

APPLICATION OF AUGMENTED REALITY IN MOBILE COMMERCE

By

Wan Jack Wei

A REPORT

SUBMITTED TO

Universiti Tunku Abdul Rahman

in partial fulfillment of the requirements

for the degree of

BACHELOR OF INFORMATION SYSTEMS (HONS)

INFORMATION SYSTEMS ENGINEERING

Faculty of Information and Communication Technology

(Perak Campus)

MAY 2018

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DECLARATION OF ORIGINALITY

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Date : _____

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ABSTRACT

In this project, an Android mobile commerce shopping application integrated with AR technology will be developed to address the problem faced. Current m-commerce users are facing problems of lacking a detailed visual representation of the product they are viewing. The implementation of AR technology in m-commerce will increase the interaction and engagement of users, leading to a higher conversion rate of purchase. The project will have an impact to the shoppers and sellers as it will enhance their shopping experience leading to a higher rate of purchase. Survey on the user perception of the augmented reality in mobile shopping application have been carried out and it shows a positive result. Existing mobile shopping application do not have this augmented reality feature in their app. Although there are some application out there that implements AR technology, but they are not an app that performs retail transaction. An Android mobile shopping application with augmented reality feature has been developed in this project. User testing have been performed to validate the concept. The output of this project will have impacts and contribution to the market of m-commerce comprising of the sellers and customers. The technologies involved in the development of the m-commerce prototype are Unity3D, Vuforia SDK, Android Studio, Java and C# programming language.

TABLE OF CONTENTS

REPORT STATUS DECLARATION FORM	i
TITLE PAGE	ii
DECLARATION OF ORIGINALITY	iii
ACKNOWLEDGEMENTS	iv
ABSTRACT	v
TABLE OF CONTENTS	vi
LIST OF FIGURES	ix
LIST OF TABLES	xi
LIST OF ABBREVIATIONS	xii
Chapter 1: Introduction	1
1.1 Problem Statement and Motivation	1
1.2 Background Information	2
1.3 Project Objectives	4
1.4 Project Scope	5
1.5 Impact, Significance and Contribution	6
Chapter 2: Literature Review	7
2.1 Review on Similar Applications	7
2.1.1 Review on IKEA Catalogue	7
2.1.2 Review on Shop 4 Rings	9
2.1.3 Review on Shopee App	11
2.1.4 Review on Lazada App	13
2.2 Comparison between Similar Applications	15
Chapter 3: System Design	17
3.1 Block Diagram	17
3.2 Use Case Diagram	18
3.3 Flowchart of the application	20
3.4 User Interface Design	22

Chapter 4: Design Specification	31
4.1 Methodologies	31
4.2 Tools, Connectivity, Hardware and Software Requirements	33
4.2.1 Tools Used to Develop the Mobile Application	33
4.2.2 Connectivity Requirements for Users	34
4.2.3 Hardware requirements	34
4.2.4 Software Requirements	35
4.3 Verification Plan	35
4.4 Survey Analysis	36
4.4.1 Survey methodology	36
4.4.2 Survey Results and Analysis	37
4.5 Implementation Issues and Challenges	46
4.6 Timeline	47
Chapter 5: System Testing	48
5.1 System Testing	48
5.1.1 Test Objective: Validate required fields when sign in	48
5.1.2 Test Objective: Validate required fields when register account	49
5.1.3 Test Objective: Login with valid account information	50
5.1.4 Test Objective: Register account with an existing username	51
5.1.5 Test Objective: View product in AR mode	52
5.1.6 Test Objective: Add product into shopping cart	53
5.2 User Acceptance Testing	54
Chapter 6: Discussion and Conclusion	56
6.1 Project Review	56
6.2 System Strengths and Limitations	57
6.3 Future Work	58
6.4 Conclusion	58
REFERENCES	59
APPENDIX	61
Appendix A: Questionnaire	61
Appendix B: AR Watch marker and instructions	66
POSTER	67

PLAGIARISM CHECK RESULT	68
CHECK LISTS	70

LIST OF FIGURES

Figure Number	Title	Page
Figure 2.1	Viewing the 3D sofa model using augmented reality	7
Figure 2.2	User trying on the ring virtually in the Shop 4 Rings app.	9
Figure 2.3	Screenshots of Shopee app	11
Figure 2.4	Screenshots of Lazada app	13
Figure 3.1	Block diagram	17
Figure 3.2	Use Case Diagram of Augmented Reality M-commerce Shopping	18
Figure 3.3	Flowchart for the product purchasing process	20
Figure 3.4.1	Login screen	22
Figure 3.4.2	Register account screen	23
Figure 3.4.3	Product home screen	24
Figure 3.4.4	Product items screen	25
Figure 3.4.5	Product item details screen	26
Figure 3.4.6	Shopping cart screen	27
Figure 3.4.7	AR Mode screen	28
Figure 3.4.8	AR Menu screen	29
Figure 3.4.9	My Account screen	30
Figure 4.1	Methodology for developing the mobile application	31
Figure 4.2	Respondents knowledge of AR technology	39
Figure 4.3	Respondents acceptance of AR technology in mobile shopping	39
Figure 4.4	Results of respondents' agreement on statement 1, 2, 3 and 4.	41
Figure 4.5	Results of respondents' agreement on statement 5, 6, 7, 8 and 9.	41
Figure 4.6	The mean of the statements.	45
Figure 4.7	Gantt chart for the development of the mobile application (6 January 2018 – 27 September 2018)	47
Figure 5.1.1	System check for unfilled fields during Sign In	48

Figure 5.1.2	System check for unfilled fields during Register account	49
Figure 5.1.3	Sign in successful with correct username and password	50
Figure 5.1.4	Register account with an existing username	51
Figure 5.1.5	Display watch in AR mode	52
Figure 5.1.6	Product added into shopping cart	53
Figure 7.1	Poster of the project	67
Figure 7.2	Plagiarism check result	68

