Augmented Reality Advertisement on Android as A New Marketing Strategy (ReADroid)

by

Nur Iswadi bin Zainuddin

Dissertation submitted in partial fulfilment of
the requirements for the
Bachelor of Technology (Hons)
(Business Information Systems)

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CERTIFICATION OF APPROVAL

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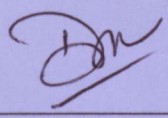
Approved by,



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CERTIFICATION OF ORIGINALITY

This is to certify that I am responsible for the work submitted in this project, that the original work is my own except as specified in the references and acknowledgements, and that the original work contained herein have not been undertaken or done by unspecified sources or persons.

NUR ISWADI BIN ZAINUDDIN

Abstract

Augmented Reality Advertisement on Android as A New Marketing Strategy is a project to study the effectiveness of using augmented reality technology in marketing strategy based on the prototype being developed called Augmented Reality Advertisement on Android (ReADroid). ReADroid is an Android application for chocolate based advertisement which animate when the smartphone camera is pointed to the chocolate wrapper by using augmented reality (AR) approach. In the conventional physical advertising method which mostly dull and static, viewer has high tendency to ignore without giving any bodily responses towards the advertisement. This problem leads to viewer difficulties to remember the advertisement well. By creating and developing an interactive and engaging AR advertising application, ReADroid ensure that half of the advertisement viewers remember about the advertisement. As a little number of researches has been done to investigate the effectiveness of AR advertisement, this project is contributing to the evaluation on the usability and receptivity of users towards the AR advertisement. Men and women between 15 to 35 years old are the main target group that will be using ReADroid on their Android smartphone to see the AR chocolate based advertisement on the chocolate wrapper. In order to facilitate the requirement changes, ReADroid development is based on the modified version of Waterfall Methodology Model called Sashimi Methodology Model. Based on the data gathering and analysis, by using Qualcomm Augmented Reality (QCAR) as the AR framework, together with Unity 3D Pro, Blender and Android Software Development Kit (SDK), ReADroid satisfy more than 50 respondents' needs by allowing user to criticize or praise the advertised products directly at the advertisement, play the games provided, view the promotion or visiting the advertiser website. As conclusion, this interactive application will solve the ineffectiveness in conventional physical advertisement, thus creating bigger platform for business to acquire more profit.

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First and foremost, I owe my deepest gratitude to God for this accomplishment of the final year project and to whom I owe my very existence. I would like to express my deep appreciation and gratitude to the following people for helping me upon my final year project completion.

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Not to be forgotten, I would like to thank to all of my friends and acquaintances that willing to help me on answering the survey questions for both problem analysis and testing purposes. Their responses helped me to acquire as much data as possible in completing this project. Besides, it is a pleasure to thank to the Unity Community who has helped in giving the guidance when writing the code for my project. I am really indebted to all of them.

Finally, I thank my parent for giving me the financial and moral support along the completion of my final year project. I hope, with the support from all of the people I have mentioned above, this project will contribute to the people on improving the reliability and relevancy of augmented reality technology among the world community.

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CHAPTER 1

INTRODUCTION

As the world spins on, technology grows rapidly across various fields to improve our life. Daily routine become easier and more effective with technological advancement in health, medical, automotive, tourism, education, communication and many more. This chapter will describe the overview of the project that covers the following topics.

- Background of study
- Problem statement
- Objective and scope of study
- Relevancy and feasibility of the project

1.1: Background of Study

In the context of business, profit is the first priority as the outcome for the activities created. Technological advancement helps business to be more efficient for all activities involved between the stakeholders. In order to maximize the business profit, marketing is a very crucial element to be concerned. Marketing helps business to strategize the best method possible to gain and retain the customers. Various methods can be used in marketing such as promotion, advertisement, pricing and product strategy, and the others. All of them are used to gain the profit through customer satisfaction and not through the sales volume. [3] This statement differentiates between marketing and selling target.

Profit through customer satisfaction is possible to be achieved when great focused being positioned to the advertisement instead of the product and pricing strategies only.[3] Without the visibility from customer's eyes, an excellent product with extremely reasonable price could not attract the customer attention. Thus, advertisement has become the success factor of business performance that influences customer awareness, attitudes and buying behavior. [10]

By taking the advantages of technological advancement, advertisement can be improved for full impact on the audience by creating an augmented reality (AR) advertisement. As Android has been widely used, the AR advertisement can be implemented on Android platform so that it will be practical for the community to use. Android offers more advanced computing ability and connectivity than a conventional mobile phone. The developer will be provided with free tools and guideline to develop this open source stack for mobile devices that includes an operating system, middleware and key applications. [9]

There a lot of AR application created for Android. Layar is one of the famous AR applications for markerless-based AR application. Layar is an AR browser used to display layers of digital info in the phone's field of vision to show user the things user cannot see.[11] Instead of Layar, Blippar is also famous to provide AR scene for advertisement used by Tesco. [12] This is the marker-based AR application. There is also Pocket Universe that will tell the user the name of the constellation when pointing the camera to the sky. [11]

In term of promoting chocolate through advertising, it will be interactive since the AR advertisement is alive when pointing the Android smart phone camera to the marker. The interesting part is buyers will be provided with a game and able to play the game as a medium to make them easily remember the product. The games become more interesting because they are also using augmented reality technology. By luck, there are also several games available for buyer to get for each of the chocolate they bought. As a result, buyers tend to buy more chocolate continuously until they get the game that they want from the chocolate wrapper itself. There are many more features available in order to make the advertisement become more interactive, effective and attractive.

1.2: Problem Statement

Based on this topic, there are two problems which cover on the current conventional physical advertisement used and the current augmented reality advertisement existed in the market.

Firstly, a research has been done in India to investigate the awareness of Amul's chocolate advertisement to the community. [21] The objectives of the research are to seek the performance of Amul's Chocolate brand and customer awareness through the advertisement so that a conclusion can be made regarding the relationship between sales and advertisement. *(See Figure 3)* Data gathering through the survey has proven that there was lack of awareness from the community especially the main consumer of chocolate which is the children and teenagers. [21] Although chocolate is actually consumed by almost everyone in the world across age and gender, the advertisement still need to be an attractive advertisement to capture children and teenagers eyes towards the chocolate. The advertisement used was so dull and not attractive with limited colors. Since the advertisement being displayed in the newspaper, definitely there was no animation can be used to make the advertisement even looks more interesting. As conclusion, dull and unattractive advertisement is the main problem in current physical advertisement.

Due to the above problem, it became such a domino effect to the advertiser because lack of awareness from dull advertisement made the viewer most likely did not remember the brand or even the advertisement they already viewed before. [21] This is because there is no bodily response from the viewer when they viewed the advertisement. The body response is possible to be created by allowing the viewer to interact with the advertisement itself. This implementation will create long-term memory effect from customer side towards the brand name. [34]

As the conclusion, the impacts from weak advertisement created low awareness among the people. Consequently, people will not contribute towards the selling revenues and even this will not increase the chances of stronger brand name through mouth-to-mouth promotion. In the other way, the positive impacts existed when customer viewed the advertisement frequently and keep telling the others about the advertisement. Then, the news spread will increased the popularity of the brand among the community and increase the tendency of getting high profit from the sales.

Secondly, in term of the current AR advertisement existed in the market, there is small number of research conducted to study the effectiveness of the AR advertisement. *(See Also 2.5: Augmented Reality in Physical Advertisement)* Thus, the advertiser is worried to invest in AR advertisement since it can be categorized as not stable and reliable technology yet. The history also proven that AR for hands-up display rapidly used since 2006 but AR advertising just started for the last two years. [35] The technology does not reach the maturity period yet whereby the researcher also struggling to prove the effectiveness of AR advertising. Thus, this research is conducted in order to study the effectiveness of AR advertising.

1.3: Objective

The objectives of this project are:

- To create and develop an interactive and engaging augmented reality advertising application.
- To investigate the effectiveness of the application which effecting half of the viewers to have long-term memory towards the advertisement.
- To evaluate the user perception for the augmented reality application in term of usability and receptivity.

1.4: Scope of Study

There are five main elements in the scope of this project:

- Smartphone
- Android operating system
- Chocolate based product
- Augmented reality
- Women and men of age between 15 to 35 years old (*See also 1.6: : Feasibility of the Project within the Scope and Time Frame*)

1.5: Relevancy of the Project

The project is relevant to make the chocolate-related advertisement become more attractive and visible through the AR advertisement. Besides, this application overcomes the limitation in physical advertisement where the AR advertisement will be more interactive and engaging with the viewers. The more people viewed the advertisement, the higher possibilities created for the customer to come back to the advertisement and higher chances of buying the product. The responses from the people viewed will increase the possibilities mentioned before and strengthen the brand name. This is because interactive advertisement creates long-term memory among the viewers toward the advertisement. In simple words, AR advertisement will contribute for higher chances of getting more profit for the business.

1.6: Feasibility of the Project within the Scope and Time Frame

Based on the scope mentioned before, chocolate advertisement usually displayed in the magazine but this time around, the chocolate wrapper itself will be used to be the medium for the advertisement to prove the concept of this AR advertisement. Chocolate is also a well-known food product and consume by everyone from different demographic background and the best example to be used.

Besides, smartphone is used as the media for the end user to install the application. Between smartphone, feature phone and the others, it has been reported on third quarter of 2011 that smartphone lead the phone sales by 67% and exceeded 118 million quantity sold worldwide. (*See also Figure 1*) In 2012, smartphone is expected to exceed the quantity of personal computer sold since the price is getting lower by time. In United States, 64% of the American who intended to buy a smartphone within the price of USD200 to USD250 ended up buying a smartphone for less than USD200 after few months. [36] Thus, large segmentation of smartphone users and the rapid drop of smartphone price make it affordable for everyone and indirectly more users are able to be reached as well.

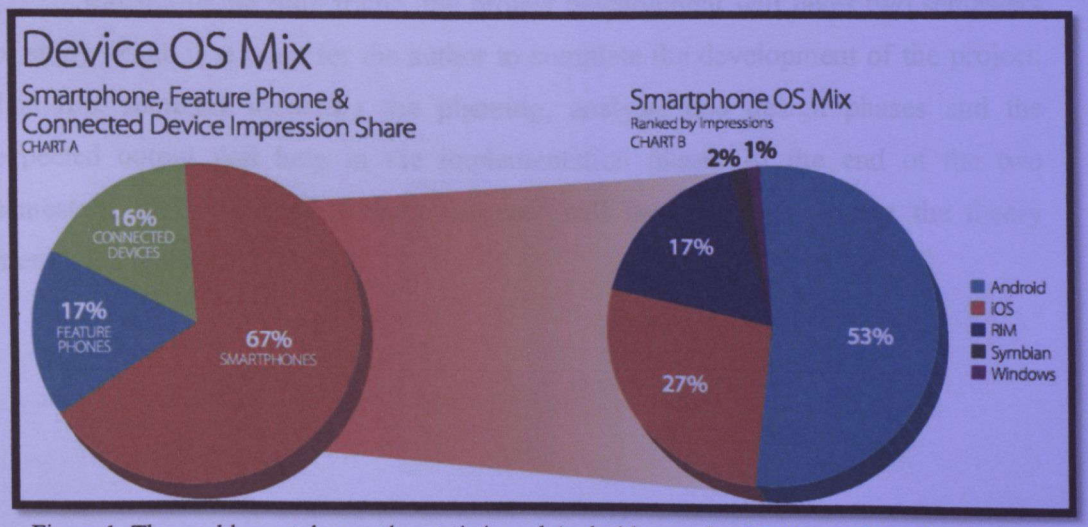


Figure 1: The world smartphone sales statistic and Android users for Q3 2011 [36] [37]

Meanwhile, Android operating system is used for the same reason as mentioned for the smartphone. Based on Figure 1, 53% among the smartphone users chose to use Android as the operating system compared to iOS, RIM, Symbian and Windows. Instead of the large segmentation, Android is an open source operating system and free to be used. Google also provides free development kit to be used along with the development and there are a lot of groups and forum available discussing about issues and facts among the developers. Thus, development in Android will be much easier with these aids and tools.

The advertisement will be displayed on the chocolate wrapper and targeting on men and women from the age of 15 to 35 years old. This is because most of the Android users come from this range of age. Thus, the tactic used for this advertisement is to deliver the message through this group of people for the large consumer of chocolate that most likely not using Android smartphone which is the children. For example, a mother that buys a chocolate for her son or daughter will bring smile and happiness to the kids. From the example, it shown that the chocolate actually targeted on the children but the advertisement used the mother as the medium to reach this large community of chocolate consumer.

Regarding the time frame, the project development will takes two semesters of study which is enough for the author to complete the development of the project. The first semester involving the planning, analysis and design phases and the expected output will help in the implementation phase. At the end of the two semesters, the testing result from the user will be obtained to prove the theory mentioned in this project.

CHAPTER 2

LITERATURE REVIEW

This chapter mainly discusses the general idea of the project. Several keywords are discussed along with problems addressed in the previous chapter until the idea of the proposed solution.

2.1 Marketing

"Marketing is the process whereby companies create value for customers and build strong customer relationships in order to capture value from customers in return". [3][13] Nowadays, marketing become more challenging and the objectives focusing on satisfying customer needs rather than acquiring more customers. [3] The importance behind the understanding of the customers and markets is marketer able to design strategy specifically to find the right products for the right customers. As a result, business will be able to retain their customers as one of the continuous equity. Thus, marketing strategy can be interpreted as the main factor for business to remain survives in the market.[13]

There are various components under marketing in which the integration of them will create a strong marketing strategy. For example, the product strategy, pricing strategy, target market, promotion, advertisement, outlet location, supply chain and the others are the components of marketing. All of the elements are important and failed in one of them will affect the business. Advertising plays big role in order to make the product brand is visible to the customer to support the other marketing strategy. It has been proven that advertising becomes high priority for business to spend more for it. According to ZenithOptimedia, business around the world spent almost USD $500 thousand for each year of 2007, 2008, 2009 and 2010 for advertisement at major media like newspapers, magazines, television, radio, cinema, outdoor and internet across the regions. [14] This proves that the power of the advertising help business to succeed and many of the businesses put great emphasize on advertisement to escalate the revenues.

2.2 Advertising

Advertising can be defined as "any paid form of non-personal presentation and promotion of ideas, goods or services by an identified sponsor". [3][17] It is also one of the key factors that affect business performance and influence customer awareness, attitudes and buying behavior. [10] Basically, most of the advertising targeting on three main objectives which are to inform, persuade and remind the audience. [4] It has been proven that the effectiveness of an advertising been measured by the emotional response, long-term memory and bodily response by the customer. [4] Thus, a good advertisement should have all these basic characteristics to be able to attract the customers.

In order to deliver the advertisement in the best way, various media fully utilized the media advantages to ensure the advertisement gives emotional response, long-term memory and bodily response to the customer. "Hong Ming", the PETRONAS television advertisement successfully won People's Choice Award showing that the advertisement impacted the audience. [15] The advertisement is about the various ethnics in Malaysia and touches audience's heart because even children become best friend from different races. Besides, DIGI uses "Yellow Man" as mascot in all of their advertisement and made audience easily remember DIGI because of it. (*See Figure 2*) The advertiser used the advantages from the television features by using interesting song to make the advertisement easier to be remembered and gave bodily response to the audience that tend to tap their feet when listening to the song. [18]

There are various media can be used for advertising like newspaper, television, internet, radio, magazine, outdoor media, and many more. Each of the advertisement media has their own advantages and disadvantages. Television advertisement is easy to deliver and gives impact to the audience because of the music and visual effect provided. This makes it easier to deliver the advertisement message with sight, sound and motion effects and get the audience attention as well. However, physical advertisement is different compared to the television advertisement (commercial).

Figure 2: The Yellow Man mascot in DIGI advertisement and the cover page of "Saji" magazine for August 2008 released
Source: *http://paper-semiotic.blogspot.com/* and
http://jomlah-zarina.blogspot.com/2010_08_01_archive.html

2.3 Physical Advertisement

Physical advertisement can be defined as "advertisement with all these properties like durable, personal and dimensional". Physical advertisement target on specific group and communicate with the targeted group over the time. It also able to be touched, smell and has its height and weight. [19] Basically, physical advertisement includes the newspaper, magazine, brochure, fliers and newsletter. Most of the physical advertisement in the newspaper having difficulties to compete among all of the advertisement clusters although it is highly reachable for the entire community or custom group of people. Besides, physical advertisement definitely does not have music and high visual effect in order to convince the audience. Thus, conventional physical advertisement depends on the brand name and the size of advertisement slot used in the newspaper to attract the readers. Physical advertisement is not really successful to give bodily response to the viewer because of this limitation especially in term of no interaction between the viewer and the advertisement.

However, the most successful physical advertisement is the magazine and the wrapper or packaging of the product. The advertisement will be able to get high reader involvement and attention because the reader paid it and they will appreciate every single thing on the magazine or the package itself. [16] Even if the advertisement size is small, it will still stand out because it got the high reader involvement. Besides, rather than focusing on the overall community and failed at the end of the day to get any customer, both of them are better in focusing the niche market. Thus, the advertisement in the magazine or the packaging of the product usually suit with the reader preferences.

For example, Saji is one of the Malaysia food magazines. Saji provides the reader with food recipes, information, special tips, healthy food and many more. Usually, inside the magazine, there are several advertisements. For example, for the September 2011 released, there is one commercial for Daisy Margarine that promoting the product to be used in preparing food. [20] As the outcome, food that used Daisy Margarine will bring happiness to those who eat it. This is the same in the chocolate advertisement inside the August 2010 released in which the main topic also discussed about chocolate. (*See Figure 2)*

Product packaging is also consider as the advertising strategy because the early perception of the customers towards the product is created based on the packaging itself. [43] Different product has different strategy of packaging in order to give the best first impression to the customers. The quality of packaging will attract the attention of the buyers and generate the revenue as well. As a result, the effectiveness of advertising through packaging will create long term memory towards the product. For example, the Brazilian drink called Smirnoff Caipiroska is using a very creative packaging for their product as one of the method to advertise their product. They created the bottles with lemon wrapper for the lemon flavors and customer need to peel the bottle's wrapper before they can open and drink it. [44] Thus, customer can easily remember their product because the advertiser allows customer to get bodily response and emotional response and experience of peeling the fruit by themselves.

Figure 3: The advertisement used to promote Amul Chocolate and the packaging of Smirnoff Caipiroska, the Brazilian Drink.
Source: *http://www.amul.com/products/amul-chocolate-info.php* and *http://www.demilked.com/creative-product-packaging-design-part-2/*

The problem with the current chocolate advertisements is they are not interesting enough to convince the physical advertisement viewers especially for the products with the weak brand name. In the context of Amul chocolate advertisement in India, the target people is the teenagers and the children but the advertisement provided did not have enough animation to attract this target group since chocolates are consumed largely in this segment. [21] Due to this problem, the advertisement failed to create the awareness about the chocolate consumer and even the reader faced difficulties to remember the advertisement to make it stand out among the others. *(See Figure 3)* There is no interaction between the viewer and the advertisement that makes it attractive. As a result, there is no bodily response from the reader to the advertisement at all. The advertisement in magazine is considered under the physical advertisement. Thus, the animation is impossibly to be created for the advertisement so that reader can interact with it. However, the latest augmented reality (AR) technology made this addressed problem is possible to be countered.

