The results are tabulated. The demographic of respondents are tabulated in Table 6.7. The result of questionnaire for respondents is summarised in Table 6.8.

Table 6.7: Demographic of Respondent

Respondent	Gender	Age	Know AR?	Experience AR?	How many years used mobile?
1	Female	12-17	No		<3
2	Male	18-21	No		>5
3	Male	12-17	No		3-5
4	Female	18-21	No		3-5
5	Male	22-25	Yes	Yes	>5
6	Male	18-21	Yes	Yes	>5
7	Male	12-17	No		<3
8	Male	22-25	Yes	Yes	>5
9	Male	22-25	Yes	Yes	3-5
10	Male	22-25	No		>5
11	Female	22-25	Yes	Yes	>5
12	Male	18-21	No		>5
13	Male	18-21	Yes	Yes	>5
14	Female	18-21	No		3-5
15	Male	22-25	No		>5
16	Male	22-25	Yes	No	>5

17	Female	18-21	Yes	No	>5
18	Male	22-25	No		>5
19	Female	18-21	No		>5 y
20	Female	12-17	No		3-5

Table 6.8: Results of Effectiveness Testing by Questionnaire

	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12
R1	3	4	4	4	3	4	5	3	4	4	4	3
R2	4	3	4	5	4	4	4	4	3	4	5	4
R3	3	5	4	4	5	4	4	3	5	4	4	5
R4	3	4	3	3	3	4	5	3	4	3	3	3
R5	3	3	4	4	3	4	5	3	3	4	4	3
R6	3	4	4	3	3	3	4	3	4	4	3	3
R7	4	4	4	2	3	4	3	4	4	4	2	3
R8	5	5	4	2	2	4	3	5	5	4	2	2
R9	4	3	3	5	4	3	3	4	3	3	5	4
R10	5	4	4	5	5	5	5	5	4	4	5	5
R11	2	3	5	2	3	4	4	2	3	5	2	3
R12	2	3	5	5	4	5	5	2	3	5	5	4
R13	2	4	5	3	3	5	3	2	4	5	3	3
R14	5	5	5	5	3	4	4	5	5	5	5	3
R15	4	3	4	4	4	3	4	4	3	4	4	4
R16	4	4	4	4	4	4	4	4	4	4	4	4
R17	4	4	5	4	4	4	4	4	4	5	4	4
R18	5	5	5	4	5	4	5	5	5	5	4	5
R19	4	4	5	5	5	5	3	4	4	5	5	5
R20	2	3	3	5	3	4	4	2	3	3	5	3

Notes:

R-Respondent

Q-Question

6.4.2.1. Effectiveness Testing by Multimedia Expert

Table 6.9 shows the demographic of multimedia expert. Table 6.10 shows the results of interview for expert.

Table 6.9: Demographic of Multimedia Expert

Name	Lim Yong Kian
Current Occupation	Software Engineering
Workplace	nPlay Sdn Bhd
Work Experience	3 years
Work experienced in UX/UI area?	3 years

Table 6.10: The Result of Interview for Multimedia Expert

Question	Answer
1. Regarding the campaign you just experienced, please express your view towards the food waste issue in our county.	Not to waste food. Don't leave food on the table in any food court
2. Do you think AR is suitable for awareness campaign? Why?	Yup, because it can provide graphical interaction for user to understand more on food awareness will impact everything is our live.
3. Will you recommend to your friends and family about this AR awareness campaign? Why?	Yes will do, because now still have many place that have people dun have food such as Africa ,China etc.
4. Do you experience any limitation during the usage of AR campaign? State the problem.	Difficulty to watch the video because it is vertically display from my screen.

5. Leave your comment to this campaign (Best and worst experience).	Best-The graphics is nice for the video on newspaper idea is nice Worst-Should put more focus on user experience and user behaviour. Suggestion- 1) If can put on the video that about the south Africa kids that don't have food and drinks would be much better for increase awareness 2) Too many word 3) Maybe you can put some graphics that can interaction with user.