LIST OF TABLES

Table Number	Title	Page
Table 2.1	Table of comparisons between similar applications	15
Table 4.1	Connectivity requirement for user	34
Table 4.2	User device's hardware requirements	34
Table 4.3	User device's software requirements	35
Table 4.4	Login verification plan	35
Table 4.5	Manage shopping cart verification plan	35
Table 4.6	Codes used for Likert Scale questions	37
Table 4.7	Results of respondents demographic information	38
Table 5.1.1	System validate empty field test plan	48
Table 5.1.2	System validate empty registration details test plan	49
Table 5.1.3	System login with valid account information	50
Table 5.1.4	Account registration with existing username	51
Table 5.1.5	View product in AR mode	52
Table 5.1.6	Add product into shopping cart	53
Table 5.2	Users' emotions and feedbacks	54

LIST OF ABBREVIATIONS

<i>App</i>	Application
<i>AR</i>	Augmented Reality
<i>CPU</i>	Central Processing Unit
<i>E-commerce</i>	Electronic Commerce
<i>GPS</i>	Global Positioning System
<i>IDE</i>	Integrated Development Environment
<i>M-commerce</i>	Mobile commerce
<i>NFC</i>	Near-Field Communication
<i>QR</i>	Quick Response
<i>RAM</i>	Random Access Memory
<i>SDK</i>	Software Development Kit
<i>SLAM</i>	Simultaneous Localization and Mapping
<i>UAT</i>	User Acceptance Testing
<i>UI</i>	User Interface

Chapter 1: Introduction

1.1 Problem Statement and Motivation

Current mobile commerce applications are lacking of a more detailed and realistic visual representation of the products.

In most of the mobile commerce applications specialising in mobile shopping in Malaysia, users cannot view the products in the real-world environment, especially when they are shopping for products like furniture, watch, jewellery and other decorative products. For example, the products being sold in Lazada app and Shopee app only display the products sold in 2D images. Users are lacking of a more detailed and realistic visual representation of the products. It makes the shopping experience in m-commerce looks dull and static. Besides, it doesn't involve much engagement with the users as users are just seeing some images and just swipe through the product lists. Also, the products received that purchased through online may not fit to users' expectation (Kuriachan, 2014). This might cause by the difference in the early perceive of the product than what it really looks like. When performing online shopping, customers cannot feel or touch an item, see how it functions, or distinguish how it will be fitted in home. The lack of this interactivity and existence in the online shopping experience leads to ambiguous buyers and more carts being abandoned (Williams, 2018).

By integrating augmented reality technology in the m-commerce application, users can enhance their view of the physical world through the generated product image over users' view of the real world. It will create a more realistic visual sensation in the eyes of the users. With such enhancement of the product visual representation, users are more interested to using the m-commerce application and see how the product will be looking in the actual environment. As a result, users' interaction with the m-commerce application will be increased through the incorporation of feeling, both physical and emotional into shopping experience (Olsson, et al., 2011). Increased interaction with the m-commerce application will eventually lead to a high possibly of purchasing the product. The application of augmented reality technology in m-commerce will also allow users to determine whether the product suitable for them in the real-world by overlaying the image on top of the actual environment and this helps in making purchase decisions.

1.2 Background Information

Mobile Commerce

Mobile commerce, also called as m-commerce, is the sales of goods and services via wireless mobile devices specifically smartphones through the Internet. Mobile commerce is also the delivery of electronic commerce capabilities directly into the consumer's hand, anywhere, via wireless technology (Argade & Chavan, 2015). M-commerce is also known as the next generation of electronic commerce (e-commerce). Ubiquitous access to information almost on anytime and anywhere is the advantage offered by mobile commerce. As more people nowadays are able to own a smartphone, it has provide a good opportunity for the m-commerce to reach the market at large. M-commerce is an emerging trend of modern shopping experience with the advancement in telecommunication network such as 3G and LTE 4G and also the content delivery over wireless devices which is becoming faster, more secure and scalable.

The growing adoption of e-commerce has offered m-commerce a strong foundation. The fast growth of m-commerce is being determined by several positive factors, which include the demand for applications from an increasingly mobile consumer base; the rapid adoption of online commerce because of the resolution of security issues; and advances in technology that have mobile devices with substantial computing power and advanced capabilities (Investopedia, n.d.).

The major industries affected by m-commerce include financial services which involve mobile banking and brokerage services. Besides, the telecommunications industry which service changes, bill payment and account review, and most of all, the service/retail industry as consumers and vendors are given the platform to offer products or services and place orders on-the-go. Many of the e-commerce owners are building their mobile shopping site and application to target mobile customers as it is the most effective way to market their business to smartphone customers.

Augmented Reality

The word *augmented* which originated from the word *augment* means *to add something*. Augmented Reality (AR) is the enriched version of reality where live direct or indirect views of the physical, real-world environment are augmented through computer-generated images over user's view of the real world (Chavan, 2016). In Augmented Reality (AR), input such as sound, graphics, videos, touch feedback or GPS data are added into the view of the physical real world and thus enhances user's current perception of reality. Augmented reality uses the natural real environment and overlays the digital data on top of it. AR is used with the intention of enriching the experienced surroundings or situations and to offer enhanced experiences.

There are a few categories of AR technology that exists, each with their variances in their objectives and application usage.

i) Location-based augmented reality applications

Location-based augmented reality, also known as markerless, position-based or GPS, uses the sensors such as digital compass, accelerometer, GPS and velocity meter embedded in the mobile devices to provide data based on the location. It is commonly used for mapping directions, finding nearby businesses, and other location-centric mobile applications (Reality Technologies, 2016).

ii) Marker-based augmented reality applications

Marker-based augmented reality applications operate by enabling the software to pinpoint particular patterns (e.g. QR code or brand symbol) when used in conjunction with a device camera. It will then overlay the information upon the physical real-world environment. The digital information shown on top of the recognised area can be animated or 3D visual image.

iii) Superimposition Based Augmented Reality

Superimposition based augmented reality replaces the original view either partially or fully with the object's newly augmented view. Object recognition plays a vital role in superimposition based augmented reality because the application cannot replace the original view with an augmented one if it cannot determine what the object is.

1.3 Project Objectives

1. To study user perception on the application of augmented reality in mobile commerce.

In order to find out the perceptions of users on the application of augmented reality in mobile shopping, questionnaires will be designed and distributed to target respondents which are the users of mobile online shopping. From the results gather, users' expectation and acceptance of this AR implementation will be identified. This is significant for the designing and development of the mobile application so that it satisfies the needs and wants of mobile commerce users.