2.4 Augmented Reality

Augmented reality (AR) is related to the concept of virtual reality (VR). Both of the concepts "enable a person to experience and explore interactively, predominantly through his or her sense of vision, but also via studio, tactile and other forms of feedback". [1] The main point that differentiate between both of them is "VR attempts to create an entirely artificial environment while AR aims to blend the virtual objects into the real world". [1]

A little bit about the history, the term augmented reality was firstly used in 1992 for 'Virtual Fixtures' and 'KARMA' projects. Virtual Fixtures is a project used by the US Air Force to assist in completing their tasks without reading the manuals. It was just the same for KARMA or Knowledge-based Augmented Reality for Maintenance Assistance that used AR to show the real time instruction through the augmented scene. [35] However, AR was actually existed since 1957, but on that time, no specific term was given to this technology. The used of AR was slow until around the year of 2000 where ARToolkit is available in the market for free. Years later in 2008, the first AR application for smartphone was created after the enhancement made to the mobile AR application like MARS. Previously, the viewers need to carry heavy backpack, but, Wikitude which was the first AR application for smartphone simply use a mobile and light smartphone to see AR scene. After ARToolkit has been ported to Adobe Flash (FLARToolkit), AR is getting famous and widely used until today.

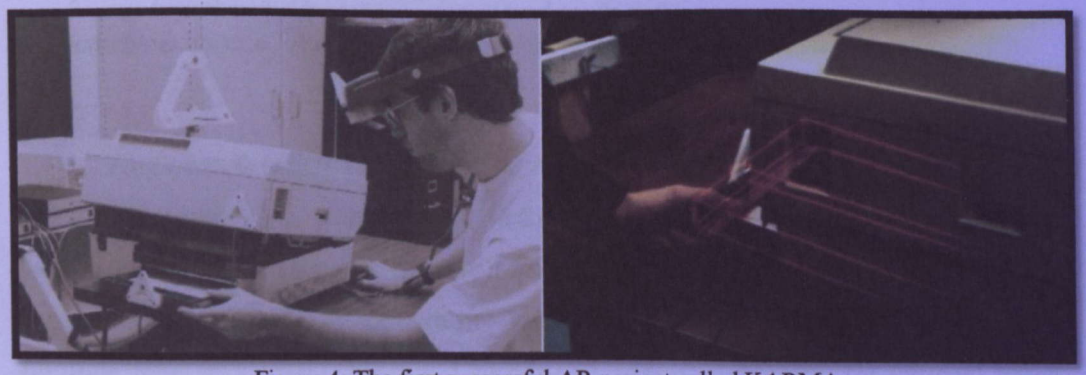


Figure 4: The first successful AR project called KARMA

Basically, there are three types of augmented reality being used widely which are marker-based AR, markerless AR and Layar Goggles. [2] Both markerless AR and Layar Goggles implementation would be harder and involving a lot of computing methods for the developer but not for the end user. The camera which used to capture the real environment allow user to simply point it to anywhere to get the AR scene.

Nevertheless, marker-based AR only works when the camera is pointed to the marker. It needs to be separated from the rest of the image once the camera captured it, in order to extract the marker contour. Based on the contour extracted, it enables the translation matrix to be calculated and applied on top of the image captured earlier. [1] Basically, this is the general workflow for marker-based AR applications.

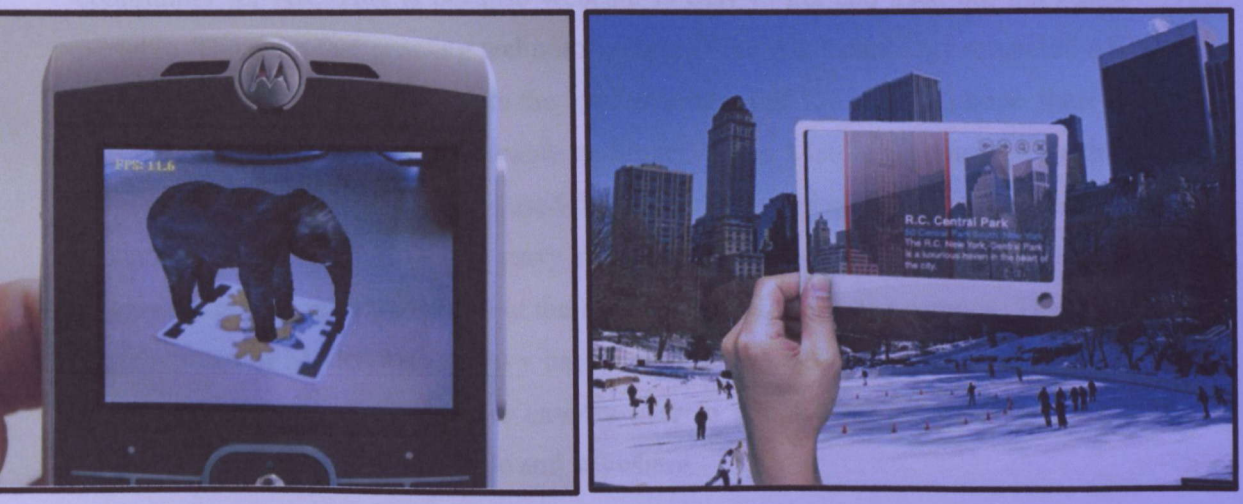


Figure 5: The example of marker-based and markerless augmented reality.
Source: *http://handheldar.icg.tugraz.at/stbtracker.php* and
http://blogs.exeter.ac.uk/augmentedreality/blog/2010/09/19/what-is-augmented-reality/

Augmented reality has been used in various fields. AR helps the community to have better daily life. For example, in the medicine, AR has been used to visualize the anatomical joint of patient in the form of X-Ray. This is important to help the doctor identifying any broken at the joint. [28] Besides, AR also been used to simulate fetus movement, birth and surgery simulation especially for unusual cases. So, doctors are able to take precaution actions for any unexpected things that were identified by the simulation. Most of the tool being used to see the AR scene is Head Mounted Display (HMD). (*See also Figure 6*)

Figure 6: The tools used to see AR scene for fetus movement, birth and surgery simulation

Instead of HMD, webcam also a very popular tool used among the community for AR. This is because webcam is easy to get and used but not really portable. Thus, the fast growing technology forcing the AR technology to enable AR to be accessed everywhere. Before the implementation of AR in smartphone, there is one AR technology used for wearable computer called Mobile Augmented Reality System (MARS). [29] MARS was used for campus tour and using the markerless AR technology. The user needed to carry the computer inside the backpack with the goggles to get the information about the building and places in the campus. The main disadvantage of MARS is the heavy backpack that user needed to carry. Today, the increasing number of smartphone enables user to simply carry a small and light phone to see the AR scene anytime and anywhere.

Figure 7: The picture of a user who used MARS

As conclusion, AR technology can be used to mix the real world with the virtual world to make an effective animation for the physical advertisement especially in the context of chocolate advertisement. The augmented 3D object created on top of the marker helps in enhancing reader experiences when viewing the advertisement. This should also align with the characteristic of effective advertisement that been measured by the emotional response, long-term memory and bodily response by the customer toward the advertisement [4]

2.5 Augmented Reality in Physical Advertisement

The implementation of augmented reality in physical advertisement has grown rapidly and being implemented in a lot of industry such as automobile, food, game, engineering and many more. In Europe, AR advertisements grow rapidly and even double the number of commercials. [24] The research also proved that the new method in advertisement by using AR technology is a good alternative to help achieving the objectives of advertising. However, small number of researches done on this effectiveness makes this technology being considered as not reliable among the advertiser.

One of the researches regarding the AR advertising effectiveness was done by Acentric. By using CAR magazine, they conducted an advertisement test for Mercedes Benz with 79 members of the respondents was instructed to use the AR advertisement in the website. As a result, it showed that 63% of the participants bother to check out the AR advertisement beyond the advertisement animation by viewing the website which can be considered as impressive. Even better when Acentric found that 86% of the participants who bother to view the online content remembered about Mercedes Benz. [22] Based on the research, comparing between the static image and text usually used in the traditional advertising, AR advertisement constructed customer memory to remember the advertisement through the experiences and action related to the product better. [23]

Another research was conducted by Department of Computer Graphics Technology, Purdue University for Mini Cooper advertisement. Since introducing people to the product is the primary goal of advertising, before the customers attracted the product, the viewer must firstly admit the existence of the product and remember the details as well. The research conducted between two separated groups in which one of the groups will be exposed to 2D ads (the conventional physical advertisement) meanwhile the other one for 3D ads (AR advertisement). As a result, 82% of 2D ads able to remember the factual information compared to 59% for 3D ads. However, 100% of the 3D ads able to identify the color of the car while 93% of the 2D ads able to do so. Thus, augmented reality advertisement was successful in presenting visual components of a product but 2D ads was more effective in presenting factual information. [23]

In the other perspective, a research was conducted for child's toy advertisement. This research was aim to differentiate between the effectiveness in conventional physical advertisement and AR advertisement. Similar as the other research, two groups among 100 parents was formed to differentiate between both of the methods in advertising regarding their consideration to buy and pay for the toys. 74% of the AR advertisement viewers willing to buy the product for £7.99 each compared to 45% among the conventional physical advertisement viewers for £5.99. As a conclusion, people are willing to buy for higher price if they are engage with the advertisement or product through interaction and sense of touch. [38]

Nevertheless, the AR advertisement is still growing rapidly across various fields and industries although only a few research done regarding the effectiveness of it. For example, AR advertisement has been used in the automobile industry as well. Nissan introduced MINI Cabrio by giving the chance of the brochure's reader to look at the exterior and interior design of MINI Cabrio from the augmented 3D car. Besides, customer was also able to change the color and model of the car according to their preferences. [25] AR advertisement also has been used by Volkswagen. To promote the upcoming VW Volkswagen Beetle in 2012, Volkswagen used creative advertisement method for the "Juice Up" campaign in Vancouver and Toronto. iPhone and iPad users will be able to see the animation of the massive Volkswagen Beetle jumping out from the gigantic billboard located at the building and smashing through transit shelters. Volkswagen enhances the advertisement to inform the

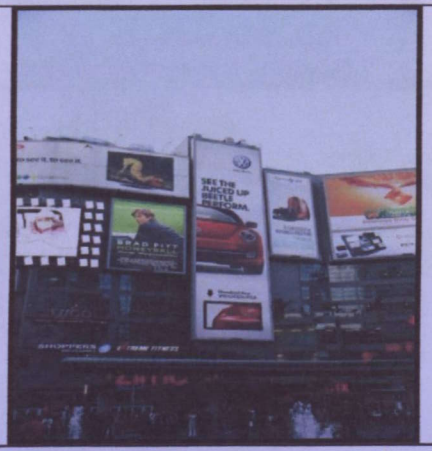
community that the Volkswagen Beetle is much more aggressive and performance-oriented compared to the prior cars produced by Volkswagen. [26] Based on both of the products, the problem with the advertisements is expensive products will not able to attract the customers to buy the products on the spot. This is because customers still need to see, feel and touch the product before they decide to buy them. But still, AR helps Nissan and Volkswagen to increase the possibly of more customer attracted to the product and strengthen the brand names.

In the food industry, one of the advertisers that used AR advertisement is Doritos. Doritos advertised the AR advertisement to promote "Doritos Sweet Chilli" that enabled the buyer to see Doritos's character come to life when pointing the camera to Doritos's package. The viewer could upload the character to the website and adopted Doritos's Character as a pet. The adopted pet uploaded at the social network site used by Doritos's customer to find their Doritos Lover between the users. [25] The drawback of this advertisement is people already bought the product by the time they wanted to view the AR advertisement. This is not aligned with the marketing objective for advertisement which is to influence customer awareness to increase the business profit from the selling. However, the good thing is because of the advertisement, people tend to buy the product in order to get the game.

Based on the entire example given before, there are several methods used to get the augmented 3D objects on top of the marker. (*See also Figure 6*) Some of the advertiser used the computer's camera like Nissan, Burger King and Dorito. The other alternative is using the smartphone like what Volkswagen used for their AR advertisement. Since smartphone is small, light and mobile, the implementation of AR advertisement using smartphone with mobile Internet adoption will be able to go further in the industry as expected. [24]

Figure 8: Augmented Reality Advertisement for Physical Advertisement

Industry	Advertiser	Description	Media	Picture
Food	Dorito	Doritos advertised the AR advertisement to promote "Doritos Sweet Chilli" that enables the buyer to see Doritos's character come to life. The audience also able to upload the character to the website and adopted Doritos's Character as a pet. The adopted pet uploaded at the social network site used by Doritos's customer to find their Doritos Lover between the users. [25]	Package	
Automobile	Nissan	Nissan introduced MINI Cabrio by giving the chance of the brochure's reader to look at the exterior and interior design of MINI Cabrio from the augmented 3D car. Besides, customer was also able to change the color and model of the car according to their preferences. [25]	Brochure	-
Automobile	BMW	In conjunction with the new release of BMW Z4 in 2012, BMW come out with a new AR advertisement from the website so that customer can print out the marker and tests drive the car at any plain table by pointing the camera to the printed marker. The most interesting part was when the BMW Z4 leaved the colored tire marks that viewer able to see it in the computer screen. BMW let the targeted customer to feel the excitement and joy while driving the brand new BMW Z4. [25]	Website	

Game	Oasis	The advertiser offered AR experiences for the target customer to see RubberDuckZilla destroyed Tokyo. For the first time they used this approach, Tokyo became the targeted market to promote RubberDuckZilla which is a very big yellow duck character in Oasis's game. [25]	Newspaper	-
Automobile	Volkswagen	To promote the upcoming VW Volkswagen Beetle in 2012, Volkswagen used creative advertisement method for the "Juice Up" campaign in Vancouver and Toronto. iPhone and iPad users will be able to see the animation of the massive Volkswagen Beetle jumping out from the gigantic billboard located at the building and smashing through transit shelters. Volkswagen enhances the advertisement to inform the community that the Volkswagen Beetle is much more aggressive and performance-oriented compared to the prior cars produced by Volkswagen. [26]	Billboard	
Shopping	Tesco	Tesco collaborated with Blippar to enhance their "Big Price Drop" campaign for the last 26th September 2011 in United Kingdom. The smart phone users will be able to use their phone camera to see the printed Big Price Drop campaign in the newspaper animated. The point is to give the chances for the customer to access more information about the price drop for their products using a very interactive method and enable the customer to download the new daily recipe too. [30]	Newspaper	

Food	Burger King	In promoting Burger King's $1 Cheese Burger and Whopper Jr, Crispin Porter Bogusky created AR advertisement for this product that enables the customer to see augmented 3D Cheese Burger when pointing the camera to $1 note. Besides, the advertiser let the viewer to choose any sandwiches to appear on top of the $1 note virtually. [27] This advertisement was very effective to attract the viewer and also successfully delivered the message to the customer.	$1 note	
Food	PepsiCo	PepsiCo advertised 7Up brand under the two-month campaign called "You Click, Allu Arjun Dance". The advertisement targeted in India and allowed the customer that bought 7Up to see the dancing video of Allu Arjun, the Indian dancer, from the marker provided at the 7Up bottle. The objective of this campaign was to spread the 7Up brand among the youngsters by using Allu Arjun as the product icon. [31]	Package	
Automobile	Toyota	To promote Toyota Hybrid Auris, Toyota come out with a new advertisement that gave the chances for their possible customers to test drive the new Auris even before it was released to the market. By using AR, they were able to print out certain markers that represented augmented 3D building, trees and many more to create their own landscape. Then, the keyboard used to control the Auris to move around the augmented landscape created earlier. [32]	Website	-

Engineering	General Electric	To promote GE's Smart Grid windmill technology, from GE Website, viewer will be able to print the marker provided to get the augmented 3D windmill on top of the marker. Powered by FLARToolkit, the advertisement also enhanced viewer experience by adding additional features to the augmented advertisement so that the turbines spin faster when viewer blow to the computer's microphone. [33]	Website	
Food	Cadbury	Blippar created an AR games for Cadbury under the program called "Spot vs. Stripes". When the customer buys the chocolate bar, they will be able to play a very simple game from the wrapper itself. The score from the game can be uploaded to the website to win the lucky draw.	Package	

2.6 Augmented Reality in Android

The AR implementation among smartphone is rapidly grown compared to the previous method of using wearable computer. Compared to the conventional method, smartphone is portable and powerful to process AR scene although in limited memory capability. In this project, Android has been chosen as the platform for the smartphone to implement AR. It was reported that Android leads the smart phone platform with the selling more than 100 million units in Q4 2010. [7] *(See also 1.6: Feasibility of the Project within the Scope and Time Frame)*

Android is an open-source project by Google that become a platform for smartphone and it includes the operating system, the software development kit, application framework and key applications. [6] The kernel used is based on Linux kernel and most of the parts of Android build based on the Apache 2.0 open source license and allow everyone to develop their own Android customization. Google provides a lot of tools to help programmer to create their own application based on the Software Development Kit (SDK) (*See Also 3.3: Android SDK*) and applications framework provided together with the libraries like OpenGL ES, SQLite, Surface Manager and the others. Most of the Android application is written in Java Programming Language but still, C Programming Language can be used with Native Development Kit (NDK) (*See Also 3.3: Android NDK*) and they are running on its own virtual machine, Dalvik Virtual Machine (DVM). The facilities provided encourage AR development using Android as the platform.

There are various tools can be used to develop AR application on Android based on the AR library such as Magnitude, Qualcomm AR (QCAR), Popcode, Android AR (AndAR), Android AR-Kit, Mixare and NyARToolkit. Each of the libraries has their own advantages and disadvantages.

Firstly, Magnitude is an open-source framework used for designing AR application on Android with the last code committed on 13th June 2010. It is one of the Google code project and free to be used. Magnitude was also claimed as easy to use because of the plug-in oriented introduced to the developer. [39] However, this library focusing more on GPS oriented application especially for markerless AR application.

Qualcomm AR (QCAR) is also one of the famous libraries used for AR application development on Android. Today, QCAR has already expanded their capability by making it supported for iOS and multiple development tools including Eclipse, Xcode and Unity. QCAR is also free to be used and focusing more on marker-based AR. [40] However, the process of loading external object from the SD card would be much completed with QCAR and most of the objects definitely need to be loaded from SD card.

Other than that, Android AR (AndAR) is a framework that enabling AR on Android. AndAR is free and an open source project that more focusing on marker-based AR under the GNU General Public License. [41] ARToolkit is one of the earliest and famous tools used for AR development and AndAR is actually the Android version of ARToolkit under ARToolworks Inc. *(See also 3.3: Tools)* Instead of that, AndAR is much simpler in loading objects from SD card compared to QCAR. Thus, AndAR has been chosen as the AR library for ReADroid development at the first place because of the benefits mentioned before.