6.4.2.2. Effectiveness Testing by Interview for Public

For the first question, all the respondents expressed that they notice food waste is a serious issue in Malaysia, and it occurs because of variety of reasons. Two respondents think that AR is suitable for awareness campaign in contrast another two respondents think oppositely. However, all of the respondents will introduce to their friends and family. When experiencing the campaign, all of them are facing different kind of problems. The results collected from interview by respondent 1, respondent 8, respondent 11 and respondent 16 are tabulated into Table 6.11, Table 6.12, Table 6.13 and Table 6.14.

Table 6.11: The Result of Interview for Respondent 1

Question	Answer
1. Regarding the campaign you just experienced, please express your view towards the food waste issue in our county.	A lot of Malaysian waste food. Sometimes, it concerns me; I think people wasting food because of the food is not delicious.
2. Do you think AR is suitable for awareness campaign? Why?	For now not really. Because people now not really know AR especially the youngster and elderly, they won't initially explore it.
3. Will you recommend to your friends and family about this AR awareness campaign? Why?	Yes, because it is very new technology, it is interesting and attractive.
4. Do you experience any limitation during the usage of AR campaign? State the problem.	Ya, the Tomato part. The voiceover hasn't finish but already go to the next part. For Carrot part, the button is too sensitive.
5. Leave your comment to this campaign (Best and worst experience).	Best- I like the Fish part, the video is more interesting than reading. Worst-I don't like to read instruction, but in Carrot part, it forced me to read it.

Table 6.12: The Result of Interview for Respondent 9

Question	Answer
1. Regarding the campaign you just experienced, please express your view towards the food waste issue in our county.	It is a serious matter for food waste in Malaysia. About 15000 tonnes of food wasted daily. We need to come out a solution or otherwise the problem will never be solved.
2. Do you think AR is suitable for awareness campaign? Why?	Yes, AR is a modern technology that seems to have potential to attract interest from public.
3. Will you recommend to your friends and family about this AR awareness campaign? Why?	Yes, it is interesting that this AR awareness campaign able to be experience using smartphone and there are a lot of cool things inside.
4. Do you experience any limitation during the usage of AR campaign? State the problem.	The application need to back each time to scan different image.
5. Leave your comment to this campaign (Best and worst experience).	Very interesting and creative design, A lot of cool things. But it can be better if this application can be built with more language.

Table 6.13: The Result of Interview for Respondent 11

Question	Answer
1. Regarding the campaign you just experienced, please express your view towards the food waste issue in our county.	Many people are wasting food as they don't want to eat or they don't like to eat. They don't eat the food because they don't like the taste or the portion is too big. People should know their ability, don't

	take too much if can't finish the food.
2. Do you think AR is suitable for awareness campaign? Why?	Not really. Many people still don't know about AR technology. Not everyone will explore AR unless there is someone demonstrates it.
3. Will you recommend to your friends and family about this AR awareness campaign? Why?	Yes. It is an interesting awareness campaign, as it involves AR technology.
4. Do you experience any limitation during the usage of AR campaign? State the problem.	The images are hard to scan. Besides that, it will be better if there is subtitle on every narration
5. Leave your comment to this campaign (Best and worst experience).	Provide more infusive information to raise the awareness of food waste. The 2D animation is interesting. The 2D graphic can be more colourful.

Table 6.14: The Result of Interview for Respondent 16

Question	Answer
1. Regarding the campaign you just experienced, please express your view towards the food waste issue in our county.	In my personal view, most of the Malaysians do not cherish the food resources and do not pay attention to the food waste issue
2. Do you think AR is suitable for awareness campaign? Why?	Yes, AR is something new and interesting thing for most of us, I believed that it can attract the attention of modern people
3. Will you recommend to your friends and family about this AR awareness campaign?	Yes, there are 7 billion people in our world, and I think that saving food helps to manage

Why?	the resources of Earth
4. Do you experience any limitation during the usage of AR campaign? State the problem.	Yes, problem of too much information
5. Leave your comment to this campaign (Best and worst experience).	Best experience will be it provides many information, bad experience will be too little of game play

6.4.2.3. Effectiveness Testing by Observation for Public

All the respondents finished all the three modules with different time consume, because each of them has met different problems. The observation is recorded and tabulated into table. Table 6.15 shows the results of observation for respondent 9. Table 6.16, Table 6.17, Table 6.18 and Table 6.19 shows the results of observation for respondent 10, respondent 12, respondent 15 and respondent 19 respectively.