2. To develop a mobile shopping application with augmented reality technology.

To let users have a detailed visual representation of the product, augmented reality technology is used so that the watch can be displayed in the real-world environment through the camera of the mobile devices. With this AR technology in the mobile shopping application, users will have more interaction and intention in purchasing the watch.

3. To perform user testing with the mobile application.

The mobile application will be tested with the mobile commerce users to have a better understanding of their experience on using the mobile application. From here, users can provide their feedbacks and recommendations based on their hands-on experience of the mobile application. This is important for the continuous improvement of the mobile application.

1.4 Project Scope

The scope of this project covers the integration of AR technology in mobile shopping application in helping to gain more engagement and interactions from users. An Android mobile application will be developed for this project. The application specializes on mobile shopping specifically for watches. The application of AR technology enables users to visualize on the watch shown at the product page to be displayed at the physical real-world environment. This helps users to have a more immerse experience and increase their interest of using the application. In the application, users are able to view the watch information which includes of price, specifications, descriptions, etc. Users can choose to view the watch through the conventional 2D photos or by augmented reality view. In augmented reality view, users can view the watch as if they were wearing it. Besides, the application enables users to take a screenshot of the AR view and share it on social media like Facebook, Instagram or Twitter. If users are interested to the selected product, they can add them into their wish list to be view at another time. A shopping cart will be provided in the application to let users add products to be purchased and calculate the total price for payment purpose. Also, users can track their order's delivery status through the application.

1.5 Impact, Significance and Contribution

By integrating the augmented reality technology in current mobile shopping application and developing this mobile application, both the shoppers and product sellers will be getting benefit from it in different aspects. Through integrating AR in mobile shopping, a consumer spends more time engaging with the product and they become more invested in that purchase. According to the study by Retail Perceptions, a total of 61% of shoppers favour to shop at stores which provide augmented reality than others that don't. Hence, the implementation of AR technology in m-commerce can drive sales. With that to say, this will certainly benefit the sellers as the sales rose and helps to boost m-commerce industry as a result of this AR integration. Besides, AR also benefits the sellers in a way that it helps shoppers to understand the product as they already can see the product colours, shapes and textures. Shoppers already know what they are buying and this can reduce the uncertainty and dissatisfaction when they received the product. As a result, it will reduce the rate of shoppers returning the products and this save costs in terms of time and money for both party.

By applying AR in mobile shopping application, current situation of mobile shopping application looks dull and static will be improved as user will feel more interesting and entertaining to use the application with this feature. This is to say, this project will be able to bring the current mobile shopping experience to a next level.

Furthermore, the implementation of AR in m-commerce application can help current sellers to improve their sales. 71% of the shoppers would shop more frequently at a retailer if they are offering augmented reality (Retail Perceptions, 2016). Also, the usability and user experience can be evaluated so that a better improvement can be made for the future m-commerce.

Lastly, this project can contribute to the e-commerce industry on how customers purchase products online. AR in mobile shopping is serving to resolve those dilemmas with the visualisation of product. With AR, it is possible to look on virtual products in real environment, enable shoppers to spend more time to visualize and configuring products in the real world, making them having less doubts about their online purchase (Williams, 2018).

Chapter 2: Literature Review

2.1 Review on Similar Applications

2.1.1 Review on IKEA Catalogue

IKEA Catalogue is released by IKEA, the furniture giant at year 2013. The application has more than 2,000 products comprises of nearly the full collection of the company's unlauted sofas, chairs, coffee and dining tables as well as storage units. IKEA Catalogue incorporated AR technology in their app by utilising the device's rear camera and gyroscope sensor. User can tap onto the 3D button to enter the AR mode where user can add furniture to their real-world environment. The 3D model of the furniture will be displayed at the position of the room being pinpoint as it's really there. This helps users to imagine and arrange the furniture at their place.



Figure 2.1: Viewing the 3D sofa model using augmented reality

Strength

The IKEA Catalogue provides a simple tutorial for the first-time access to the AR mode. Users can learn how to navigate through the AR mode easily to best place the furniture at their place. Besides, the displayed 3D furniture can be viewed at different angles and have similar appearance with the real physical products.

Weakness

The IKEA Catalogue is using the marker-based tracking to position the 3D furniture model to the room. It requires a printed catalogue from IKEA to scale the 3D model perfectly to the room. Without the printed catalogue, it is not able to move around the room. Besides, the app unable to let user to perform purchase transaction. Lastly, user cannot keep track of their items added to 'favourites' if they access the app on another device.

2.1.2 Review on Shop 4 Rings

Shop 4 Rings is an iOS application that combines hand and finger recognition technology with augmented reality to help users to virtually wear rings on their fingers. Users can actually try the rings to know whether the design is suitable for them or not. With the AR technology in the app, it helps users to experience shopping as in the physical jewellery shop. The app utilises the iPhone's rear camera to scan the photo of user's hand and the AR technology will then position the digital ring image on the finger. User can choose to place the ring on a different finger by simply swipe left or right, or double tap to zoom in and adjust its placement.