However, during the intersection period between analysis and development phases in the software development life cycle, the author has changed from using AndAR to QCAR as the framework for AR development on Android. This is mainly because there are a lot of documentations, tutorials and information can be found for the purpose of ReADroid development including the great community from the Unity Community and Qualcomm Forum. More comparison between both of the framework will be explained later in the next chapter.

There are more tools available to use and most of them are not suitable to be used for this project. For example, Popcode is one of the great framework because it has a lot of libraries and capable in doing more AR functionalities. But, Popcode is quite complex and only works with specially designed Popcode's markers. Mixare is also another great framework but it is just like Magnitude where it is more focusing on geographical localization. Another ARToolkit version for Android is NyARToolkit. NyARToolkit supports many languages and able to identify multiple markers. However, it is quite complex to understand within the time frame of the project.

2.7 Proposed Solution

Today, the main challenge in the chocolate advertising is to deliver the advertisement in the interactive and attractive way so that customer will be easier to remember the brand name and aware about the product. This is important as part of the subliminal marketing that uses the stereotypes existed in the community with high graphic design element to achieve the business, marketing and advertising goals. By taking the advantages of technological advancement, this challenge is possible to be countered easily to make advertisement become more effective and lead to the business growth.

Augmented Reality Advertisement on Android (ReADroid) maximizing the advertising effectiveness by using AR technology to make the advertisement from the chocolate wrapper come to life. By using QCAR (*See Also 3.3: QCAR*) as the AR framework, when pointing Android phone camera to the marker at the chocolate wrapper, user will be able to see the freeze advertisement become alive and able to be interacted with like viewing the promotion, drop a comment and many more.

The interesting part is when pointing Android phone camera to the bottom part or the bottom side of the chocolate wrapper, user will be able to play a game. There are four different kind of games based on different kind of textures. Thus, user does not know which textures they will get and they tend to buy more until they get the game that they want. This interactive advertisement will give the audience long-term memory toward the product. The element used in the advertisement is also important to ensure the targeted customer feel to come back to the advertisement again because of its attractiveness.

CHAPTER 3

METHODOLOGY

For any software development it is an essential to plan well the project by gathering the requirement before designing and implementing the software. Different methodologies have been created to cater different needs of different project in a specific duration of time. Thus, this chapter will elaborate more about:

- Choosing System Development Methodology
- Planning, Analysis, Design and Implementation Phases
- Tools
- Key Milestone

3.1: Choosing Software Development Methodology

In this project, the modified Waterfall Methodology or Sashimi Model is used for the software development. Based on the software development process, each of the phases will be developed systematically and sequentially from one to another in a downward fashion and there will be an overlapped between the phases. It means that the analysis phase starts before the planning phase is finalized, design before analysis is completed and et cetera as shown in Figure 9.

Based on the methodology, it was very crucial to identify the system requirements in order to minimize the requirement changes as the project proceeded. Thus, implementation phase was easier since the planning, analysis and design phases were specified in detail before the implementation phase begin. The overlapped enabled two phases to be run concurrently and reduce the project duration. Besides, software will be able to adapt the changes during the overlapped phases for any software improvements because it allowed more regression. [8] The overlapped between design and implementation phase enabled various tools to be tested in order to maximize the software performance and facilitate the debugging process to satisfy each of the functional and non-functional requirement criteria.

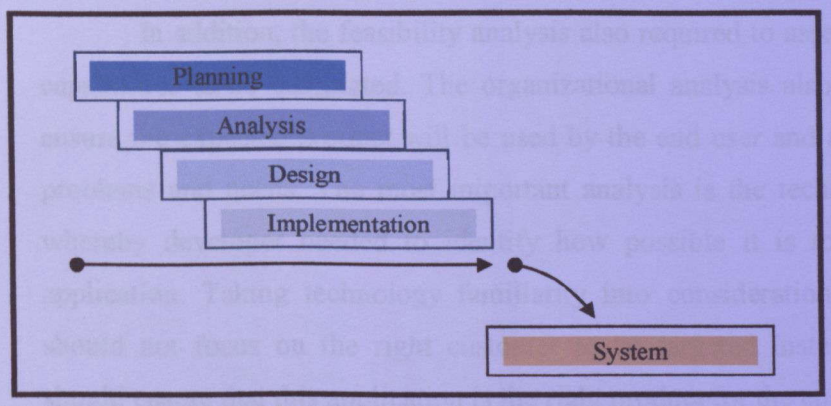


Figure 9: The Sashimi Model of Software Development Process

3.2: The Phases

3.2.1 Planning Phase

In the planning phase, background of study has been conducted thoroughly. Based on the prior studies, several challenges are identified as the main problems in advertising. To get more understanding about the topic in depth, several journals, website, books and article is reviewed. The problems identified also need to be proven correct and supported by various sources.

For technical research, the advantages and disadvantages on the current product available in the market today which failed to counter the addressed problem above need to be recognized. The objectives and scope of study identified, help to give direction to the project on the expected output at the end of the software development. All of the media, tools and knowledge require along the project need to be develop or polish. There are many tutorials in the web explained the step by step guidance for beginners to learn about Android development, QCAR, Android AR, ARToolkit and the hardware. Google groups for Android and QCAR development also available for any discussion related to the issues and problems found among the community.

In addition, the feasibility analysis also required to assess the project capabilities to be completed. The organizational analysis also important to ensure the expected product will be used by the end user and align with the problems and needs. The most important analysis is the technical analysis whereby developer needed to identify how possible it is to develop the application. Taking technology familiarity into consideration, the product should not focus on the right customer to be targeted instead; developer should ensure that this application is the right product for the customer.

3.2.2 Analysis Phase

In the analysis phase, the requirement is listed to understand clearly several important questions like who, what, when, and where will the application be. Based on the problems identified in the planning phase, the functions of the application will be identified together with the user of the application. In this phase, developer should understand very well about the project and the expected application to be developed.

In the same time, along the progress of the project, questionnaires will be distributed using Facebook and email by using random sampling to prove the hypothesis created in this paper is correct. (*See also Attachment 1*) The questionnaire will cover on the responses of the targeted people toward AR advertisement and show the effectiveness of using AR in food industry advertisement. Since the methodology used is Sashimi Model, the design part already started meanwhile the questionnaire is still in progress. This situation has shown the overlapped between analysis and design phase. Consequently, the result of the questionnaires that will be acquired in the future will help to improve the existed design. The result of the questionnaire will be discussed in the next chapter.

For the current design, the requirement gathering can be divided into several key aspects that relate to the technical management of the project either functional or non-functional requirements

ID	Func1: Ability to augment the advertisement in the real world
Area	Functional (For User)
Description	The application should be able to make the freeze advertisement in the printed media comes alive when pointing Android phone camera to the marker provided. With a character animated, it will become the mascot for the product.

ID	Func2: Ability to play games
Area	Functional (For User)
Description	The application should allow the user to play games when pointing Android phone camera to the bottom side of the chocolate wrapper.

ID	Func3: Ability to see Promotion
Area	Functional (For User and Web Administrator)
Description	The products or services promoted at the advertisement are available in the form of coupons or tickets once the user viewed the AR advertisement in certain time. Before that, user is linked to the advertiser web site to get more details about the advertisement. This will require internet connection for the function to work properly.

ID	Func4: Ability to drop comment
Area	Functional (For User)
Description	In certain situation, user might have some questions or criticism about the advertisement. Thus, user able to drop their words at the advertisement and make it visible to the public.

ID	UI1: Splash Screen
Area	Graphical User Interface (For User)
Description	After the application is started, user will be presented with a very short splash screen meanwhile waiting for the camera to be initialized.

ID	Func5: Ability to link to the website
Area	Functional (For User)
Description	When user needs more information about the advertiser, user is able to click at the respective button and it will immediately link to the website of the advertiser.

ID	Nav1: Automatically adjust view based on the phone position
Area	Graphical User Interface/ Navigation (For User)
Description	Once the camera is adjusted to the right side or left side of the object, it will display the right part or left part of the 3D object. This means that the changes in camera coordinate will not affecting the object coordinate in the augmented scene.

3.2.3 Design Phase

Graphical User Interface

In the figure below, it shows the graphical user interface for the application. Figure 11 shows the splash screen that will be displayed after the application was initialized while waiting for the camera initialization. At the right side, it is the common AR advertisement menu screen with the booking, sharing and commenting features. These features are available at most of the advertisement created. Meanwhile, Figure 12 shows different perspectives of a sample 3D object when moving or rotating the camera. The navigation will displayed the object augmented to the real world in fixed coordinate. Thus, user would be able to navigate in 3D space to get a better view of the 3D object

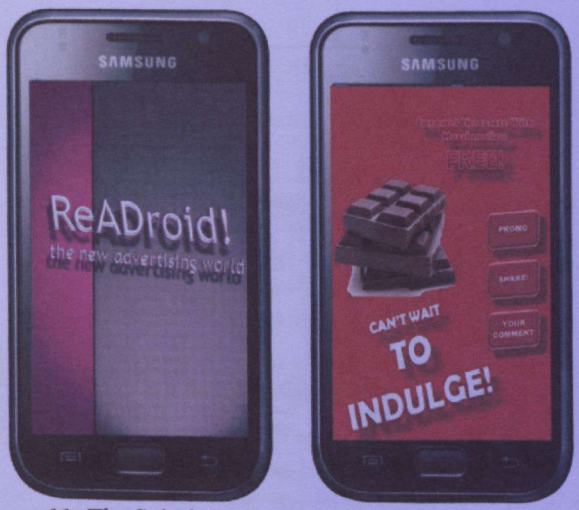


Figure 11: The Splash Screen and AR Advertisement Interface

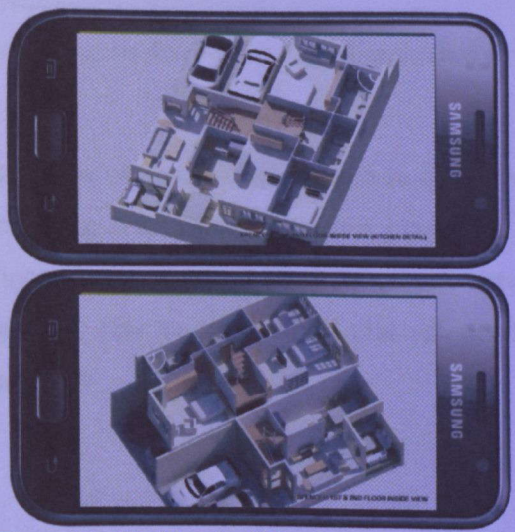


Figure 12: 3D object in different angle perspectives

Comparing the Development between AndAR and QCAR.

The early stages of the development, the author used AndAR as the framework for AR development. However, for several reasons, the development will be continued by using QCAR framework. Thus, this part will describe on the reasons behind why the author changed from using AndAR to QCAR based on their features and low level software architecture it selves.

AndAR Low Level Software Architecture

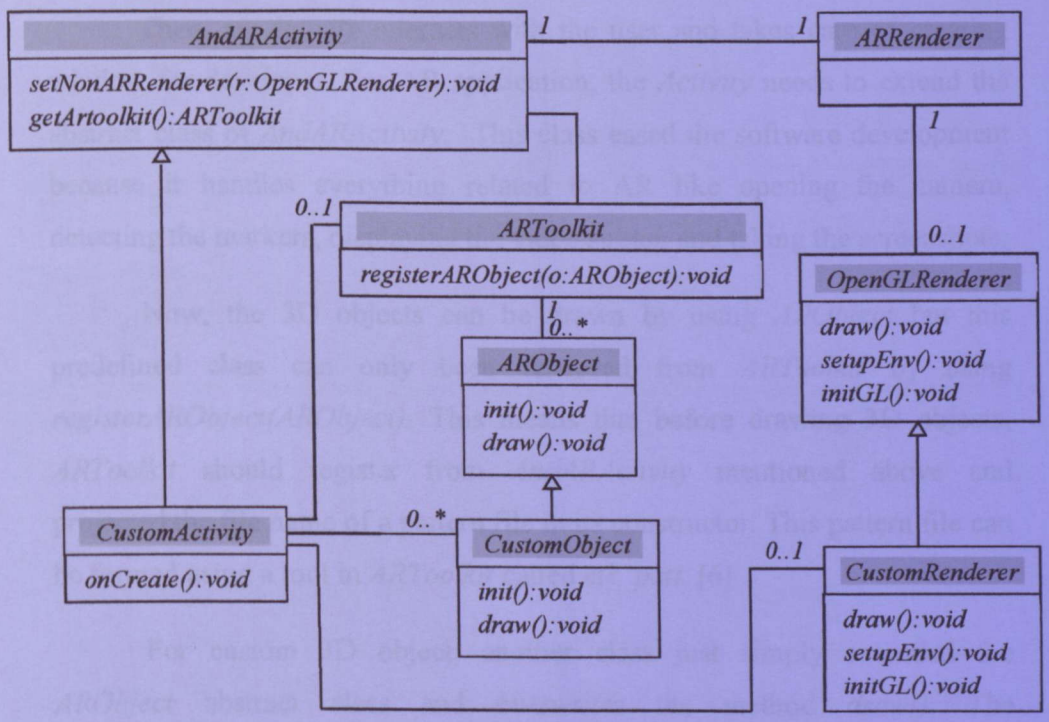


Figure 13: Simplified class diagram for common AndAR application on Android [6]

The figure above show the common classes used in the development of AR on Android platform using AndAR. *ARRenderer* class deal with everything related OpenGL. Since the augmented scene is mixed between augmented and non-augmented 3D objects, the class created need to implement *OpenGLRenderer* interface.

OpenGLRenderer is a predefined interface class where the implementation of the class came along with the predefined methods like *initGL()*, *draw()* and *setupEnv()*. *initGL()* is the method called when the OpenGL surface is initialized. Then, method *setupEnv()* will be called before the augmented objects are drawn. The method also being used to describe and initialize the effect of the 3D objects like lighting, material, texture, fogging and many more. Lastly, *draw()* is called repeatedly for each frame to draw the non-augmented 3D objects and used to calculate the software performance using frame per second (FPS).

Then, an *Activity* interacts with the user and takes care of creating window for developer. For AR application, the *Activity* needs to extend the abstract class of *AndARActivity*. This class eased the software development because it handles everything related to AR like opening the camera, detecting the markers, displaying the video stream and taking the screenshots.

Now, the 3D objects can be drawn by using *ARObject* but this predefined class can only been retrieved from *ARToolkit* by using *registerARObject(ARObject)*. This means that before drawing 3D objects, *ARToolkit* should register from *AndARActivity* mentioned above and projected the file name of a pattern file in its constructor. This pattern file can be formed using a tool in *ARToolkit* called *mk_patt*. [6]

For custom 3D object, another class just simply extended the *ARObject* abstract class and overwrites the method *draw()*. The transformation matrix will be applied and aligned to the marker before the method *draw()* is invoked.[6] Thus, the selected augmented 3D objects stored in *assets* folder will appear exactly on top of the markers.

Basically, the description mentioned above is the low level software architecture of AR application on Android using AndAR framework which has been developed by Tobias Domhan from Graz University of Technology.

QCAR High Level Software Architecture

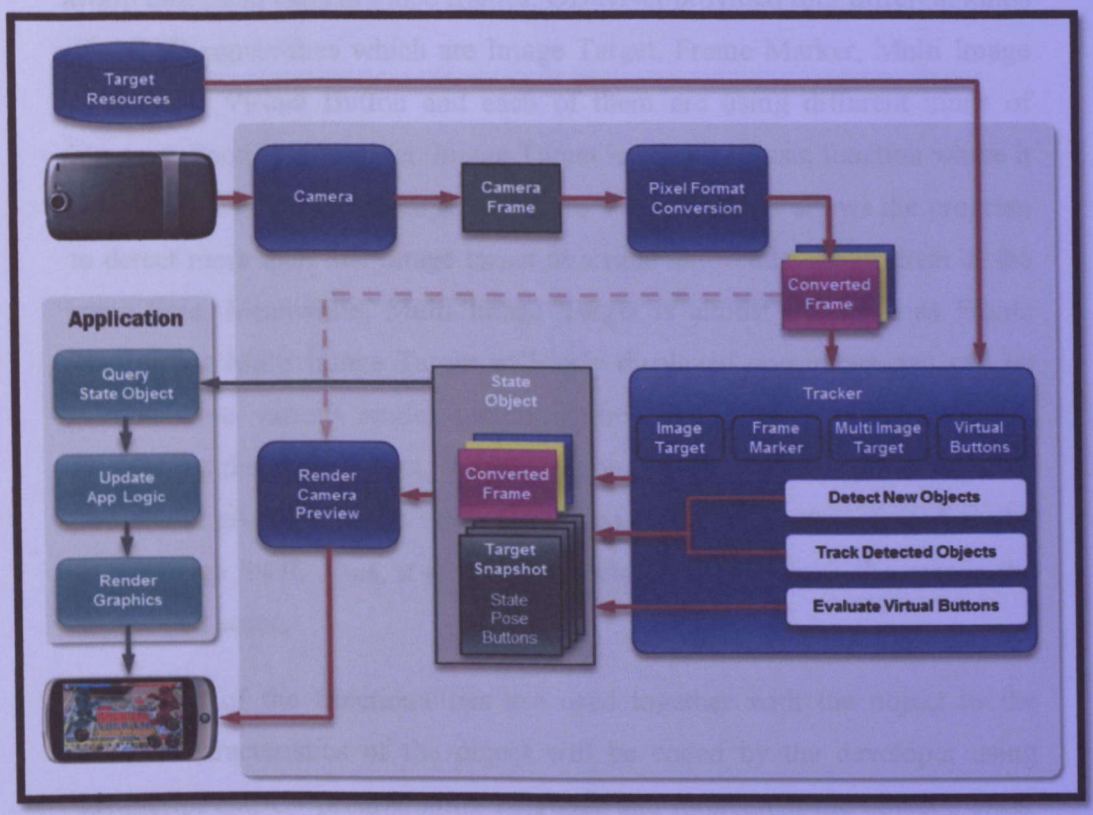


Figure 14: Data flow diagram of the QCAR framework in an application environment. [45]

QCAR or Qualcomm Augmented Reality is a framework created by Qualcomm Development Network (QDevNet). QCAR also can be used with Unity 3D Pro as an extension. In the framework of QCAR, Target Resources control the target image of the AR scene. The target image can be created by using Target Management System from QDevNet official website. The system help to identify either the textures uploaded are good enough to be the target image and a good target image requires a lot of colors contra. After all, Target Management System will resize the target image accordingly and generates dataset that contain the XML config file which is also described about the registered target image at the database. [45] Then the camera is able to detect the target image for further processing. The image capture will be passed to the tracker. Along the process, Pixel Format Conversion will convert the image captured from the phone camera format such as YUV12 to standard OpenGL ES rendering format such RGB565. [45]

Based on the target image detected, tracker will detect and track real world objects in camera video frames. QDevNet provided four different kinds of QCAR capabilities which are Image Target, Frame Marker, Multi Image Target and Virtual Button and each of them are using different kinds of library defined by QDevNet. Image Target is the most basic function where it will detect a single image target at a time. Frame Marker allows the program to detect more than one image target at a time and render all of them at the same time. Meanwhile, Multi Image Target is almost the same as Frame Marker but Multi Image Target will only displayed one image and can be viewed from various angles including the backside of the target image. Besides, as the name depict, Virtual Button allows the developer to create a button and gives responses when user press the virtual button created on the target image itself. Thus, it allows the world interaction from the user in the augmented scene.