Table 6.15: The Result of Observation for Respondent 9

Question	Answer
1. Did user finish experiencing the content?	Yes
2. How long user spends with the content?	2 minutes 20 seconds
2. Are user facing problem while using the apps? If yes, please state the problem.	• Skip the instruction • Lost to aim to the sticker

Table 6.16: The Result of Observation for Respondent 10

Question	Answer
1. Did user finish experiencing the content?	Yes
2. How long user spends with the content?	4 minutes 32 seconds
2. Are user facing problem while using the apps? If yes, please state the problem.	• Accidently press two button • No sound

Table 6.17: The Result of Observation for Respondent 12

Question	Answer
1. Did user finish experiencing the content?	Yes
2. How long user spends with the content?	5 minutes 15 seconds
2. Are user facing problem while using the apps? If yes, please state the problem.	• Cannot scan image on table, have to scan it upright • Always skip the instructions • Tends to scan different sticker with same module. • Lost aim to the sticker

Table 6.18: The Result of Observation for Respondent 15

Question	Answer
1. Did user finish experiencing the content?	Yes
2. How long user spends with the content?	5 minutes 40 seconds

2. Are user facing problem while using the apps? If yes, please state the problem.	• Taking too long to scan due to internet speed • Skip the instruction

Table 6.19: The Result of Observation for Respondent 19

Question	Answer
1. Did user finish experiencing the content?	Yes
2. How long user spends with the content?	8 minutes 27 seconds
2. Are user facing problem while using the apps? If yes, please state the problem.	• Take too long time to finish reading article • No follow instruction

6.5 Test Results and Analysis

This section will discuss about the results and analyse the data. Respondents answered the question based on their satisfaction. For example, if the respondents have stronger agreement to the statement, they will give a higher mark. Based on the result obtained from the questionnaire, the score of each question is calculating by mean, median and mode. Mean is the average value of the result, median is representing the middle value of the set of result and mode is the most frequent value from the result. Table 6.20 shows the formulas of measure of central tendency. Table 6.21 shows the result of calculation by measure of central tendency.

Table 6.20: Formulas of Measure of Central Tendency

Measure of Central Tendency	Formula
i. Mean	$\frac{Sum\ of\ all\ data\ values}{Number\ of\ respndents}$
ii. Median	$\frac{Middle\ value\ of\ data\ set}{2}$
iii. Mode	*Most frequent value*

Table 6.21: Results of Mean, Median and Mode based on Effectiveness Testing by Questionnaire

Question	Mean	Median	Mode
1. I know the consequence of wasting food.	3.55	4	4
2. I know the tips to save food.	3.85	4	4
3. This campaign enhances my knowledge about food waste.	4.2	4	4
4. Tracking the images is quick and easy.	3.9	4	4
5. I can navigate quickly and easily.	3.65	3.5	3
6. The elements of interface design (position, text, button, and colour) are visible and easy to find.	4.05	4	4
7. It is easy to operate the application.	4.05	4	4
8. The instruction is clear and easy to understand.	4.1	4	5
9. The navigation is smooth and without lagging.	3.9	4	4
10. The button is working without error.	4.3	4.5	5
11. This campaign is attractive and I am enjoying experiencing it.	4.55	5	5
12. I would like to experience it again.	4.2	4	4