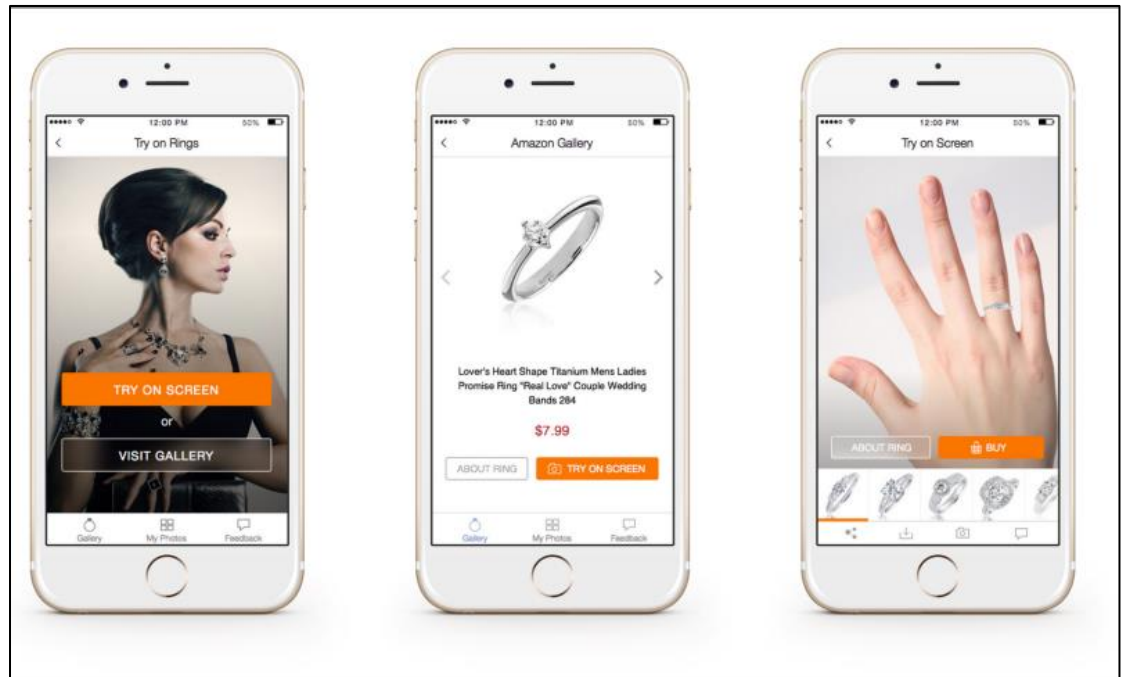


Figure 2.2: User trying on the ring virtually in the Shop 4 Rings app.

Strength

The content design and navigation in the app is simple and appealing. The integration of AR into the jewellery shopping increase the interaction of users with the application. Users can have a better idea on how the product look on their hands. Besides, there's also a share function which enables the users to share their buys and wishes with friends. It can link with social media platform such as Facebook, Twitter and Instagram.

Weakness

The application need to take a photo and then process it with their AR technology to put the ring on user's hand. The digital ring image is not overlaying on the user's hand at real-time. User cannot view the ring at different angles.

2.1.3 Review on Shopee App

Shopee app is a mobile shopping application available in both Android and iOS. Shopee app provides an online marketplace for sellers to sell their products of different categories such as health & beauty, toys, mobile gadgets, home appliances, clothing and many more. Shopee is listed as the top 1 downloaded shopping app in Google Play Store from the statistics shown by iPrice Group (iPrice Group, 2018). Shoppers can view all products information, add them to wishlist, add to shopping cart for purchasing intention and share the products with others through the app.

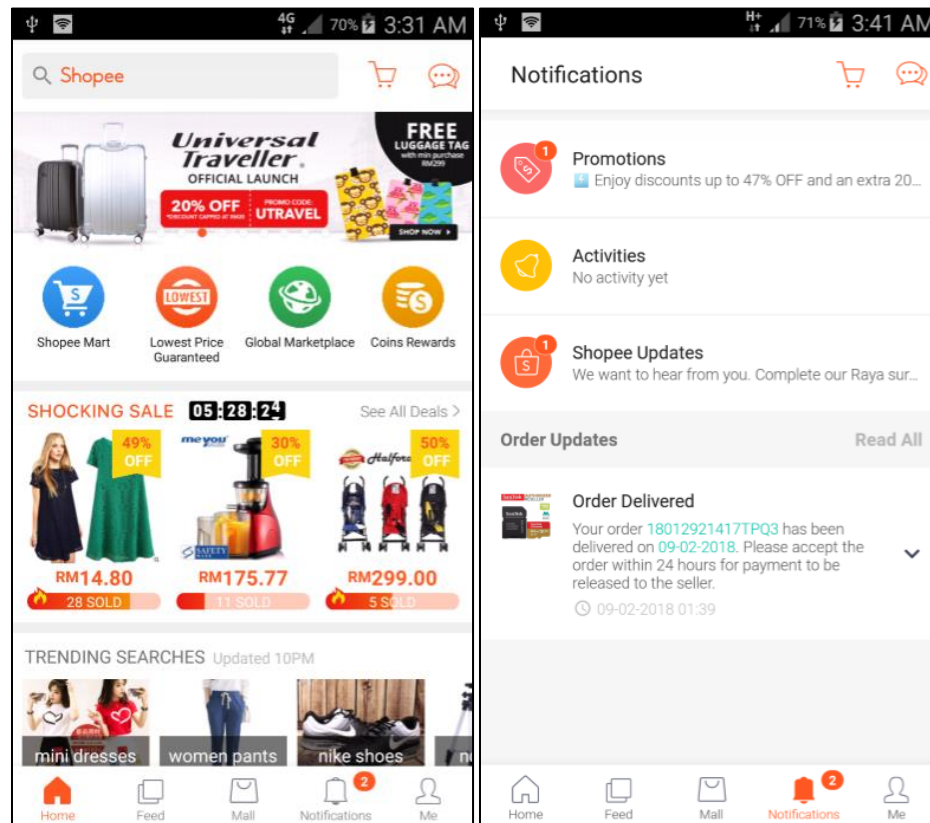


Figure 2.3: Screenshots of Shopee app

Strength

- Enables users to upload their products for selling with simple steps
- In app chat function available for users to communicate directly with sellers
- Able to track order status
- Easy navigation within the app

Weakness

- Cannot view the product virtually in real environment
- Too much of promotions and information at home page makes it looks confusing

2.1.4 Review on Lazada App

Lazada app is another mobile shopping application that is widely used in Malaysia. It is available both on Android and iOS. Lazada app provides an online marketplace for sellers to sell their products of different categories such as electronic accessories, health and beauty products, home appliances, toys, fashion and much more. Lazada is listed as the second most downloaded app in Google Play Store according to the statistics shown by iPrice Group (iPrice Group, 2018). Shoppers can view all products information, add them to wishlist, add to shopping cart for purchasing intention and share the products with others through the app.