All of the functionalities are used together with the object in the scene. Characteristics of the object will be coded by the developer using JavaScript and C# programming language and implement the object's class. The last step of rendering, from the initialized components, each frame will require all of three basic steps (query state object, update app logic, render graphic) in order to update the state object before the application render method is called. As a result, an augmented scene will be created.

AndAR vs. QCAR

Overall, development using AndAR will be more difficult especially in giving attribute to the object. Each of it needs to be done programmatically by the developer and requires complex class hierarchy. Since AndAR is a new framework, most of the development requires full instruction from the developer to create what they desired to. However, for QCAR, most of the basic functionalities are done based on the predefined algorithm and class library by QDevNet as shown in Figure 15.

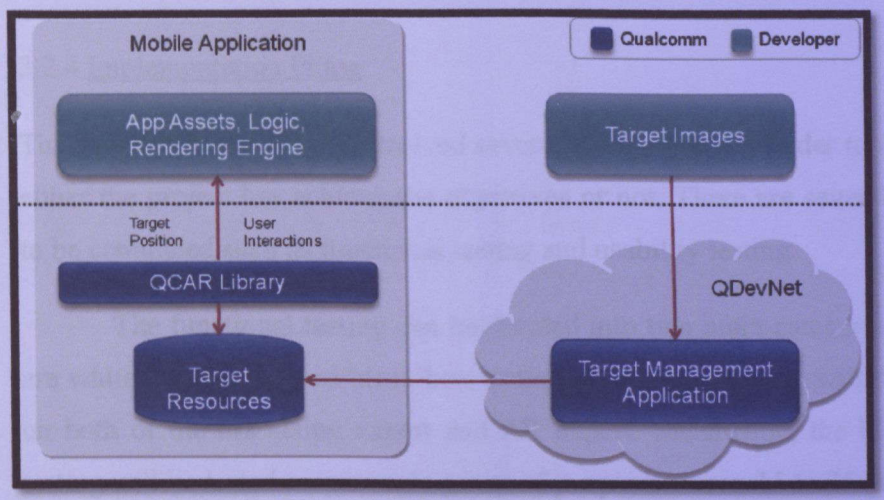


Figure 15: QDevNet process overview. [45]

Compared to the AndAR, QCAR is easier in term of creating custom target image. QCAR is able to track partial image when only half part of the target image is in the camera's sight and this cannot be done using AndAR. Besides, QCAR support various types of Android devices compares to AndAR either old model or the latest model. The community is also strong with prompt responses from the members each time a problem is posted in the group. The documentation also helps the developer to build the application easily. Although QCAR does not solve the lagging processing issue and several other problems, but it is the best framework to be used for AR development on Android currently.

Drawing Complex 3D Object Using Blender

It is definitely hard to draw complex 3D objects programmatically using OpenGL ES. Thus, one of the alternatives used is Blender. Blender is open source software for 3D modeling that enables developer to import the 3D objects into Java-usable format. The complex part of using Blender is to import the object to the project developed in Unity 3D Pro. The finished object is saved using Object File Format (OFF) because of its simplicity and consistency with OpenGL. Since OpenGL ES does not support *Quads*, the OFF file needs to be converted to *Triangles*. Finally, this object is ready to be used and increases the performance efficiency as well.

3.2.4 Implementation Phase

The implementation phase involved several testing cases in order to measure either the project has achieve the objectives or not. There are several testing to be conducted such as functional testing and usability testing.

The functional testing can be divided into two main categories which are white box testing and black box testing. White box testing will be tested on both of the marketing expert and AR expert. Meanwhile, the black box testing will be tested on a sample group of people between 15 to 35 years old. This functional testing will be implemented in order to ensure all of the functions in the application work as what it supposes to be.

Meanwhile, for the usability test, the famous System Usability Scale (SUS) will be used because it is reliable in interpreting subjective issue especially in term of system's usability and learnability. It will be conducted on two sample groups of people. To record the responses from the audience, an interview will be conducted to the sample groups and a questionnaire will be distributed to them. The first sample group is men and women between 15 to 35 years old. The questionnaire will be tested on several main scopes in order to ensure the successful of ReADroid. For example:

- The easiness of using the application without guidance.
- The capability to understand the message being delivered from the advertisement.
- The capability to remember about the advertisement, the product and the advertiser.
- The reaction before, after and while using the application.
- The perception of the user towards the application.

Instead of that, the same main scopes will be tested on different sample group of people which is the children below 15 years old. However, for this group of people, a video will be recorded to show their responses before, after and while using the application. To strengthen the result, several questions will be asked and video will be recorded for proves.

3.3: Tools

Hardware

Debugging process during the application development requires a target machine connected to the development machine. The development machine is used to install Unity 3D Pro, QCAR, Blender and the other tools for the purpose of development only. Meanwhile, the target machine here is referring to an Android smartphone connected to the development machine using 5-pin micro-USB 2.0 cable.

Since this is an AR application, it cannot be used with Android emulator for debugging process because it needs the camera to capture the image. However, the Android Logcat in the Android Software Development Kit is still relevant to be used in order to retrieve warnings and errors. Below are the specifications of the hardware used in the development of ReADroid.

Development Machine Specification (Acer Aspire 4530)

- Processor - AMD Turion X2 Dual-Core Mobile Technology RM-74 (2.20 GHz)
- Video Subsystem - NVIDIA GeForce 9100M integrated
- RAM – 2.00 GB of DDR2 667 MHz memory.
- Platform – Microsoft Windows 7 Ultimate (32-bit)

Target Machine Specification (HTC Desire Z)

- Chipset – Qualcomm MSM 7230 (800 MHz) with Adreno 205
- RAM – 512 MB
- ROM – 1.50 GB
- Platform – Android 2.2 (Froyo) Build 1.34.405.5
- Camera – 5.0 megapixel with autofocus and flash
- Internet – 3G, GPRS, EDGE, Wi-Fi

Android Development Environment

Eclipse IDE:

It is the integrated development environment like Netbeans, where the tool used by developer to build application especially in adding the layers to the application interfaces.

Android SDK:

The plug-in provided in Android Software Development Kit (SDK) assists in invoking .apk archive file to enable the .apk archive file running without using the real smart phone. It is also very useful in retrieving the warnings and errors through the Android Logcat. [6][9]

Cygwin and Android NDK:

Since Dalvik Virtual Machine only supports Java Programming Language, by using NDK, the libraries need to be linked with the libraries used in Java parts. Then, Cygwin can be used to build and update the entire project so that developer can simply run the project. [6][9]

AR Development

Qualcomm Augmented Reality or QCAR

QCAR is AR framework for Android. It handles everything related to AR in Android by using the predefined methods, algorithms and libraries developed by Qualcomm Developer Network or QDevNet.

Graphic Development

OpenGLES 1.x

It is application programming interface (API) for the embedded version of OpenGL with several limitations. OpenGL ES can be used to draw simple 3D object in virtual reality. [6]

Blender

Blender is used to create 3D object that is more complex for AR. The finished object will be published according to certain standard format that compatible with Android to be exported. This tools help to counter the problem of drawing 3D object programmatically using OpenGL ES.

Unity 3D Pro

The software is used together with the QCAR framework as the extension. Object created from Blender will be posted to Unity and AR scene will be created there. The development environment runs on Microsoft Windows and support several output including for Android, iPhone, Wii, PlayStation 3, Xbox and the others. This is where most parts of the application being developed.

3.4: Key Milestones / Gant Chart

The key milestones that need to be achieved for the Final Year Project (FYP) are as below and kindly refer to the Gantt chart at the attachment for more details.

Milestone	Date
Project Proposal	5 October 2011
Extended Proposal	2 November 2011
VIVA: Proposal Defense and Progress Evaluation	23 November 2011
Interim Report	7 December 2011
Technical Report	21 December 2011
Progress Report	7 March 2012
Pre-SEDEX	4 April 2012
Soft Bound Dissertation	12 April 2012
SEDEX	17 April 2012
VIVA	25 April 2012
Technical Report	26 April 2012

Figure 16: The key milestones of FYP

CHAPTER 4

RESULT AND DISCUSSION

This chapter discussing on all of the results collected from most of the phases in the system development process. The result helps to support the evidence towards achieving the objectives together with the discussion. This chapter will describe on several main aspects mentioned below.

- Survey data collection and analysis
- System and software architecture
- Prototype development and testing
- Challenges and solutions.

4.1: Survey Data Collection and Analysis

Based on the random sampling method, the questions have been distributed using Facebook and email for 100 respondents. (*See also Attachment 1*). Based on Figure 17, most of the respondents came from the age of 15-24 years old. Among the respondents, 58% are male and the other 42% are female.

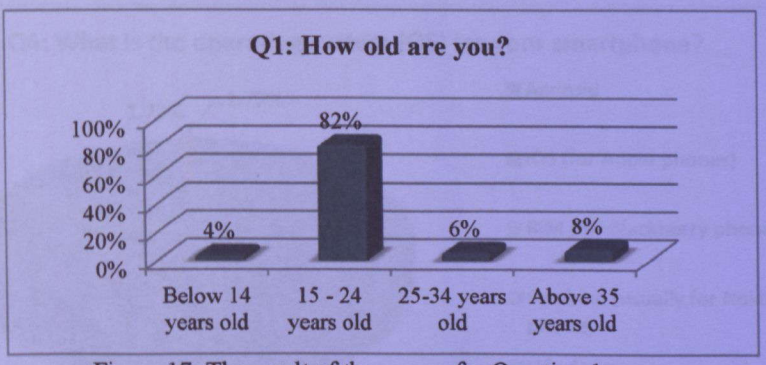


Figure 17: The result of the survey for Question 1

Based on Figure 18, among all of the respondents, 56% of them got the smartphone. From this percentage, the first and second highest groups that got the smartphone came from 15 to 24 years old group and 25 to 34 years old group with 83.93% and 10.71% for each of them. Thus, the implementation of ReADroid will be accessible by most of the targeted users of age between 15 to 35 years old because most of them have the smartphone.

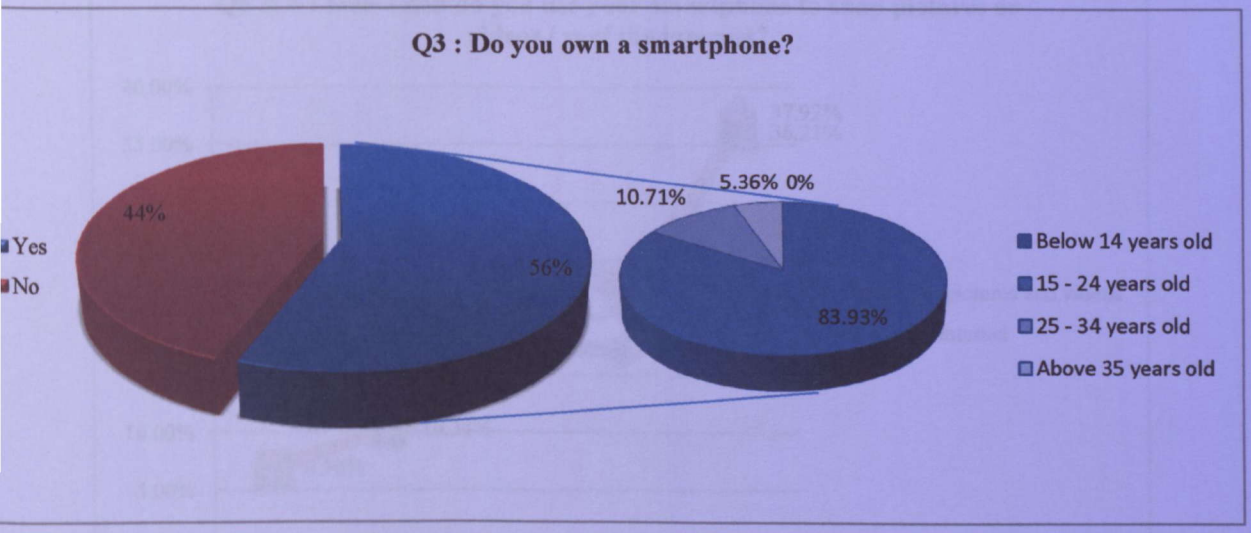


Figure 18: The result of the survey for Question 3

Among all of the smartphone users, Android is the most famous operating system followed by iOS, RIM, Symbian, Windows and Others (MeeGo). Based on Figure 19, Android is leading the OS used by the respondents far in front of the others with 51.73% from 56% of smartphone users. This show that Android is the best platform to be used as more users are able to be reached.

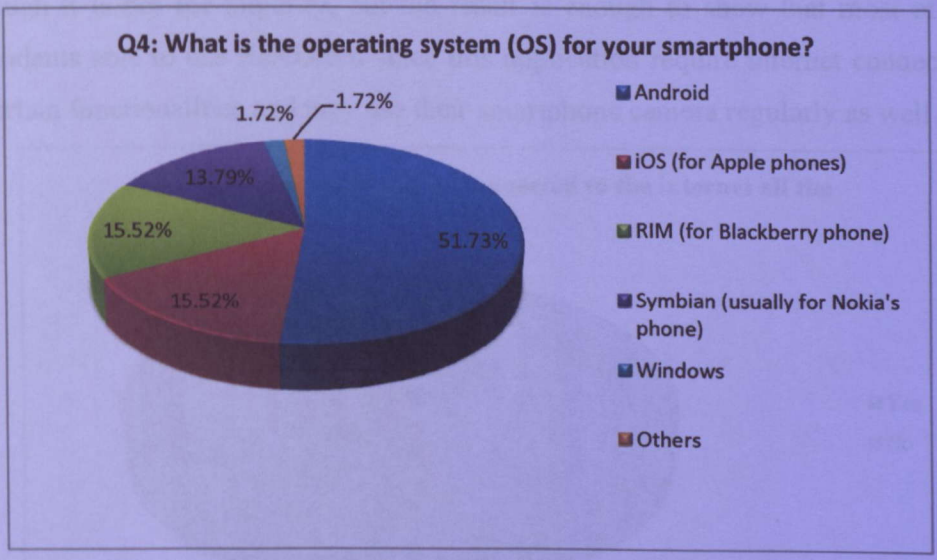


Figure 19: The result of the survey for Question 4

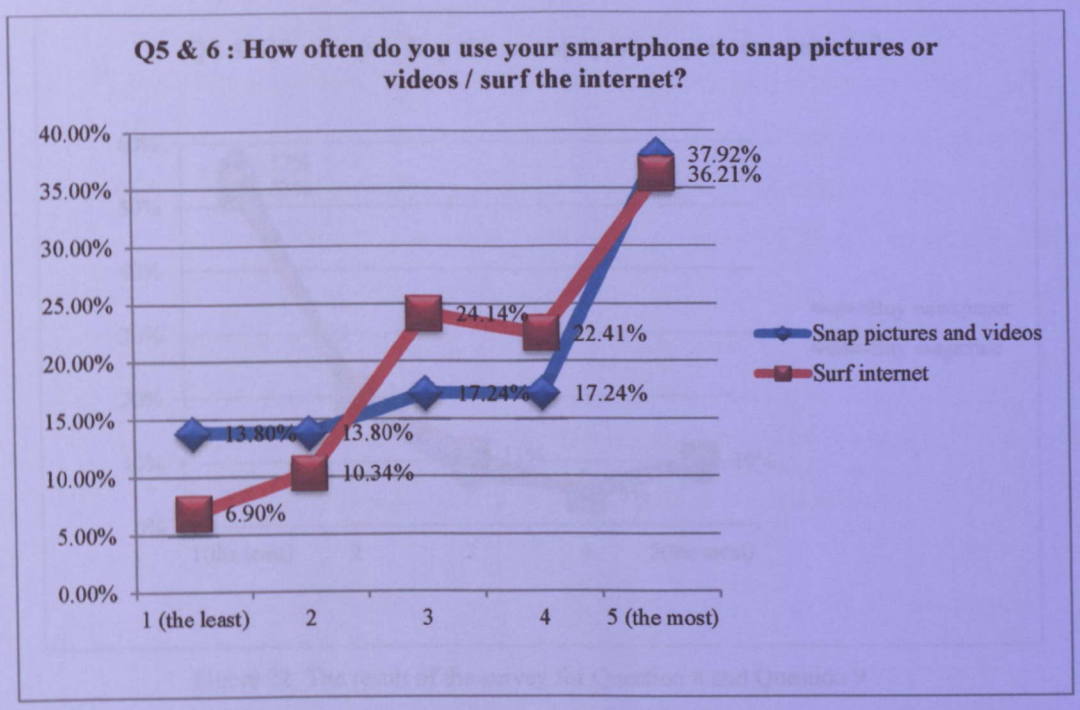


Figure 20: The result of the survey for Question 5 and 6

Based on Figure 20, most of the respondents that have the smartphone use their smartphone to snap pictures, videos and surf the internet. It also supported by question 7 based on Figure 21 that show 46.55% of the smartphone users among the respondent claimed that their smartphone is connected to the internet all the time. Although it is not the majority, but the result is enough to show that most of the respondents able to use ReADroid since this application require internet connection for certain functionalities and they use their smartphone camera regularly as well.