6.5.1 Effectiveness Testing on Learnability

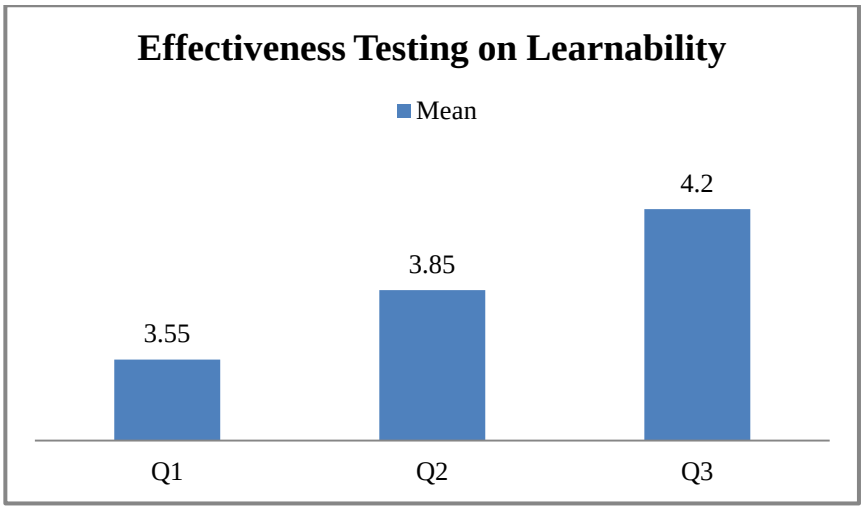


Figure 6.1: Effectiveness Testing on Learnability

Figure 6.1 shows the graph of effectiveness testing on learnability that interpreted using mean. For the category of learnability, the average of the score for question one, question two and question three are 3.55, 3.85 and 4.2 respectively. Based on the results from the survey, the result is positive. The respondents feel that they have the knowledge about food waste. Based on the results of interview for public, it can be seen that after experience the campaign, the respondents have gained the knowledge of food waste.

6.5.2 Effectiveness Testing on Speed of Use

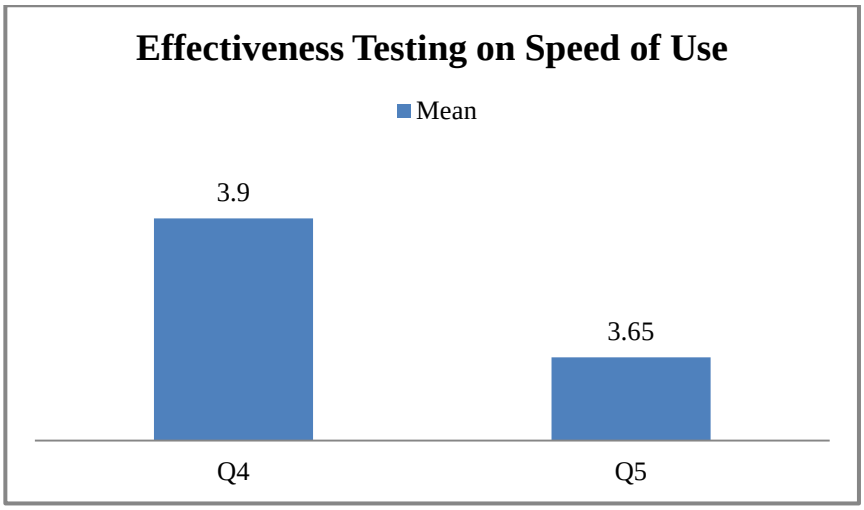


Figure 6.2: Effectiveness Testing on Speed of Use

Figure 6.2 shows the graph of effectiveness testing on speed of use that interpreted using mean. For the category of speed of use, the average score for question 4 and question 5 are 3.9 and 3.65 respectively. The result is seemed to be optimistic. However, based on the interview and observation, it can be seen that the problem of scanning target image is quite frequent. From the result of interview, a respondent comments that it is troublesome that every time have to go back to main menu to scan another target images. Therefore, it can be concluded that the speed to use this application is not smooth.