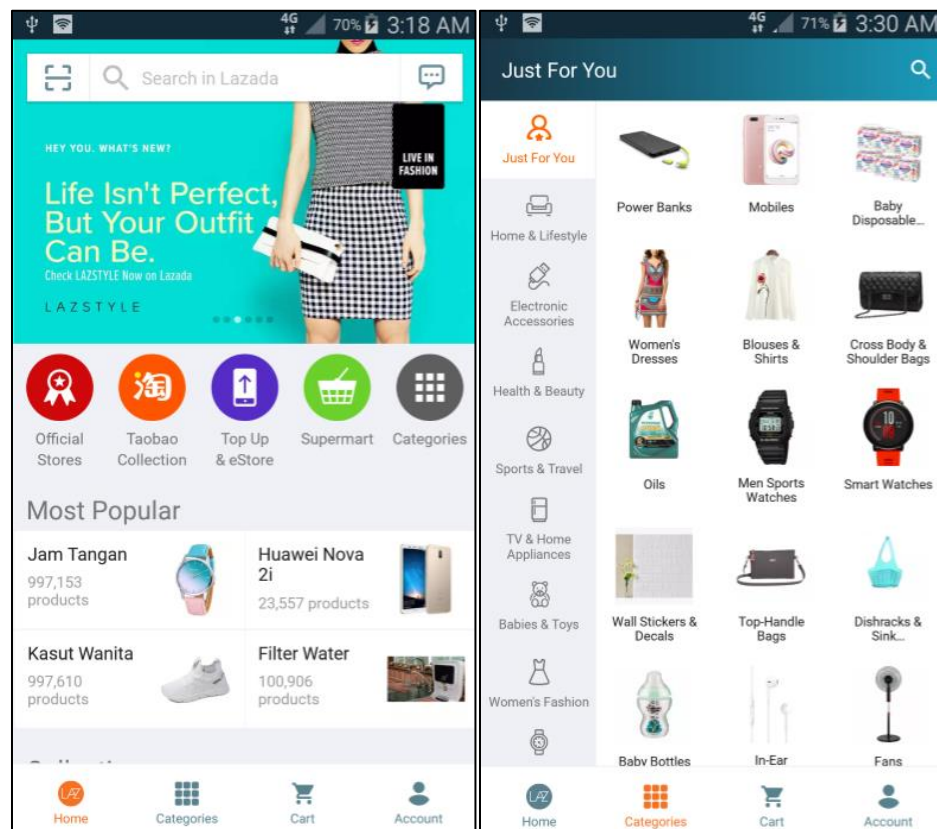


Figure 2.4: Screenshots of Lazada app

Strength

- QR code reader in the app
- In app chat function available for users to communicate directly with sellers
- Able to track order status
- Easy navigation within the app

Weakness

- Does not provide a corner for seller to upload items to be sold
- Cannot view the product virtually in real environment

2.2 Comparison between Similar Applications

Application Criteria	IKEA Catalogue	Shop 4 Rings	Shopee	Lazada	Proposed application (AR Watch)
Platform	Android, iOS	iOS	Android, iOS	Android, iOS	Android
Augmented reality feature	✓	✓	✗	✗	✓
Perform purchasing transaction	✗	✗	✓	✓	✓
Ease of use	Moderate	Moderate	Easy	Easy	Easy
Add product to wishlist/favourite	✓	✗	✓	✓	✓
User login	✗	✗	✓	✓	✓
Shopping cart	✗	✗	✓	✓	✓
Share products to social media	✓	✓	✓	✓	✓

Table 2.1: Table of comparisons between similar applications

AR Watch is the proposed mobile application for this project. AR Watch is implemented in Android OS. AR Watch mobile application is integrated with augmented reality feature which allows user to virtually view and interact the product in real world environment. The application also enables user to perform purchasing transaction just like any other m-commerce application. AR Watch is easy to be used with simple and clear navigation in the graphical user interface. Simple instructions are provided to let user know how to use

the augmented reality feature. AR Watch is equipped with essential m-commerce functionality such as user login and registration, add products to shopping cart, favourite and view order status. This proposed application not only let user to view the product in normal 2D photos, but also let user to have a more realistic visual representation of the product.

Chapter 3: System Design

3.1 Block Diagram



Figure 3.1: Block diagram

Figure 3.1 above shows the block diagram of the augmented reality m-commerce shopping application. Customer can access to application to browse for watches with or without login. Then, customer can choose to view the watch using normal view mode or augmented reality view. If customer likes the product, they must register or login to an account before can add the watch into their shopping cart. Lastly, customer can proceed with checkout and payment to complete their order.