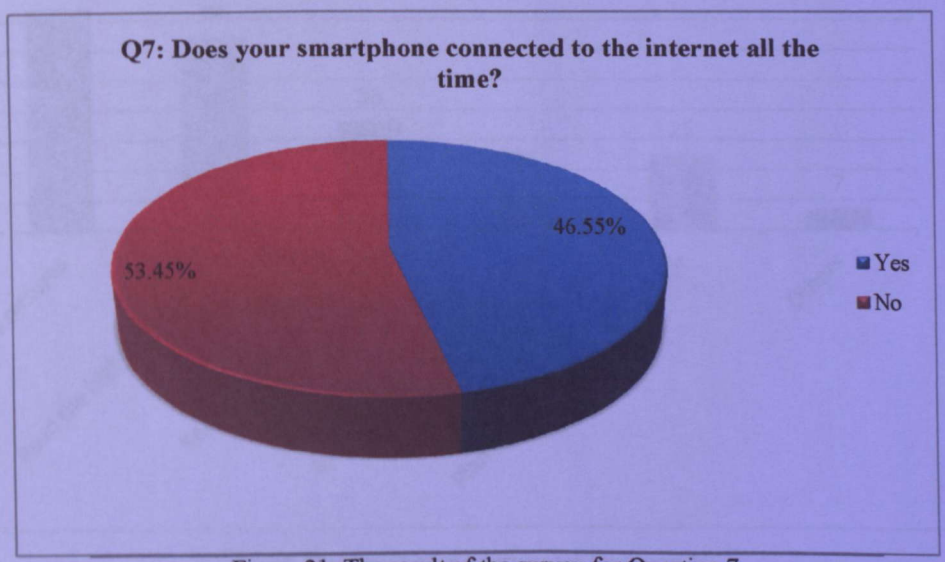


Figure 21: The result of the survey for Question 7

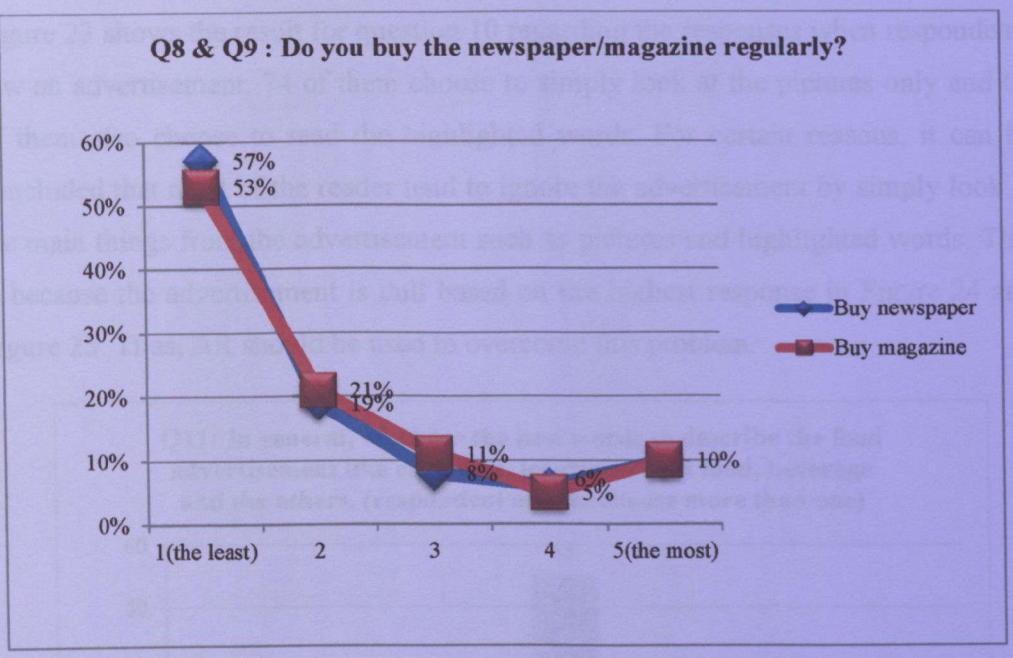


Figure 22: The result of the survey for Question 8 and Question 9

Based on Figure 22, from the question 8 and question 9, it clearly shows that most of the respondents do not buy newspaper and magazine regularly. This result can be used to show that the implementation of ReADroid can be done at the chocolate wrapper as an alternative because people will get the wrapper together each time they buy the product. Thus, people who bought the chocolate has high tendency to use the

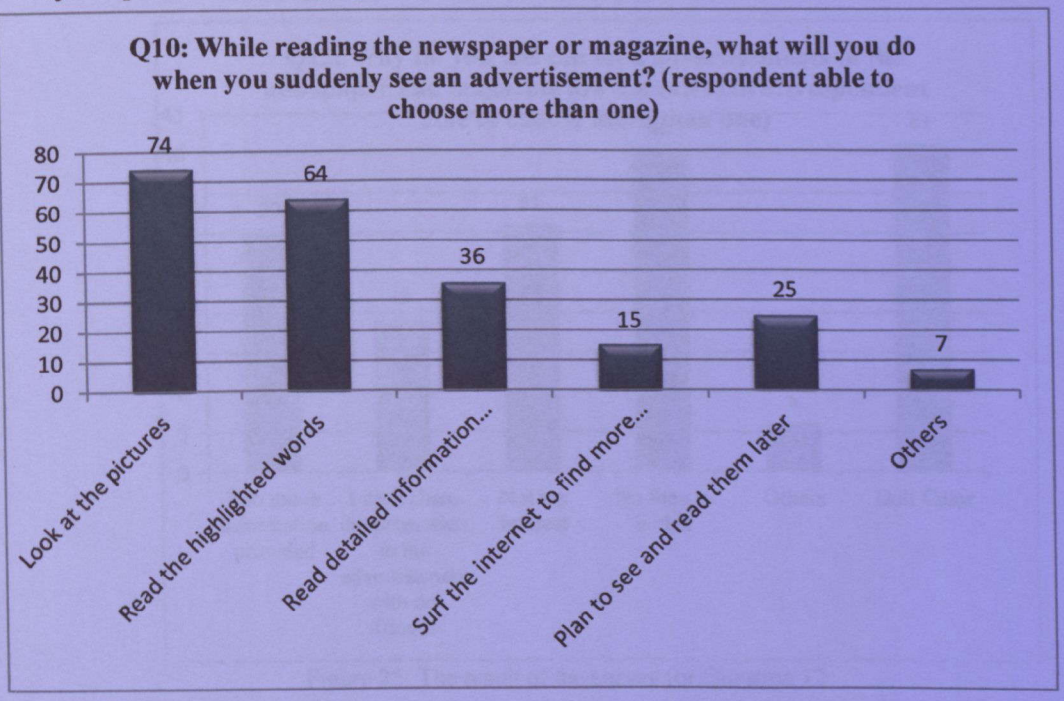


Figure 23: The result of the survey for Question 10

Figure 23 shows the result for question 10 regarding the responses when respondents saw an advertisement. 74 of them choose to simply look at the pictures only and 64 of them also choose to read the highlighted words. For certain reasons, it can be concluded that most of the reader tend to ignore the advertisement by simply look at the main things from the advertisement such as pictures and highlighted words. This is because the advertisement is dull based on the highest response in Figure 24 and Figure 25. Thus, AR should be used to overcome this problem.

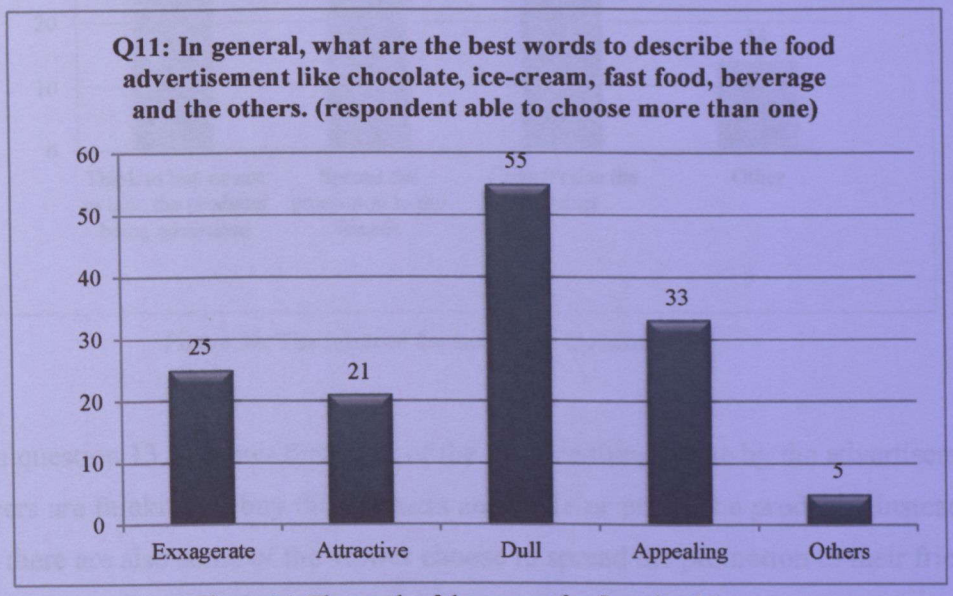


Figure 24: The result of the survey for Question 11

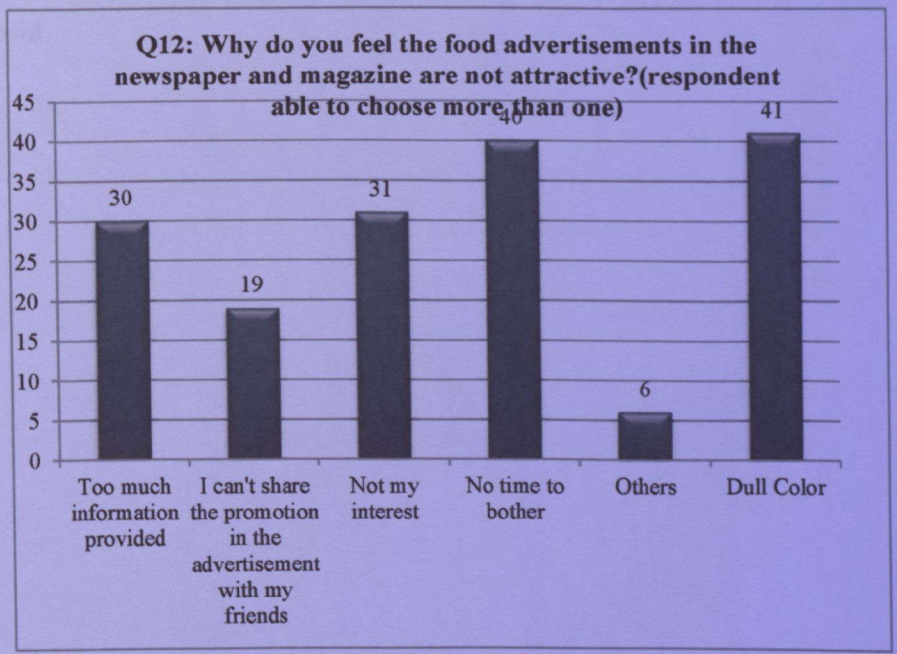


Figure 25: The result of the survey for Question 12

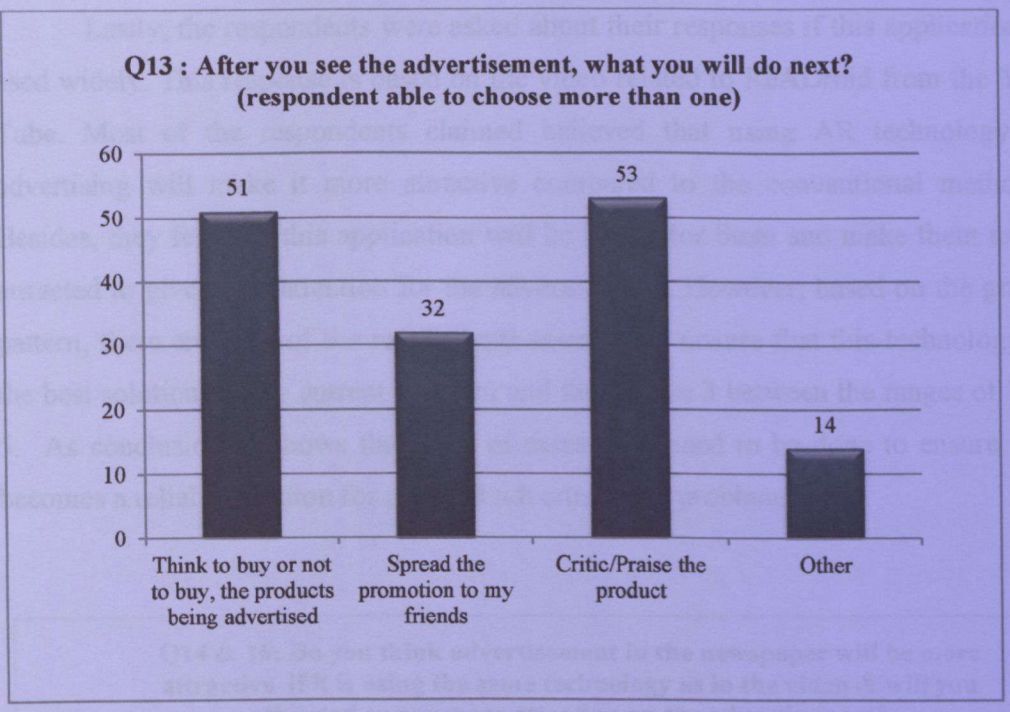


Figure 26: The result of the survey for Question 13

From question 13, it shows that most of the favorite things done by the advertisement viewers are thinking to buy the products and critic or praise the products. Instead of that, there are also some of the viewer choose to spread the promotion to their friends as well. This information can be used for the additional functionalities to be included in ReADroid.

Lastly, the respondents were asked about their responses if this application is used widely. This response is based on the video related to ReADroid from the You Tube. Most of the respondents claimed believed that using AR technology in advertising will make it more attractive compared to the conventional methods. Besides, they feel that this application will be useful for them and make them more attracted to give more attention for the advertisement. However, based on the graph pattern, there are a lot of the respondents seem to be unsure that this technology is the best solution for the current problem and they chose 3 between the ranges of 1 to 5. As conclusion, it shows that a lot of researches need to be done to ensure AR becomes a reliable solution for physical advertisement problems.

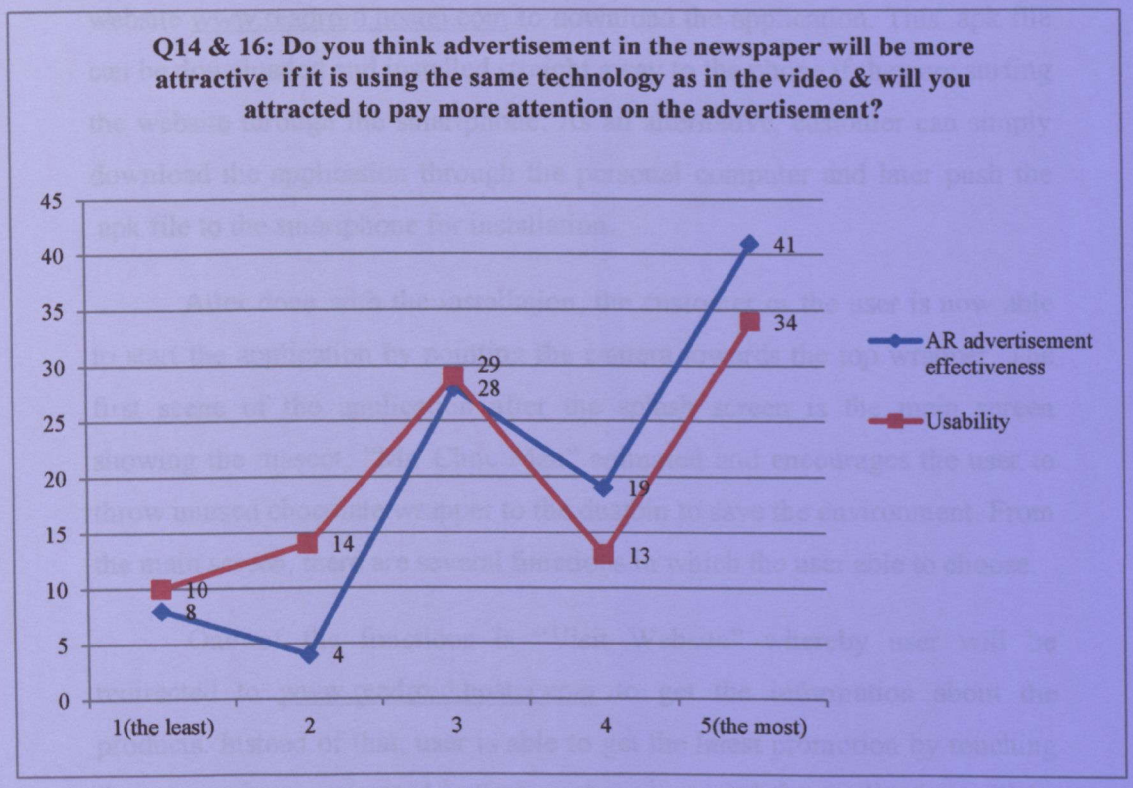


Figure 27: The result of the survey for Question 14 and Question 16

4.2: System and Software Architecture

4.2.1 System Flowchart (ReADroid)

Based on the figure 28, ReADroid is following the flowchart mentioned below in order to work perfectly. This flowchart also describes on how the application works from the first time customer see the advertisement until it terminates the application.

Firstly, when the customer buys the chocolate bar, the wrapper will be given in default. On the top wrapper, a short note will be displayed to show that the wrapper can be used with the application together with the steps to download the application. Based on figure 28, customer should proceed to the website www.readroid.hostei.com to download the application. This .apk file can be downloaded and installed straight away to the phone if they are surfing the website through the smartphone. As an alternative, customer can simply download the application through the personal computer and later push the .apk file to the smartphone for installation.

After done with the installation, the customer or the user is now able to start the application by pointing the camera towards the top wrapper. The first scene of the application after the splash screen is the main screen showing the mascot; "Mr. Choc Man" animated and encourages the user to throw unused chocolate wrapper to the dustbin to save the environment. From the main screen, there are several functions in which the user able to choose.

One of the functions is "Visit Website" whereby user will be redirected to www.readroid.hostei.com to get the information about the products. Instead of that, user is able to get the latest promotion by touching the appropriate augmented button on the screen and the application will be redirected to www.readroid.hostei.com/1_5_Promotion.html and same goes to "Drop Comment" that will be redirected to www.readroid.hostei.com/1_6_Your-Opinion.html. The most interesting function that user able to proceed is "Play Game". To play the game, user need to turn over the wrapper and use the bottom part of the chocolate wrapper to be the target marker.

Basically, there are three types of games available to the user. However, there is only one game available each time the user buy a chocolate because the bottom part of the chocolate wrapper will only print the texture image for one target marker. As one of the marketing strategy for the advertiser to maximize profit, in order for a user to get all three games, they need to buy the chocolate repeatedly until they get all three different types of game.

Referring back to the figure 28, after the user turn over the wrapper, for each of the game, an instruction will be given on how to play the games. If the user proceeds to the next scene, the game will be started and the time given to complete the games is 30 seconds followed by the last scene that will display the score or game points for each of the games.