6.5.3 Effectiveness Testing on Ease of Use

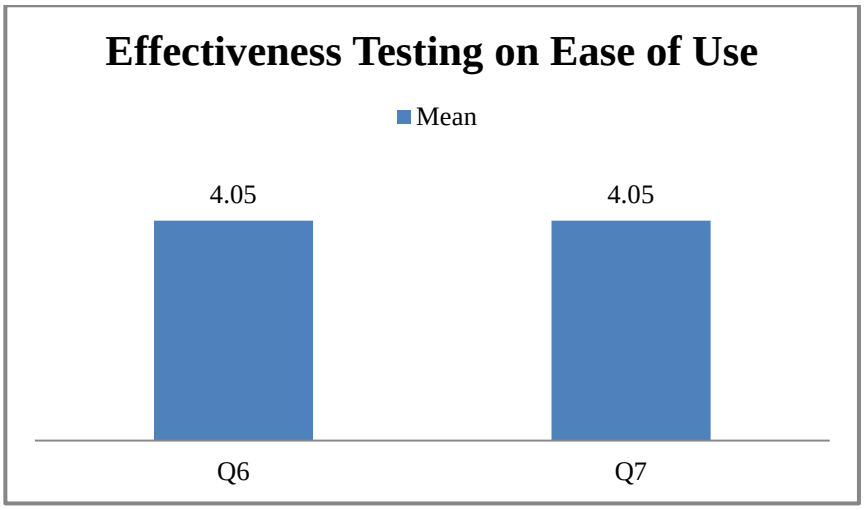


Figure 6.3: Effectiveness Testing on Ease of Use

Figure 6.3 shows the graph of effectiveness testing on ease of use that interpreted using mean. For the category of ease of use, the average score for both question 6 and question 7 are same, both are 4.05. This result is positive. From interview, there is one respondent suggested to make the graphic more colourful. Based on the observation, there is no big problem for this category. Therefore, it can be concluded that this application is considered as ease to use but it still can be improved.

6.5.4 Effectiveness Testing on Ease of Communication

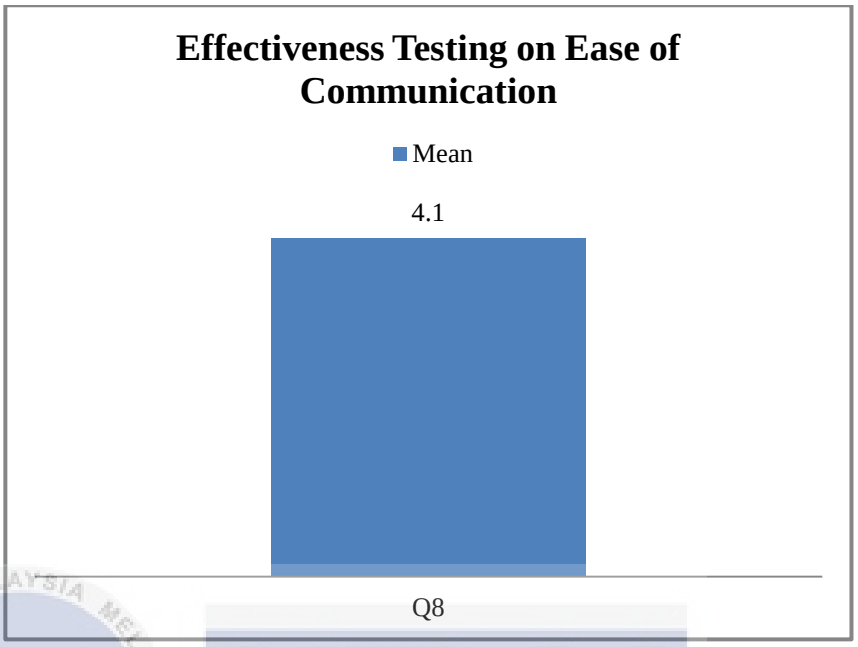


Figure 6.4: Effectiveness Testing on Ease of Communication

Figure 6.4 shows the graph of effectiveness testing on ease of communication that interpreted using mean. For the category of ease of communication, the average score for question 8 is 4.1. This result is inclined to positive. However, the results of interview for public shows that the respondent does not like to read instruction and the results of interview for multimedia expert shows that it is too many words. It can be concluded that the instruction is clear and easy to understand but people tends to ignore it.