3.2 Use Case Diagram

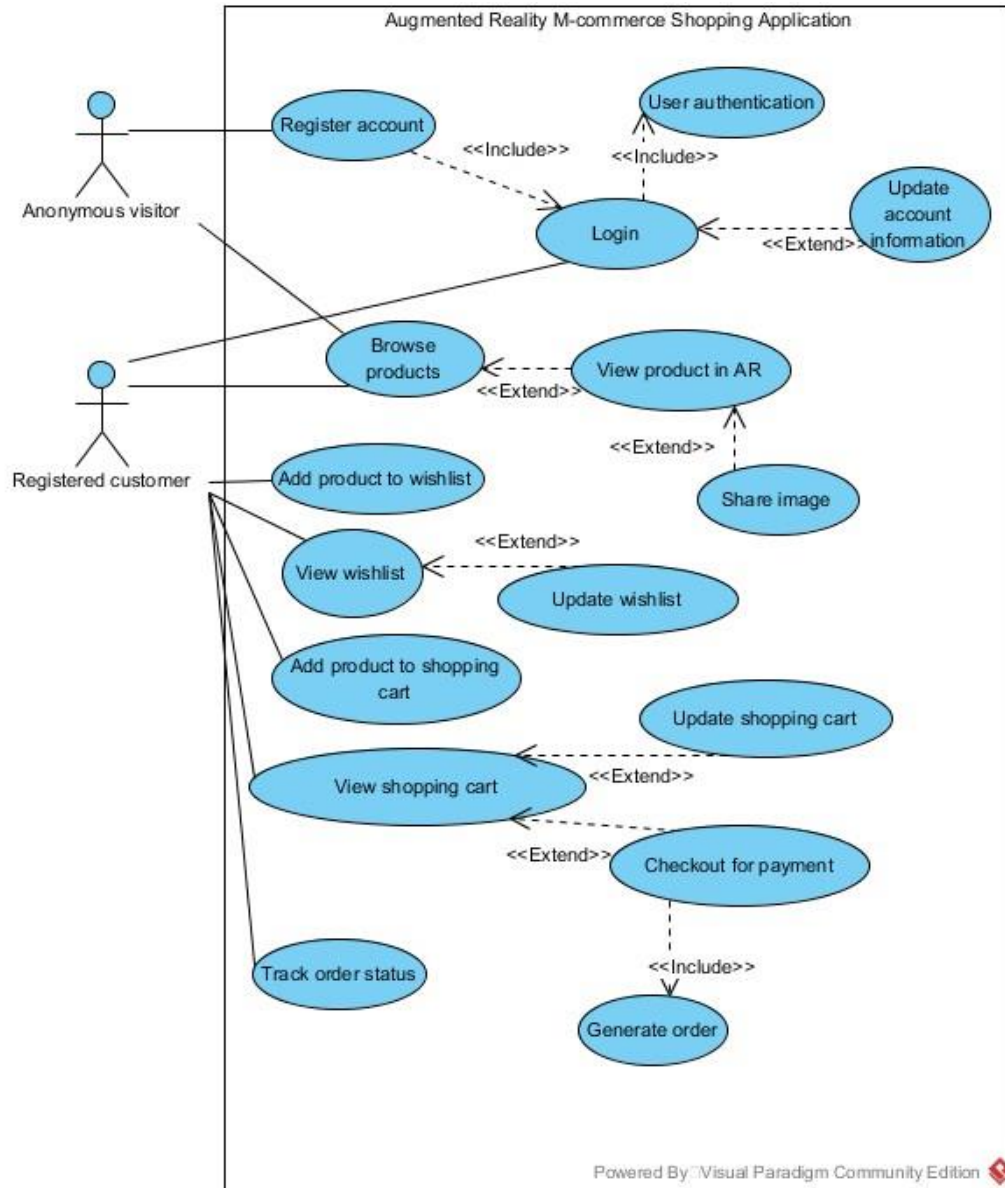


Figure 3.2: Use Case Diagram of Augmented Reality M-commerce Shopping Application

From the figure above, there are a number of functions provided for the users of the application.

1. Login

- Login is a necessary function for the application as it keeps the user's information and enable them to keep track of their wish list and shopping cart when using the app from different devices.

2. Register account

- For new visitor of the mobile application, users can register for an account. Users will have to provide information such as name, gender, email address, password, and mailing address during registration. Users will automatically login to the application when the registration success.

3. Browse product

- User can browse all the products available. Users can click into a specific product for more details. User can choose to view the product by photos or by augmented reality view. If users want to share the augmented reality view that is displayed at their screen, they can use the screenshot button and sharing feature.

4. Add product to wish list

- Customer can add the product that they like or as a bookmark to the wish list for further viewing.

5. View wish list

- Users can see all the products added to the wish list. User can also remove the product from the wish list.

6. Add product to shopping cart

- If user want to purchase an item, user can add the product to shopping cart and then continue shopping for another item or proceed to view the shopping cart.

7. View shopping cart

- Items that are added to the shopping cart will be displayed here. The system will calculate the total price to the customer. Customer can remove item from the shopping cart or proceed to checkout for payment. An order will be generated if customer has successfully proceeded the checkout procedures.

8. Track order status

- Customer can login to their account to track their order shipment status.