In each scene of the games, the user is always able to return to the main screen. Besides, the user is also able to change from one game to another by simply point the camera to the other target markers. This is because the modules are being separated by scene and not by game types. *(See Also 4.2.3 Software Architecture)*

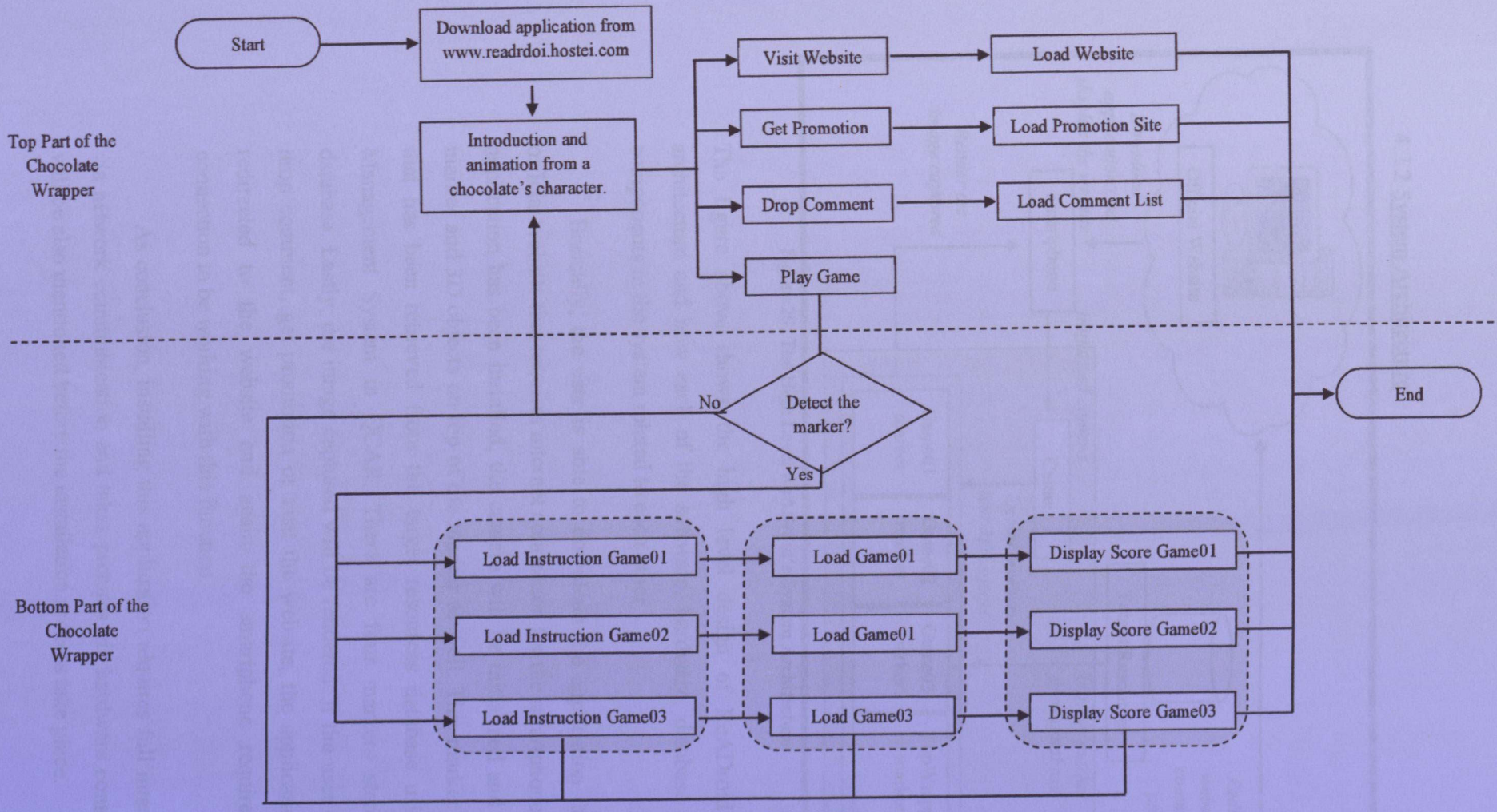


Figure 28: The flowchart of the application

4.2.2 System Architecture

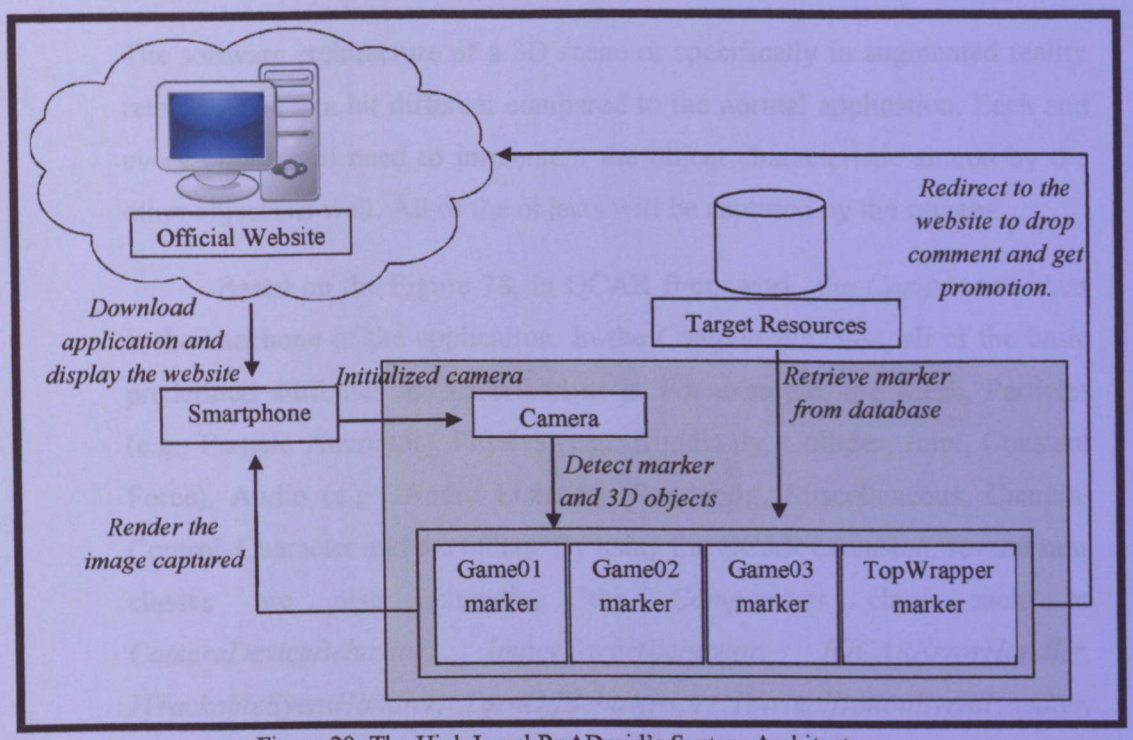


Figure 29: The High Level ReADroid's System Architecture

The figure above shows the high level design of ReADroid's system architecture and how each of the software, hardware, database and other components in the system related to each other.

Basically, the user is able to download the application through the official website that requires internet connection for the smartphone. Once the application has been installed, the camera will be initialized and detect the marker and 3D objects on top of the marker as well. This marker is the one that has been retrieved from the target resources database using Target Management System in QCAR. There are four markers stored in the database. Lastly, the image captured will be rendered. If the user chooses to drop comment, get promotion or visit the website, the application will be redirected to the website and again the smartphone requires internet connection to be working with this function.

As conclusion, installing this application requires full internet access via network communication and takes pictures via hardware controls which will be also mentioned before the installation process take place.

4.2.3 Software Architecture

The software architecture of a 3D scene or specifically in augmented reality related scene is a bit different compared to the normal application. Each and every object will need to implement the object characteristic shared by the other objects as well. All of the objects will be captured by the camera.

Based on the Figure 28, in QCAR framework, the *Components* class is the backbone of the application. In the *Components* class, all of the basic predefined attributes are described in it. For example, the Mesh, Particles (e.g.: Particle Animator), Physics (e.g.: Rigidbody, Collider, Joint, Constant Force), Audio (e.g.: Audio Listener), Rendering, Miscellaneous, Camera-Control, Character and the others. By using the QCAR extension, several new classes are also extending the *Components* class such as *CameraDeviceBehavior, ImageTargetBehavior, IQCARErrorHandler, ITrackableEventHandler, TurnOffBehavavior, IVirtualButtonEventHandler, QCARMacros , VirtualButtonBehavior, VBSoccerballEventHandle* and the others in which these classes help to create augmented scene.

For example, *ImageTargetBehavior* is used at the target image *(Game01, Game02, Game03, TopWraper)* in order for the image captured by the phone camera is able to be retrieved from the Target Management System and build the other game objects created as the children of the target image on top of it. Instead of that, several user defined classes are also created in order to add additional characteristics to the object instead of the predefined attributes including *aMainMenuButton, aPlayButton, aStartGameButton, aWebsiteButton, aExitButton, adPie01, aitem01, aScoreBoard, collision01* and the others. Most of the classes are very useful in connecting the relationship between a game object to the others.

In a 3D scene, the camera will be at the highest rank because it captures everything in the scene. By using QCAR, *ARCamera* is used as a replacement or *MainCamera*. This call will extend the other game objects in the scene as well.

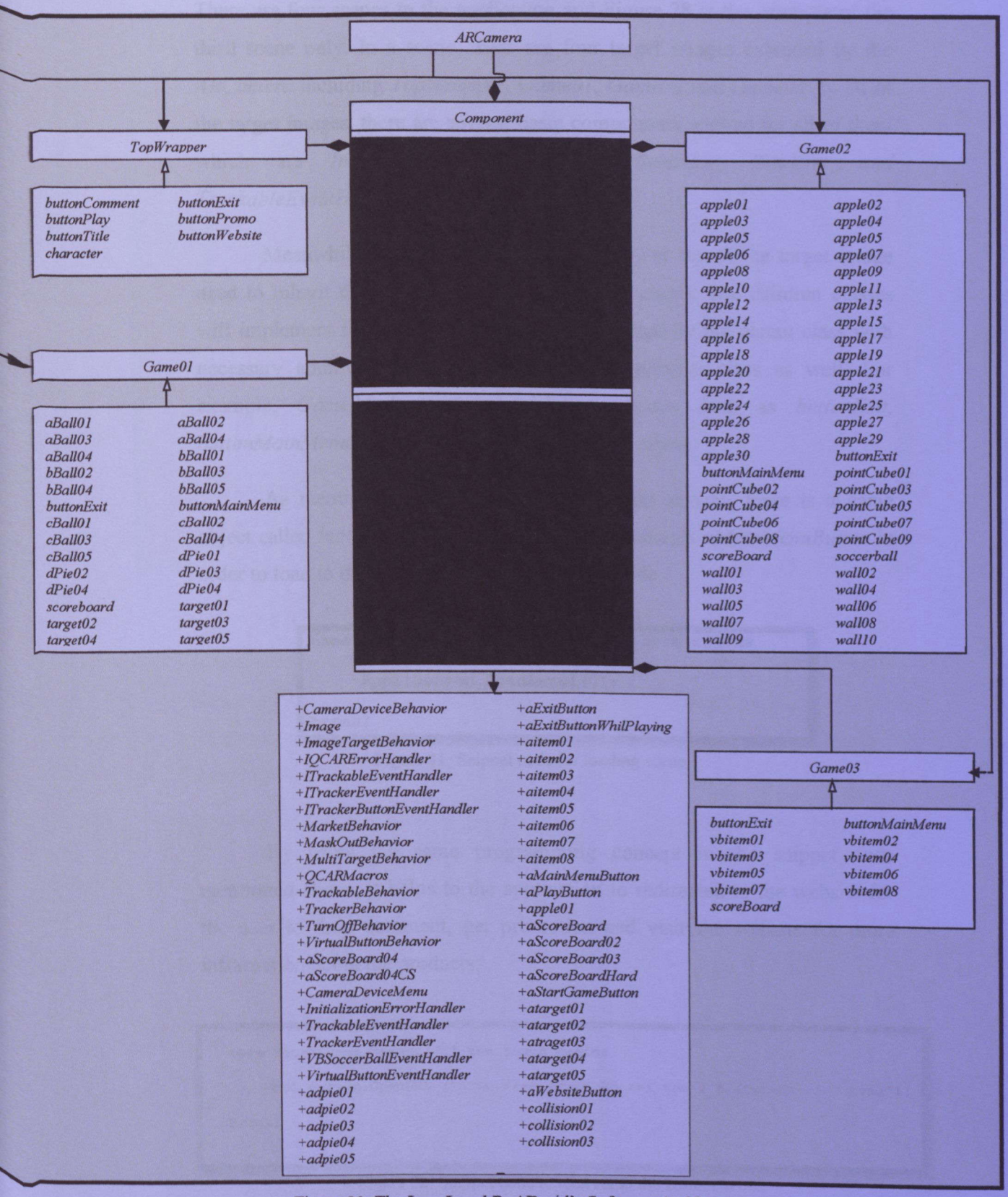


Figure 30: The Low Level ReADroid's Software Architecture

There are four scenes in the application and Figure 28 is the example of the third scene only. In a scene, there are four target images extended by the *ARCamera* including *TopWrapper, Game01, Game02* and *Game03*. In all of the target images, there are several basic components applied for all of them which are *ImageTargetBehavior, TurnOffBehavior, Renderer and TrackableEventHandler.*

Meanwhile, the 3D game objects display at top of the target image need to inherit the target image's class (parent class). The children classes will implement the same components implemented by the parent class with necessary additional attributes from the *Components* class as well. For example, *Game34* has several children classes such as *buttonExit, buttonMainMenu, vbitem01, scoreBoard* and the others.

As mentioned earlier, in all of the target images, there is a game object called *buttonMainMenu*. This object implements *aMainMenuButton* in order to load to the first scene with this line of code.

```
case TouchPhase.Began://if the touch begins
    Application.LoadLevel(0);
break;
```

Figure 31: Snippet code for loading scene

By using the same programming concept in the snippet code mentioned above, it helps to the application to redirected to the website for the user to drop comment, get promotion and visit the website for more information about the products.

```
case TouchPhase.Began://if the touch begins
    Application.OpenURL ("http://readroid.hostei.com/1_6_Your-Opinion.html");
break;
```

Figure 32: Snippet code to redirect to the comment box

4.3: Prototype Development and Testing

4.3.1 Graphical User Interface

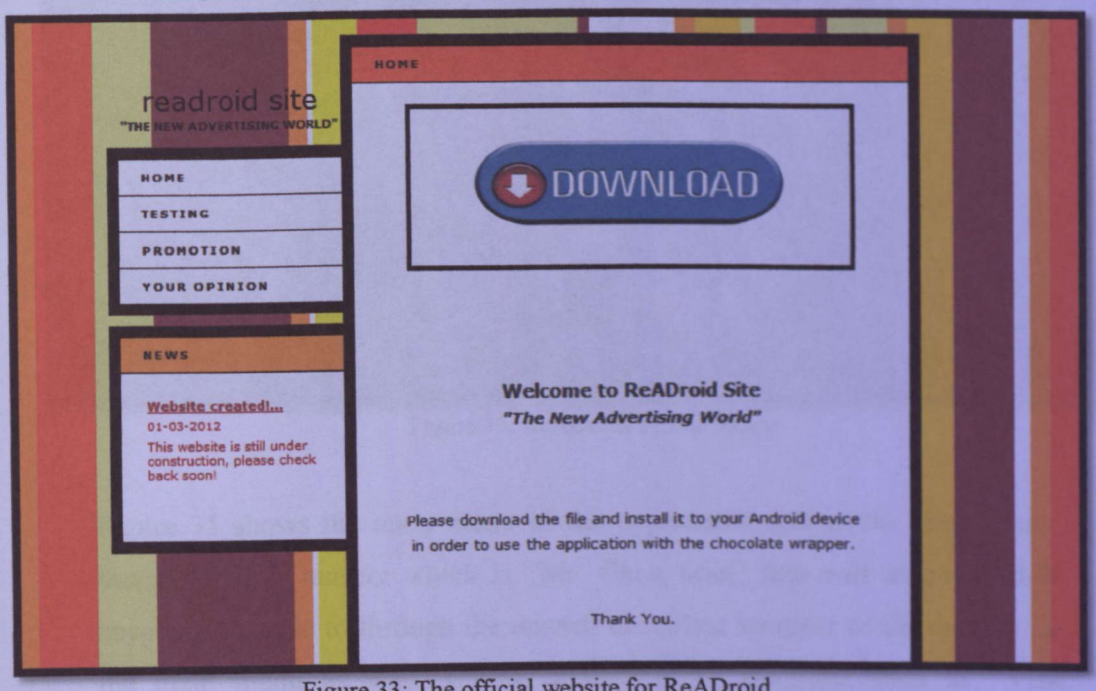


Figure 33: The official website for ReADroid

Figure 33 shows the official website for this application where it provides the information about the product and also the main medium used for the customer to download the application to their smartphone. Meanwhile figure 34 shows the splash screen of the application where this is the first GUI that user will see when using the application.

Figure 34: ReADroid's Splash Screen

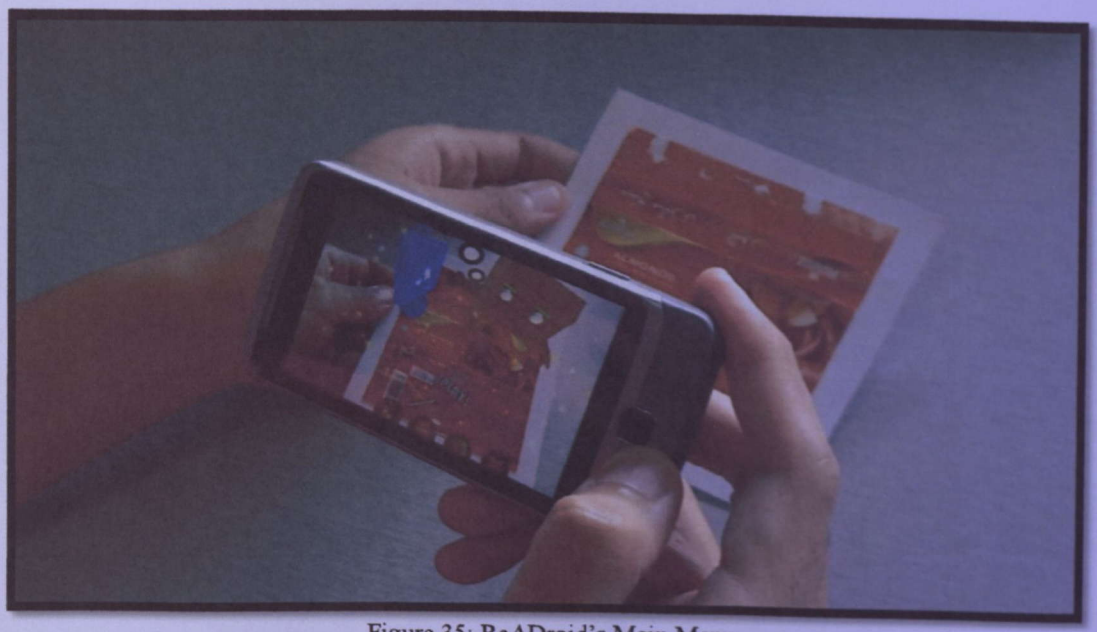


Figure 35: ReADroid's Main Menu

Figure 35 shows the main menu of the application and in the main menu, there will be a mascot which is "Mr. Choc Man" that will animate while encourage people to through the unused chocolate wrapper to the dustbin. In the main menu as well, several functions are available such as "Visit Website", "Get Promotion" and "Drop Comment". Thus, figure 36 shows the example of a user who dropped a comment to the comment box.