6.5.5 Effectiveness Testing on Error-Free Use

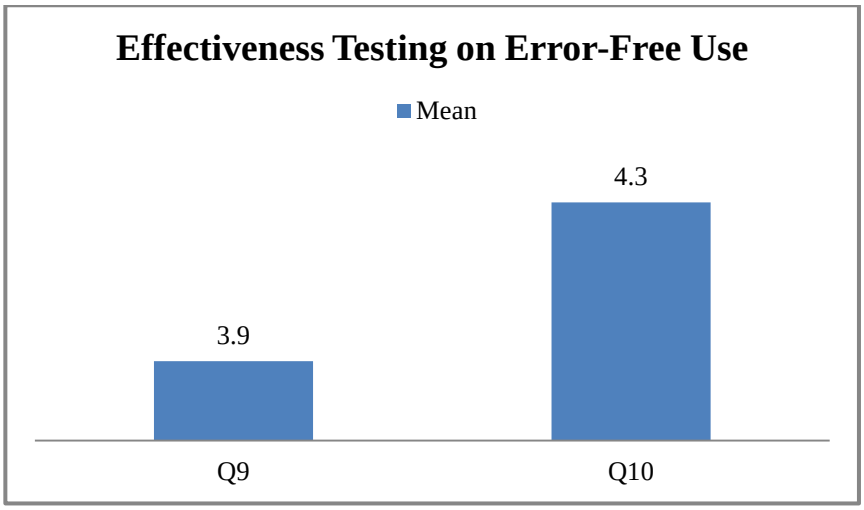


Figure 6.5: Effectiveness Testing on Error-Free Use

Figure 6.5 shows the graph of effectiveness testing on error-free use that interpreted using mean. For the category of error-free use, the average score for both question 9 and question 10 are 3.9 and 4.3 respectively. Both the results are positive. From the results of interview for public, a respondent reflected that the button is too sensitive. From the results of observations, there are few cases about touching two buttons at one time. Therefore, it can be concluded that the button is working but it is too sensitive.

6.5.6 Effectiveness Testing on Subjective Satisfaction

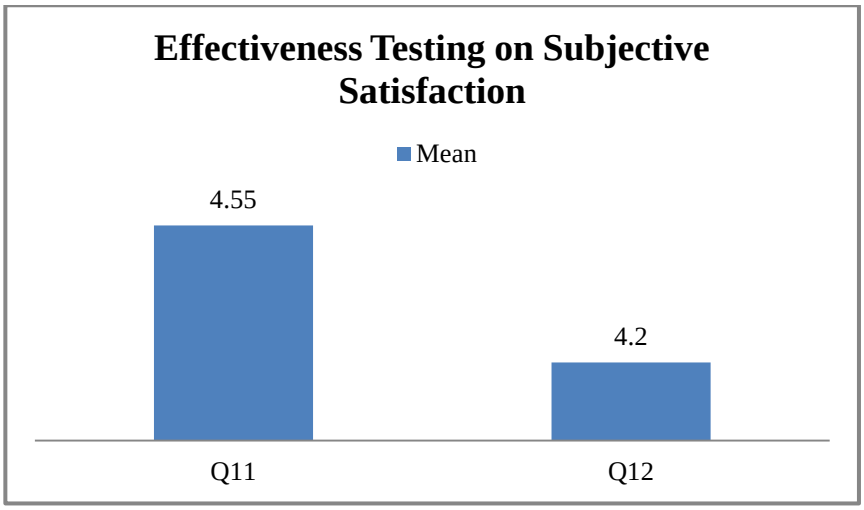


Figure 6.6: Effectiveness Testing on Subjective Satisfaction

Figure 6.6 shows the graph of effectiveness testing on subjective satisfaction that interpreted using mean. For the category of subjective satisfaction, the average score for both question 11 and question 12 are 4.55 and 4.2 respectively. The results are inclined to positive. The results from interview show that four of the respondents will recommend this campaign to their friends and family. Therefore, it can be concluded that user are satisfied to this campaign.