3.3 Flowchart of the application

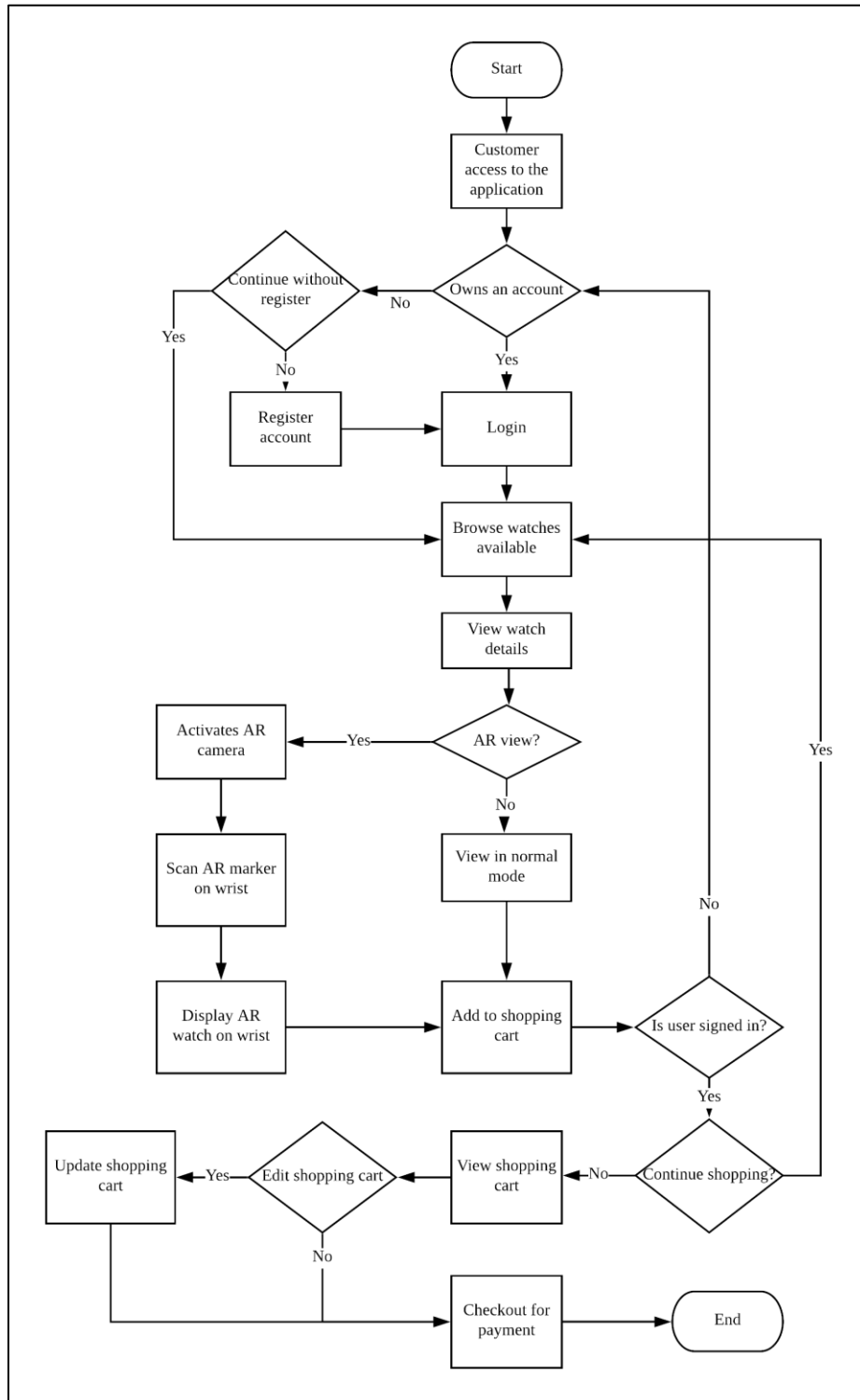


Figure 3.3: Flowchart for the product purchasing process

Figure 3.3 shows the flowchart for the process of customer purchases product. When the visiting customer first use the mobile shopping application, it will ask user whether the user owns an account or not. If user do not have an account, user can choose to proceed without registering an account or register and login with the new account. User can browse all the watches available in the mobile shopping application and select the watch for more details. When user selected a particular watch, details and photos of the watch will be display and user can choose to view the watch in existing mode or in AR view. In the AR view, the 3D model of the watch will be displayed on user's marker on wrist through the AR camera. User can add the watch that they like into shopping cart and proceed to checkout and payment.

3.4 User Interface Design

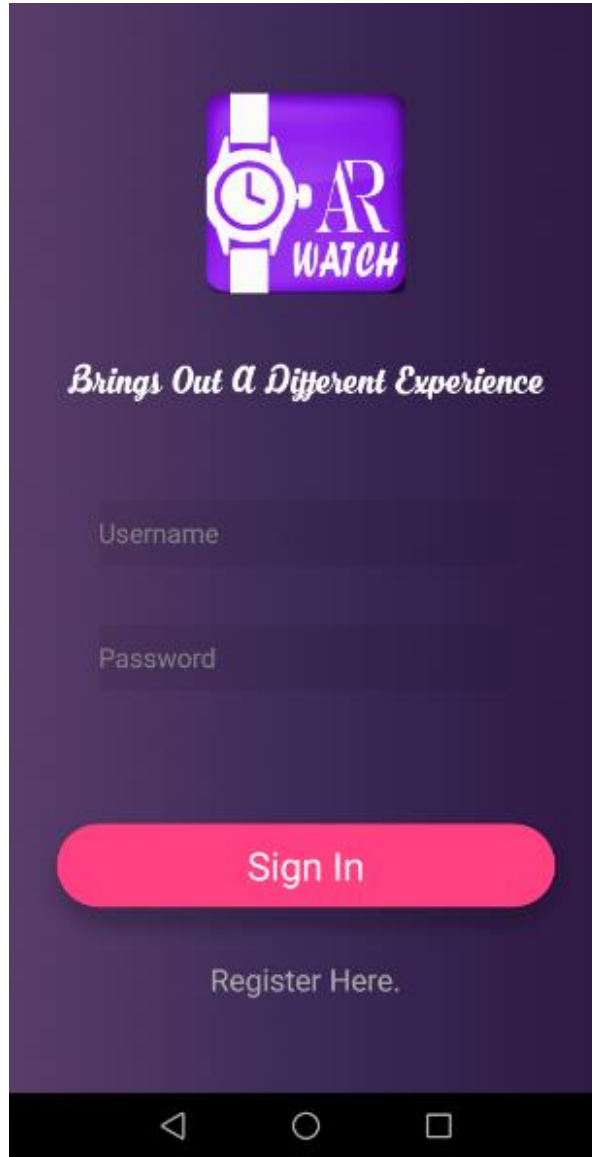


Figure 3.4.1: Login screen

When the AR Watch application is launch, user will be directed to the login screen as shown in Figure 3.4.1. Registered user will have to enter their username and password to login to their account before proceeding to the product screen. User can sign in to their account by clicking the “Sign In” button. By clicking the text “Register Here”, user will be directed to the register account screen for creating an account.

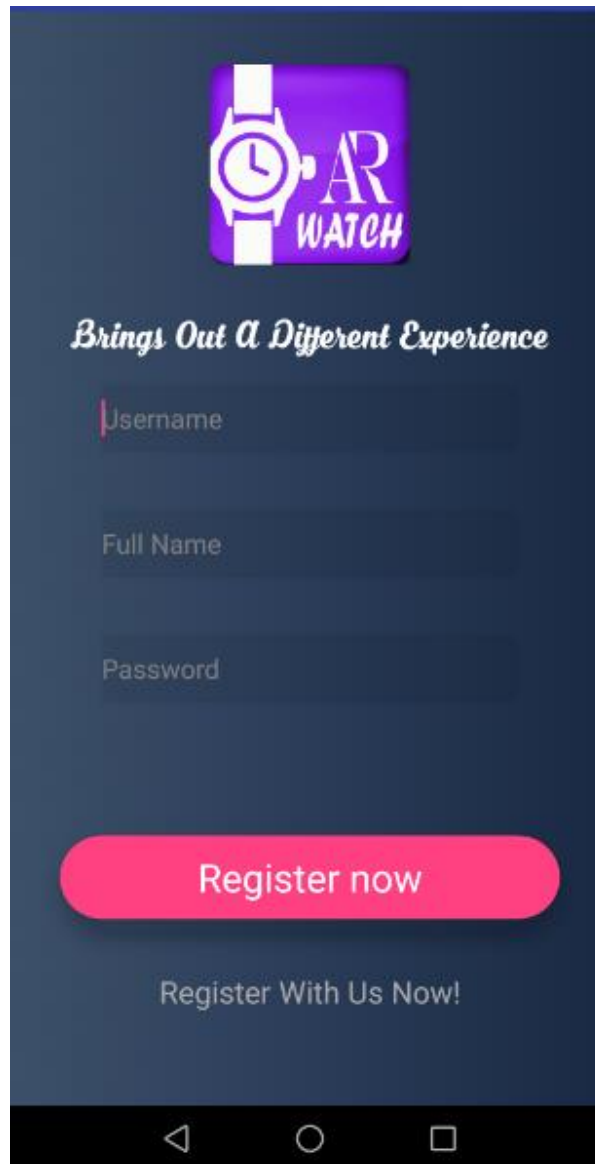


Figure 3.4.2: Register account screen

User can register for an account at this screen. To create an account, user will have to type in their desired username, full name and also the password. Then, click on the button “Register now” to create an account.