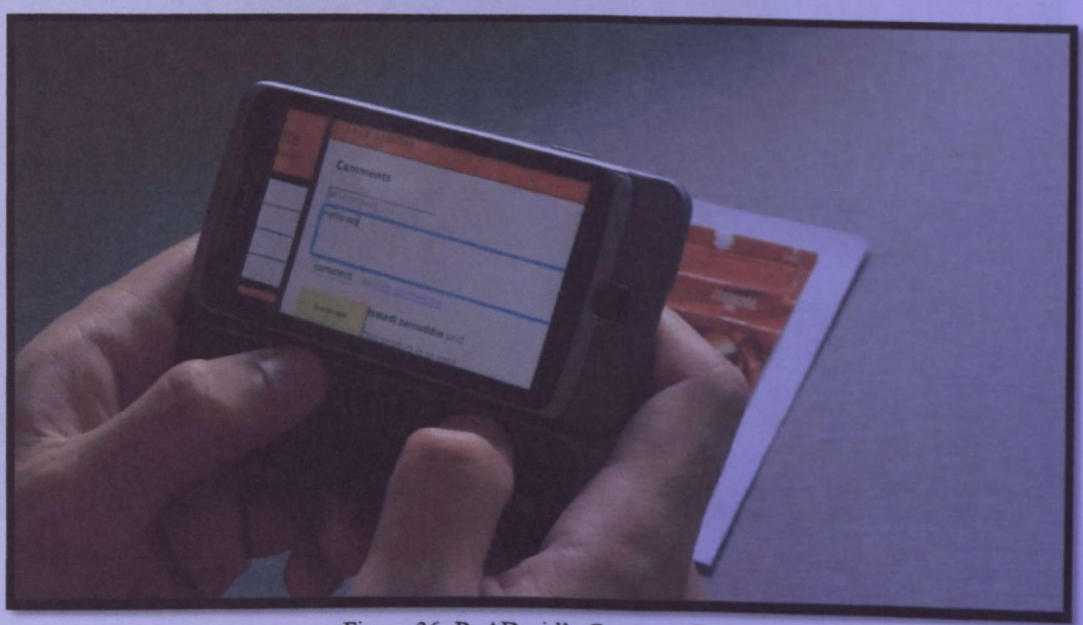


Figure 36: ReADroid's Comment Box

Figure 37: ReADroid's Game Instruction (example from Game03)

When the user turns back the wrapper, the picture shown above is the example that gives the instruction to the user on how to play the games for Game03 and it is almost the same for the other games. Once the user touches "START!" on the screen, the game will be loaded. While playing the game, user will be informed with the time left available to complete the tasks and the current point user got from the games as shown in the figure below.

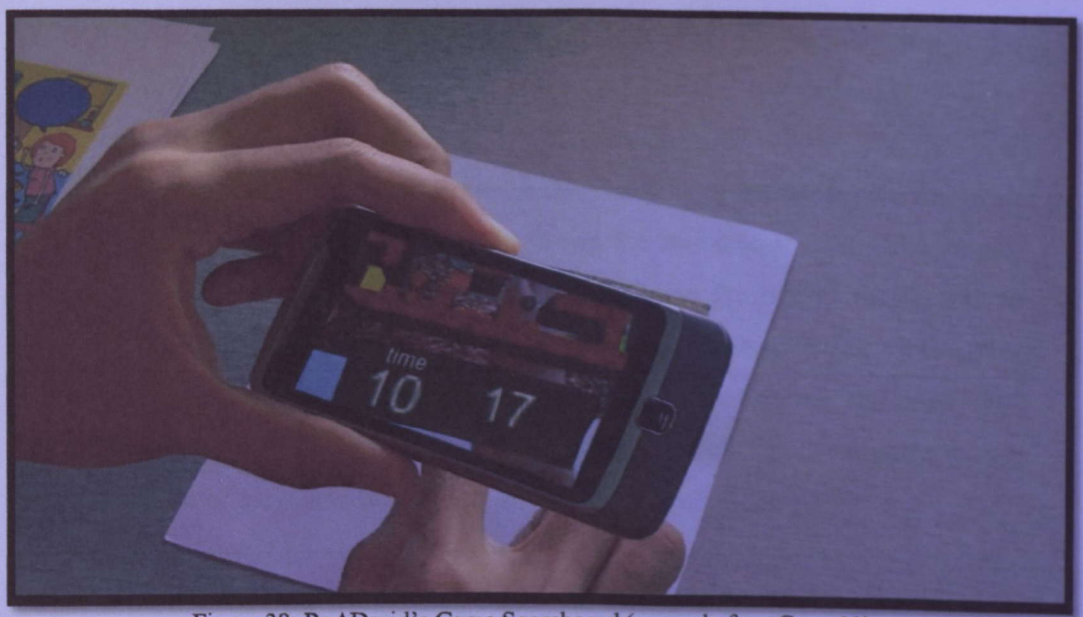


Figure 38: ReADroid's Game Scoreboard (example fromGame02)

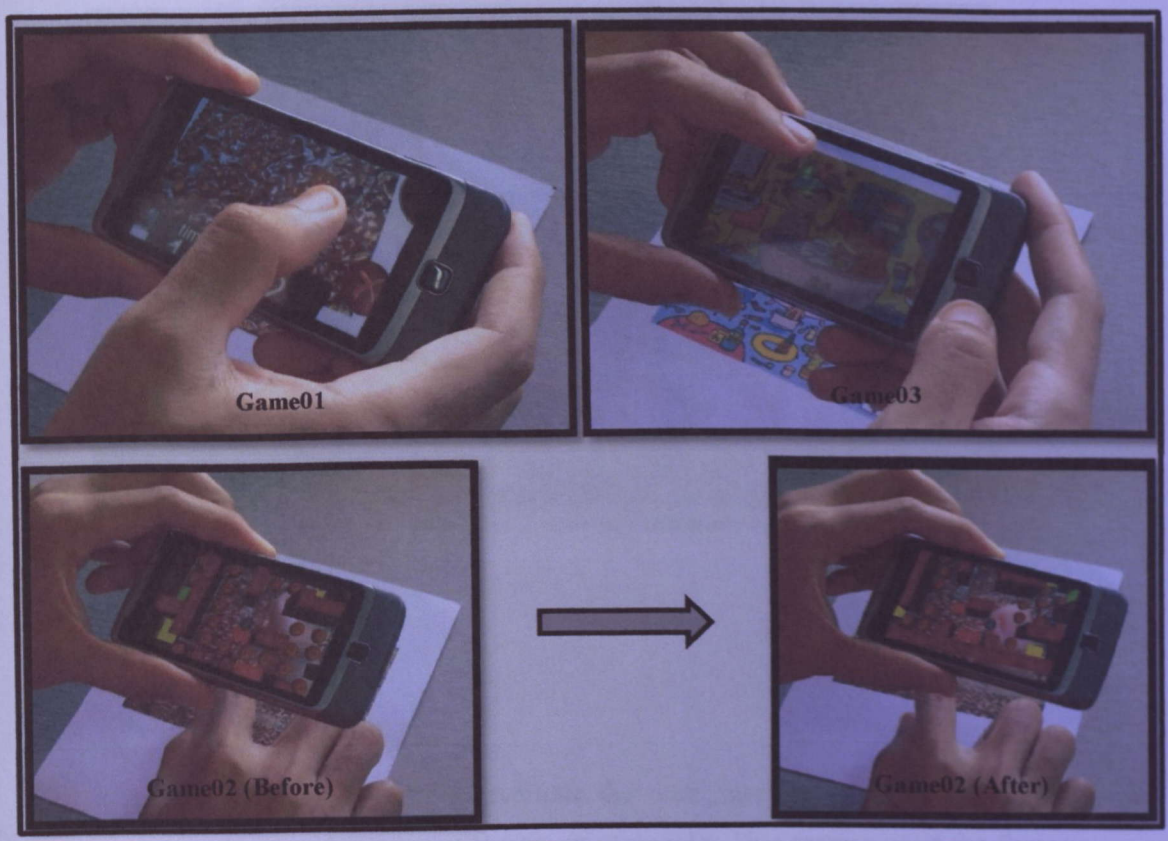


Figure 39: ReADroid's Games

Figure 39 shows various kinds of games available in ReADroid. The first game is Game01 where user needs to touch the "Garlic Bread Men" in order to score a point. The second game is Game02 whereby user needs to move his or her finger in the air in order to make to ball moving. Certain points will be given if the ball hit the "Apples" or pass through the "Red", "Yellow" or "Green" planes in which pass through the "Green" planes will awarded with the highest point. The picture above shows the movement of the augmented football before and after being hit by the fingers in the real world. The third game is Game03 where user needs to help a girl named Alice to find her stuffs missing in her own messy bathroom. After 30 seconds, the score will be displayed automatically and now, user can choose either to return to the main menu or terminate the application as shown in the figure 40.

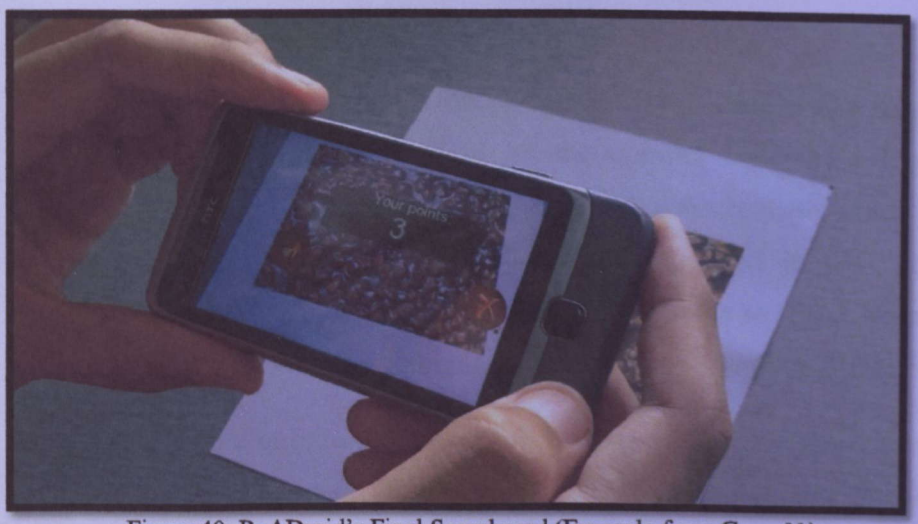


Figure 40: ReADroid's Final Scoreboard (Example form Game01)

4.3.2 Testing

A testing has been done to evaluate the user perception on the application among the sample group of the targeted people. This testing used the famous System Usability Scale to evaluate the application since this tool is reliable to measure usability and learnability of the users. [46] *(See Also Appendix02: SUS Testing)*.

The survey has been conducted among 20 males or females with the range of ages from 15 to 35 years old. They are required to use the application and give their immediate responses to the questionnaires provided without taking too much time to answer a particular question.

Each of the questions in the questionnaire does not mean anything without the total score from the user responses. Based on the responses from the users in the figure 41, the total SUS score for this application is 81.75 in which most of the users feel that this application is very easy to use and relevant to be the solution for the problem in the current physical advertisement. This score is considered as 'A' or excellent because it is more than 80 and indicate that the usability and learnability from the users' perception are high.

Instead of the questions based on the SUS, there are several open ended questions has been asked to get the opinion from the respondents regarding the application. For example, 80% of the respondents would like to buy the product if this AR technology is being used in the chocolate advertisement. This shows that AR implementation able to attract customers' attention and they even willing to pay and buy more to use the application.

Besides, a question was asked to test the memory of the respondents after using the application. 85 % of the respondents able to remember all three games they have played and the other 15% able to remember two out of three games they have played before. This shows that the interaction between the user and the application has made the advertisement easy to be remembered and thus, it will create the brand recognition for the product among the customers.

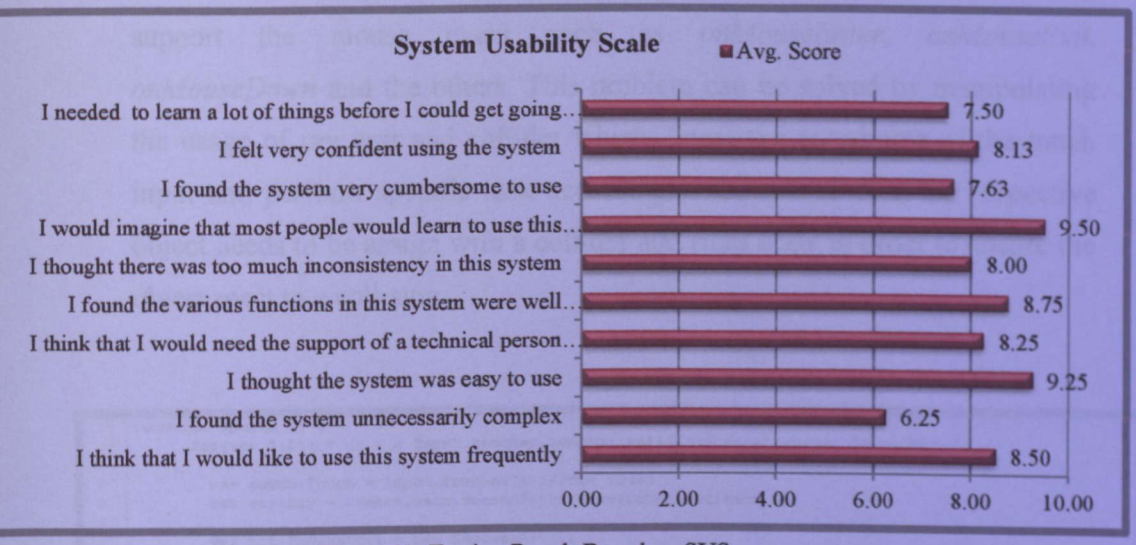


Figure 41: Testing Result Based on SUS

4.4: Challenges and Solutions

Along the development, there are several major obstacles faced by the developer in completing the development of ReADroid.

Firstly, the developer found that using AndAR as the framework will require very long and tough codes in order to come out with the 3D objects and augmented scenes. The problem became worse when the AndAR community in the internet is so passive in discussing several issues related to the framework. To ensure that the development processes going well, the developer needed to migrate several line of codes and 3D objects from AndAR to the new framework being used which is QCAR. The migration resulted to a slower development processes.

Secondly, Unity 3D Pro does not have any specific function to detect Android touch screen input because all of the predefined functions only support the mouse event such as *onMouseEnter*, *onMouseExit*, *onMouseDown* and the others. This problem can be solved by manipulating the usage of ray cast and collider which detect the coordinate of the touch input and perform specific task accordingly. Instead of that, the respective object needs to be assign with a collider and rigid body in order to ensure the object react to a collision.

```
function Update () {
    for(var i:int = 0; i < Input.touches.Length; i++)//How many touches do we have?
    {
        var touch:Touch = Input.touches[i];//The touch
        var ray:Ray = Camera.main.ScreenPointToRay(touch.position);

        var hit:RaycastHit = new RaycastHit();
        if(Physics.Raycast(ray,hit, 1000))
        {
            if(hit.collider.gameObject == this.gameObject)
            {
                switch(touch.phase)
                {
                    case TouchPhase.Began://if the touch begins
                        break;
                    case TouchPhase.Ended://If the touch ends
                        break;
                    case TouchPhase.Moved://If the finger moved
                        break;
                    case TouchPhase.Stationary://While touching the screen and didn move the finger.
                        break;
                    default:
                    break;
                }
            }
        }

    }
}
```

Figure 42: Snippet code of detecting touch screen input

CHAPTER 5

CONCLUSION AND RECOMMENDATION

ReADroid has changed the chocolate advertisement to be more attractive and visible by using AR approach. This interactive and engaging AR advertising application overcomes the limitation in conventional physical advertisement. Consequently, ReADroid creates high possibilities of customer to view and come back to the advertisement and buying the advertised product. Besides, strong brand name is created because interactive advertisement creates long-term memory among the viewers toward the advertisement. Thus, this research is another contribution on the AR technology to be usable and acceptable by the community and contributes to higher chances of getting more profit for the business.

For the future works, in the horizontal perspective, this AR advertising application for chocolate advertisement can be made compatible with other operating system such as iOS, RIM, Symbian and the others across various types of smartphone. The advertisement should be the combination of object-based and game-based rather than solely on game-based to ensure the advertisement objective is achieved. Instead of that, various games should be developed to attract more customers.

Meanwhile, in the vertical perspective, the graphic for this application should be improved. Besides, the processing time of the application should be improved and getting faster. The advertisement should be customized based on different preferences from different viewers. Therefore, the advertisement will reach the right customers at the right time.

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APPENDIXES

(Please refer to the next page)

Appendix 01: The Survey

Hi,

As for completing the final year project, I am in the midst of distributing the survey questions that are related to the enhancement of physical advertisement like newspaper, magazine, brochure and flyer. I believed, most of the people used to buy or read one of them. Thus, I would really appreciate if you are willing to participate in this survey.

About the survey:

This survey is looking for the responses of the people towards the advertisement in the newspaper, magazine, brochure or flyer. Specifically, it is referring to the food advertisement like chocolate, ice cream, fast food and the others. By using technology, this advertisement can be enhanced and the responses from this survey will be used to implement Augmented Reality Advertisement on Android (ReADroid).

Your participation in this research is voluntary and completion of the survey is an indication of your informed consent to participate. You are under no obligation to participate in the study. You can decide to withdraw at any point prior to, or during the study. If you decide to withdraw, any information that has already been provided in the survey will not be used.

If you agree to participate, please complete the questionnaires below:

http://www.surveypie.com/survey101011

Survey For Augmented Reality Advertisement on Android (ReADroid)

About this survey:

This survey is looking for the responses of the people towards the advertisement in the newspaper, magazine, brochure **AND** flyer. Specifically, it is referring to the food advertisement like chocolate, ice cream, fast food and the others. By using technology, this advertisement can be enhanced and the responses from this survey will be used to implement Augmented Reality Advertisement on Android (ReADroid).