6.5 Conclusion

In this chapter, the testing phase is discussed. This chapter has included the planning for testing and the analysis of data. Next chapter will explain the conclusion of this whole project.

CHAPTER VII

CONCLUSION

7.1 Observation on Weakness and Strengths

This part will discuss about the weakness and the strengths of this project based on the development experience during this period. There is definitely existing of weakness and strengths. Both weakness and strengths are a good reference for further development.

7.1.1. Project Weakness

i. EnTiTi is not appropriate software to develop AR campaign

Changing for another module have to back to main page and scan again, it is taking time and make people feel bored. The logic functions provided in the software are very limited, because it only uses logic to control it. Besides, the mobile application is unstable. There are many bugs in the application that will affect the fluency of the result. Not all devices support this application. Some devices are not supported to download and some devices fail to download it.

ii. Instructions are not obvious

People like graphics more than words. People tend to ignore the instructions while experiencing the campaign.

iii. The content and the impact is no rich and strong enough

There are only three modules. For a campaign, only three modules are not enough. Some users comment that there is too little of game play (In module carrot). Some users feel that the information is no enough to raise awareness.

iv. Lack of engagement

The interaction with user is little; user cannot feel fully engagement in this campaign. The user experience is still not strong enough even though they feel interesting.

7.1.2. Project Strengths

i. AR is a potential media for launching campaign

Augmented reality is still new; it can attract people's attraction compared to old style campaign which is less engagement. Users feel that this campaign is very interesting.

ii. The 2D animation is attractive

The 2D animation (motion graphic) combined of lots of graphic and the motion is match to the rhythm of voiceover. The voiceover is energetic and users are enjoying listen to it. The idea of motion graphic on the newspaper is nice and success to capture users' attention.

iii. The sticker design is special

The normal style of sticker design is normally square or circle. The sticker design of this campaign has broken the stereotype of formal style sticker design. It was different shape of vegetable with different set of colours. Users are curious to the campaign once they first saw it and they would like to know more about this campaign.

iv. The character design is cute and attractive

Users feel that the character design is simple and cute. The character is successfully attracting people especially teenagers and makes them spent more time to play with it.

7.2 Propositions for Improvement

i. Use another software to develop

Explore more on other AR development software which is more suitable for launching campaign. Aurasma is one of the software that suggested developing AR campaign in which users no need to go back main page and re-scan for other module. We need to be wise to choose software.

ii. Study more about user behaviour

People are inclined to look at graphic more than reading words. Therefore, the information including the instructions should be presented by graphic in more attractive way. It is very important to study user behaviour before designing solution and developing a user-oriented technology.

iii. Adding more infusive information

Add the real scenario to the content. For example, add some video about the starvation of children in South Africa to the end of the 2D animation, it will be much better for increase awareness.

iv. Enhance user experience

Increase more interaction with user. For example, create a button that allow user to click few times, every click will have a bite on a vegetable, last click is guiding user to throw away the vegetable, and the vegetable is crying. This can increase user engagement and at the same time, it brings out the message of do not waste food.

7.3 Project Contribution

This project has contributed to public and the society. Food waste is happened in everywhere and by everyone; therefore this campaign is benefit to the society for raising public awareness of public towards food waste. Young people are the future leaders of countries; they have the enormous amount of influence. Plus, they are very quick-leaner and information acceptor. Thus, this campaign that using new media and mobile technology is attracting them and helps to spread the message to all over the world faster. If their crisis awareness towards food waste is raised, our planet is protected; the price of food is stable and everyone has food to eat; every human is living in peace and happiness.