Section A : Personal Details

(Briefly describe your personal details based on the questions below)

1. **How old are you?** *
   - A. Below 14 years old
   - B. 15 - 24 years old
   - C. 25 - 34 years old
   - D. Above 35 years old
2. **What is your gender?** *
   - A. Male
   - B. Female
3. **Do you own a smartphone?** *

   (Hint: Smartphone is a device that lets the user to make the telephone calls and send messages, but also with additional features that almost similar to a computer. For example, able to connect to the internet, send and receive emails, snap pictures, play games and songs, create and edit microsoft office documents, and the others)
   - A. Yes
   - B. No

4. **What is the operating system (OS) for your smartphone?** *

- A. Android
- B. iOS (for Apple phones)
- C. RIM (for Blackberry phones)
- D. Symbian (usually for Nokia's phone)
- E. Windows
- F. Others (please specify) [ ]
- G. I have no idea

5. **How often do you use your smartphone to snap pictures or videos?** *

A. 1 (The least) B. 2 C. 3 D. 4 E. 5 (The most)

6. **How often do you use you smartphone to surf the internet?** *

A. 1 (The least) B. 2 C. 3 D. 4 E. 5 (The most)

7. **Does your smartphone connected to the internet all the time?** *

- A. Yes
- B. No

Section B : Physical Advertisement

(This section will provide you with the questions regarding the advertisement in the newspaper, magazine, brochure and flyers)

8. **Do you buy the newspaper regularly?** *

A. 1 (The least) B. 2 C. 3 D. 4 E. 5 (The most)

9. **Do you buy the magazine regularly?** *

A. 1 (The least) B. 2 C. 3 D. 4 E. 5 (The most)

10. **While reading the newspaper or magazine, what will you do when you suddenly see an advertisement?** *

(You can choose more than one answer)

- ☐ A. Look at the pictures
- ☐ B. Read the highlighted words
- ☐ C. Read detailed information provided
- ☐ D. Surf the internet to find more information related to the advertisement
- ☐ E. Plan to see and read them later
- ☐ F. Others (please specify) _____

11. **In general, what are the best words to describe the food advertisements like chocolate, ice-cream, fast food, beverage and the others.** *

(You can choose more than one asnwer)

- ☐ A. Exaggerate
- ☐ B. Attractive
- ☐ C. Dull
- ☐ D. Appealing
- ☐ E. Others (please specify) _____

12. **Why do you feel the food advertisements in the newspaper and magazine are not attractive? (You can choose more than one answer)** *

- ☐ A. Dull color
- ☐ B. Too much information provided
- ☐ C. I can't share the promotion in the advertisement with my friends
- ☐ D. Not my interest
- ☐ E. No time to bother
- ☐ F. Other (please specify) _____

13. **After you see the advertisement, what will you do next?** *

- [ ] A. Think to buy or not to buy, the products being advertised
- [ ] B. Spread the promotion to my friends
- [ ] C. Critic/ praise the product
- [ ] D. Other (please specify)

Section C : Augmented Reality Advertisement

(Kindly watch this video before answering the following questions. Please use right click and choose "Open link in new tab")
http://www.youtube.com/watch?v=d6irc0iwKC8

14. **Based on the video you watched earlier, do you think advertisements in the newspaper will be more attractive if it is using the same technology as in the video?** *

A. 1 (The least) B. 2 C. 3 D. 4 E. 5 (The most)

15. **Have you ever tried that kind of application before?** *

- A. Yes
- B. No

16. **If you have the application, will you attracted to pay attention more on the advertisements in the newspaper, magazine, flyer or brochure?** *

A. 1 (The least) B. 2 C. 3 D. 4 E. 5 (The most)

17. **Do you any other opinion about the augmented reality advertisement?**

Appendix 02: SUS Testing

Section A : Personal Details

1. **How old are you?** *
   - A. Below 14 years old
   - B. 15 - 24 years old
   - C. 25 - 34 years old
   - D. Above 35 years old
2. **What is your gender?** *
   - A. Male
   - B. Female
3. **Type of the smartphone** *

   (e.g: HTC Desire Z, Samsung Galaxy II)
4. **What is the operating system for your Android device?** *
   - A. 1.5 (Cupcake)
   - B. 1.6 (Donut)
   - C. 2.0 (Eclair)
   - D. 2.1 (Eclair)
   - E. 2.2 (Eclair)
   - F. 2.3.x (Gingerbread)
   - G. 3.x.x (Honeycomb)
   - H. 4.4.0.x (Ice Cream Sandwich)

Appendix 02: SUS Testing

Section B : Usability Testing Based on SUS

5. I think that I would like to use this system frequently *

A. 1 (Strongly disagree) B. 2 C. 3 D. 4 E. 5 (Strongly agree)

6. I found the system unnecessarily complex *

A. 1 (Strongly disagree) B. 2 C. 3 D. 4 E. 5 (Strongly agree)

7. I thought the system was easy to use *

A. 1 (Strongly disagree) B. 2 C. 3 D. 4 E. 5 (Strongly agree)

8. I think that I would need the support of a technical person to be able to use this system *

A. 1 (Strongly disagree) B. 2 C. 3 D. 4 E. 5 (Strongly agree)

9. I found the various functions in this system were well integrated *

A. 1 (Strongly disagree) B. 2 C. 3 D. 4 E. 5 (Strongly agree)

10. I thought there was too much inconsistency in this system *

A. 1 (Strongly disagree) B. 2 C. 3 D. 4 E. 5 (Strongly agree)

11. I would imagine that most people would learn to use this system very quickly *

A. 1 (Strongly disagree) B. 2 C. 3 D. 4 E. 5 (Strongly agree)

12. I found the system very cumbersome to use *

A. 1 (Strongly disagree) B. 2 C. 3 D. 4 E. 5 (Strongly agree)

13. I felt very confident using the system *

A. 1 (Strongly disagree) B. 2 C. 3 D. 4 E. 5 (Strongly agree)

14. I needed to learn a lot of things before I could get going with this system *

A. 1 (Strongly disagree) B. 2 C. 3 D. 4 E. 5 (Strongly agree)

Appendix 02: SUS Testing

Section C : User Perception and Memory

15. By using this new method of marketing, will you buy the product? *

- [ ] A. Yes
- [ ] B. No
- [ ] C. Not sure

16. What is the most interesting thing about this application? *

17. Describe all of the games you have played in the application. *

18. What are the other industries suitable for this application? *

19. What is your overall comment about this application? *

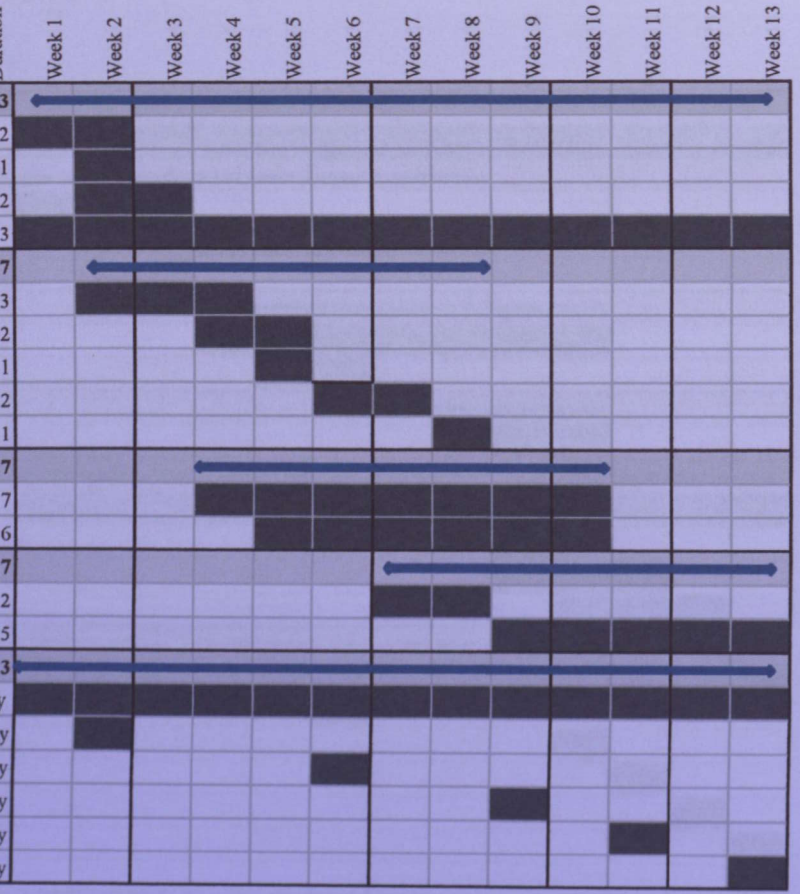
GANTT CHART

ReaDroid (FYP 1)

Project by : **Nur Iswadi bin Zainuddin**

Start/End Date : **Week 1 (26 September 2011) - Week 13 (21 December 2011)**

Num	Tasks	Start	End	Duration
1	**Planning Phase**	**Week 1**	**Week 13**	**13**
1.1	Research for problem identification	Week 1	Week 2	2
1.2	Propose solution	Week 2	Week 2	1
1.3	Feasibility analysis	Week 2	Week 3	2
1.4	Technical knowledge enrichment	Week 1	Week 13	13
2	**Analysis Phase**	**Week 2**	**Week 8**	**7**
2.1	Gather Information	Week 2	Week 4	3
2.2	Define System Requirement	Week 4	Week 5	2
2.3	Sequence Diagram	Week 5	Week 5	1
2.4	Data Collection	Week 6	Week 7	2
2.5	Data Analysis	Week 8	Week 8	1
3	**Design Phase**	**Week 4**	**Week 10**	**7**
3.1	Design software architecture	Week 4	Week 10	7
3.2	Design user interface	Week 5	Week 10	6
4	**Implementation Phase (Pre-FYP 2)**	**Week 7**	**Week 13**	**7**
4.1	Development configuration	Week 7	Week 8	2
4.2	Test demo and debug	Week 9	Week 13	5
5	**Important Dates**	**Week 1**	**Week 13**	**13**
5.1	Progress Update	26-Sep-11	21-Dec-11	Weekly
5.2	Project Proposal	5-Oct-11	5-Oct-11	1 day
5.3	Extended Proposal	2-Nov-11	2-Nov-11	1 day
5.4	VIVA: Proposal Defense	23-Nov-11	23-Nov-11	1 day
5.5	Interim Report	7-Dec-11	7-Dec-11	1 day
5.4	Technical Report	21-Dec-11	21-Dec-11	1 day



Appendix 03: Gantt Chart

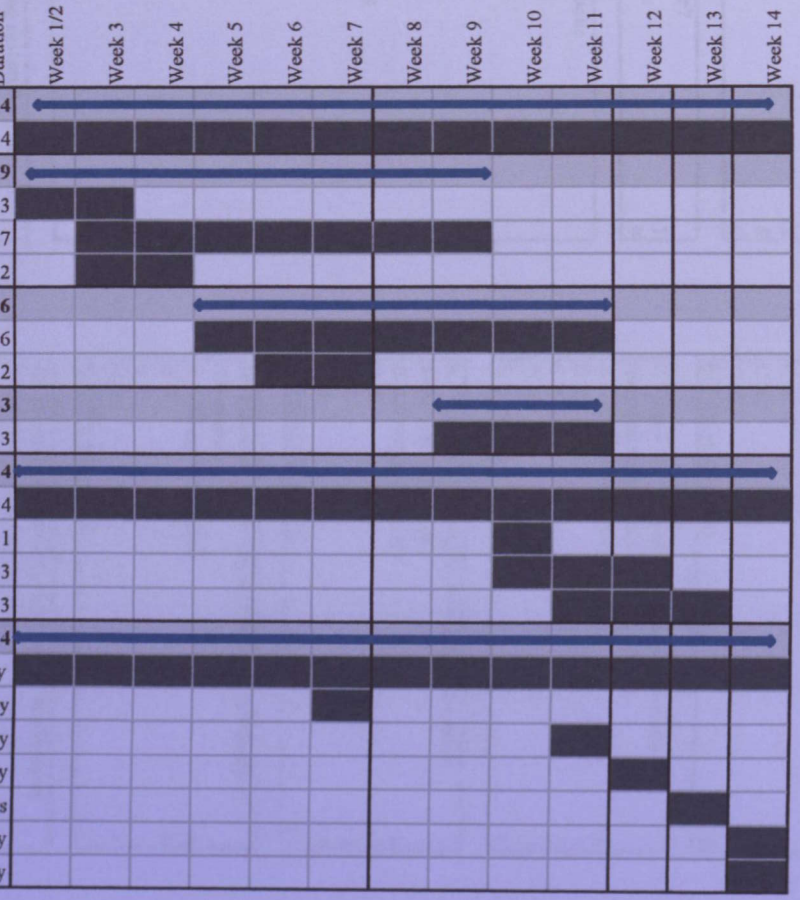
GANTT CHART

ReaDroid (FYP 2)

Project by : **Nur Iswadi bin Zainuddin**

Start/End Date : **Week 1 (23 Jan 2012) - Week 14 (27 April 2012)**

Num	Tasks	Start	End	Duration
1	**Planning**	**Week 1**	**Week 14**	**14**
1.1	Technical knowledge enrichment	Week 1	Week 14	14
2	**Game Framework**	**Week 1**	**Week 9**	**9**
2.1	Recognize the target marker	Week 1	Week 3	3
2.2	Draw 3D objects	Week 3	Week 9	7
2.3	Create scenes' framework	Week 3	Week 4	2
3	**System Integration**	**Week 5**	**Week 11**	**6**
3.1	Integrate the 3D objects	Week 5	Week 11	6
3.2	Create dummy games	Week 6	Week 7	2
4	**System Attributes**	**Week 9**	**Week 11**	**3**
4.1	Coding for objects' characteristic	Week 9	Week 11	3
5	**Testing and analysis**	**Week 1**	**Week 14**	**14**
5.1	System debug	Week 1	Week 14	14
5.2	Crash test	Week 10	Week 10	1
5.3	Usability test	Week 10	Week 12	3
5.4	Data analysis	Week 11	Week 13	3
6	**Important Dates**	**Week 1**	**Week 14**	**14**
6.1	Progress Update	23-Jan-12	27-Apr-12	Weekly
6.2	Progress Report	7-Mar-12	7-Mar-12	1 day
6.3	Pre-EDX	4-Apr-12	4-Apr-12	1 day
6.4	Soft Bound Dissertation	12-Apr-12	12-Apr-12	1 day
6.5	SEDEX	17-Apr-12	18-Apr-12	2 days
6.6	VIVA	25-Apr-12	25-Apr-12	1 day
6.7	Technical Report	26-Apr-12	26-Apr-12	1 day



Appendix 04 : Raw Data For SUS Testing

15. By using this new method of marketing, will you buy this product?	
A. Yes	18
B. No	1
C. Not sure	1

16. What is the most interesting thing about this application?
The games
The games and the chocolate man
Game, game and game
Augmented reality
I never try this kind of application before and it's awesome
The augmented reality technology where the objects look 3D
It has games. I love games
The fact that it incorporates games to make the purchase of the proudcts more fun and exciting!
Playing the games
The games is simple and easy to play
It is interesting and new. Very modern and fun!
I never believe this kind of thing really exist.
Games provided when people buy the chocolate
New method of approching the customer by providing games
Use chocolate wrapper for advertisement is very rare
Games
Allow people to critcize the product immediately
Various kind of games
This is my first time playing games in '3D'
I try to touch the cartoon but it is in virtual. Awesome bro!
The games

17. Describe all of the games you have played in the application
First game hit the ball, second game find missing things, third game play the football using fingers
Hit the ball, hit the cartoon
Interactive football, the gingerbreadman and help Anna find missing things
Pop up the ball, play the football and find missing thing
One is about touch the cartoon, touch the things found and hit the ball virtually.
The games where we need to find the cartoon flying around and the games to find missing things in restroom
Let the ball hit the apple, compare the pictures, save the teddy bear
Explore the maze blocks, find something hidden and hit the pizza or cartoon
"football" game, the "gingerbreadman" game and "Spot the difference" game
Find the missing things, hit the cartoon and hit football in a maze.
Find the hidden objects, navigating ball, and pop the gingerbread.
The "point the gingerman" game, "spot the difference" game as well as "guide the ball" game.
First game, hit the gingerman picture second game, find missing item in the picture
The touching games for cartoon, the block games and toilet missing stuff
Need to touch the teddy bears graphic. move a ball around and find missing things
Using touchscreen to touch the missing things, anime, and play football using hand
Using finger to play the ball, find hidden object, find the chocolate man
Find missing things, find flying cartoon, play the football
Press the ginger-man, handle the ball and find something missing
Play the football in block, help Anna and pop up the ball

Appendix 04 : Raw Data For SUS Testing

18. What are the other industries suitable for this application?
Oil and gas industry
Fashion
Transportation
Academic
No comment
Phone, computer gadgets, movie
Food, fashion, cinema
Books, magazines
Cinemas - where people use their phone to watch the trailer on view of the poster
topys
sports, foods, cosmetics, tourism
airlines industry
Travel and tourism
Design and architecture
Academic
Oil and gas industry
Stationery, movie trailer, services
Promote café
Transportation
TESCO, Giant, Jusco

19. What is your overall comment about this application?
This application is so interesting
Cool! Awesome! Best!
Well done
Nice
This application is so awesome
It is so cool. I can't wait that this application going to be a new trend of advertisement in Malaysia
It is good
It has great potential to be implemented in real world provided cost of changing is low
More friendly user-interface
Since it is new,few modification can be done to enhance this applicatio such as the graphic and screen sensitivity
Very goog effort to revitalize advertisement industry
You have done a very good job for your application.
I want it to be available on iPhone. Please!
Hopefully, it gonna be a new start for our advertisement advancement
No comment
I am looking forward for more interesting application related to aaugmented reality
Just one simple word, cool.
Is this application going to be free? If we need to pay, then customer won't but the product I think. I should be free.
A bit slow but it still nice and such a fresh idea
Awesome!

Appendix 04 : Raw Data For SUS Testing

1. How old are you?	
A. Below 14 years old	0
B. 15-24 years old	12
C. 25-34 years old	8
D. Above 35 years old	0

2. What is your gender?	
A. Male	11
B. Female	9

3. Type of the smartphone
HTC Desire Z
HTC Desire Z
Samsung Ace
HTC Nexus One
HTC Nexus One
Samsung Galaxy w
HTC Dream
Samsung Galaxy Young
HTC Desire Z
HTC Desire Z
Galaxy S2
HTC Desire Z
HTC Desire Z
HTC Desire Z
HTC Desire Z
Samsung Ace
HTC Nexus One
HTC Nexus One
Samsung Galaxy w
HTC Dream

4. What is the operating system for your Android devices?	
A. 1.5 (Cupcake)	0
B. 1.6 (Donut)	0
C. 2.0 (Éclair)	0
D. 2.1(Éclair)	6
E 2.2 (Éclair)	12
F. 2.3.x (Gingerbread)	2
G. 3.x.x (Honeycomb)	0
H. 4.4.0.x (Ice Cream Sandwich)	0

5. I think that I would like to use this system frequently	
A. 1(Strongly disagree)	0
B. 2	0
C. 3	4
D. 4	4
E. 5 (Strongly agree)	12

6. I found the system unnecessarily complex	
A. 1(Strongly disagree)	8
B. 2	4
C. 3	2
D. 4	2
E. 5 (Strongly agree)	4

7. I thougt the system was easy to use	
A. 1(Strongly disagree)	0
B. 2	0
C. 3	1
D. 4	4
E. 5 (Strongly agree)	15

8. I think that I would need the support of a technical to be able to use this system.	
A. 1(Strongly disagree)	12
B. 2	4
C. 3	2
D. 4	2
E. 5 (Strongly agree)	0

9. I found the various functions in this system were well integrated	
A. 1(Strongly disagree)	0
B. 2	0
C. 3	2
D. 4	6
E. 5 (Strongly agree)	12

10. I thought there was too much inconsistency in this system	
A. 1(Strongly disagree)	8
B. 2	8
C. 3	4
D. 4	0
E. 5 (Strongly agree)	0

11. I would imagine that most people would learn to use this system very quickly	
A. 1(Strongly disagree)	0
B. 2	0
C. 3	0
D. 4	4
E. 5 (Strongly agree)	16

12. I found the system very cumbersome to use	
A. 1(Strongly disagree)	10
B. 2	5
C. 3	2
D. 4	2
E. 5 (Strongly agree)	1

13. I felt very confident using the system	
A. 1(Strongly disagree)	1
B. 2	0
C. 3	4
D. 4	3
E. 5 (Strongly agree)	12

14. I needed to learn a lot of things before I could get going with this system	
A. 1(Strongly disagree)	10
B. 2	4
C. 3	4
D. 4	0
E. 5 (Strongly agree)	2