7.4 Conclusion

This project has successfully met the objectives. Before develop this campaign, the issues of food waste and the new media have to be studied. Knowing that food waste is a very serious issue and it has many ready solutions in articles and news. It needs a new way to propagate it. Augmented reality is a new media and it is suitable to be applied as a propagation media.

This campaign was developed using multimedia elements. The software was explored and the knowledge of multimedia was applied to the whole process of development. Besides, the guidance of supervisor was very helpful to develop a right product with right way. Finally, the campaign was developed successfully within the limited time.

The effectiveness testing was carried out successfully. The feedbacks from the respondents were reflecting the real situation of this campaign. Throughout three types of the testing methods which including questionnaire, observation and interview, the result was analysed and interpreted in graphically and literally. Overall, based on the survey, this campaign is considered as effective. Since most of the people are enjoying experiencing it and feeling that want to experience it again although there is many imperfections.

Last but not least, this project still has a big margin for improvement. It needs more time and power to focus on it.

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APPENDIX A

(QUESTIONNAIRES，INTERVIEW AND OBSERVATION)

Good day. My name is Tee Pei Ya, final year student of Bachelor of Computer Science (Interactive Media) in UTeM.

This is a brief survey regarding the Augmented Reality you just experienced. Your answers will help me learn something in developing AR projects. The result from this survey will only be used for academic purposes only.

Thank you very much for your time and suggestions.

Part 1: Demography

Please fill in your basic information.

1. Gender:

☐ Male ☐ Female

2. Age:

☐ 12-17 years ☐ 18-21 years ☐ 22-25 years

3. Do you know what Augmented Reality is?

(If no, skip to question 5.)

☐ Yes ☐ No

4. If yes, have you experienced Augmented Reality?

☐ Yes ☐ No

5. How long have you used mobile technology?

☐ <3 years ☐ 3-5 years ☐ >5years

Part 2: Effectiveness Testing

Please tick (√) to indicate how strong you agree to the following statements.

1=Strongly Disagree; 2=Disagree; 3=Neutral; 4=Agree; 5=Strongly Agree

Question	1	2	3	4	5
1. I know the consequence of wasting food.	☐	☐	☐	☐	☐
2. I know the tips to save food.	☐	☐	☐	☐	☐
3. This campaign enhances my knowledge about food waste.	☐	☐	☐	☐	☐
4. Tracking the images are quick and easy.	☐	☐	☐	☐	☐
5. I can navigate quickly and easily.	☐	☐	☐	☐	☐
6. The elements of interface design (position, text, button, and colour) are visible and easy to find.	☐	☐	☐	☐	☐
7. It is easy to operate the application.	☐	☐	☐	☐	☐
8. The instruction is clear and easy to understand.	☐	☐	☐	☐	☐
9. The navigation is smooth and without lagging.	☐	☐	☐	☐	☐
10. The button is working without error.	☐	☐	☐	☐	☐
11. This campaign is attractive and I am enjoying experiencing it.	☐	☐	☐	☐	☐
12. I would like to experience it again.	☐	☐	☐	☐	☐

-End of Questionnaires-

Thank you very much

Interview

1. Regarding the campaign you just experienced, please express your view towards the food waste issue in our county.

_____

_____

_____

2. Do you think AR is suitable for awareness campaign? Why?

_____

_____

_____

3. Will you recommend to your friends and family about this AR awareness campaign? Why?

_____

_____

_____

4. Do you experience any difficulty during the usage of AR campaign? State the problem.

_____

_____

_____

5. Leave your comment to this campaign. (Best and worst experience).

_____

_____

_____

Observation

1. Did user finish experiencing the content? Yes / No

2. How long user spends with the content?

Sticker 1(Tomato) :_____

Sticker 2(Carrot) :_____

Sticker 3(Fish) :_____

3. Are user facing problem while using the apps? If yes, please state the problem.

☐ Yes ☐ No

_____

_____

_____

Testing in Kedai Makanan & Minuman Jaya Corner

Testing in The Windmill Station