Figure 3.4.3: Product home screen

When user is successfully sign in, user will be directed to the product home screen as shown in figure 3.4.3. This screen will shows the category of the watches available. User can select from the category as shown i.e. Men’s Watches, Women’s Watches and Smart Watches.



Figure 3.4.4: Product items screen

Figure 3.4.4 shows the watches from the category of women's watches and smart watches. User can browse for watches of the same category on this screen. User can click on the specific watch to see the details of it.

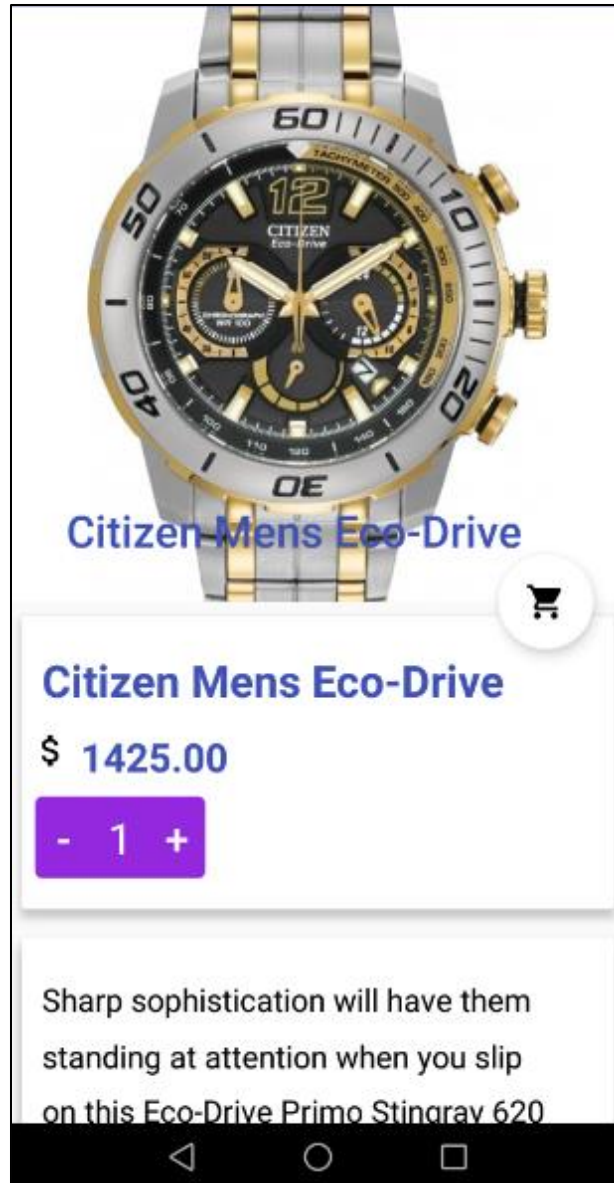


Figure 3.4.5: Product item details screen

The details of the selected watch will be displayed in this screen as shown above. Details such as product name, price, and description are available here. User can select the quantity that they want to purchase and click on the cart icon to place into the shopping cart.

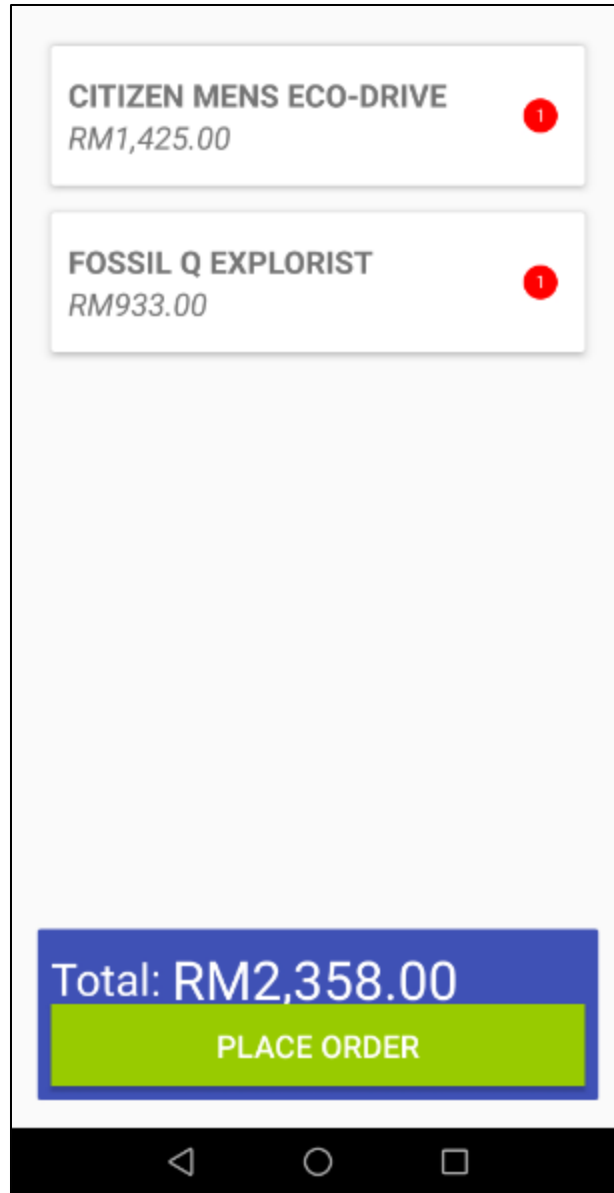


Figure 3.4.6: Shopping cart screen

The shopping cart screen will display all the watches with the quantity and price per unit. The total price will be shown at the bottom of the screen. User can press the “PLACE ORDER” button once confirm.

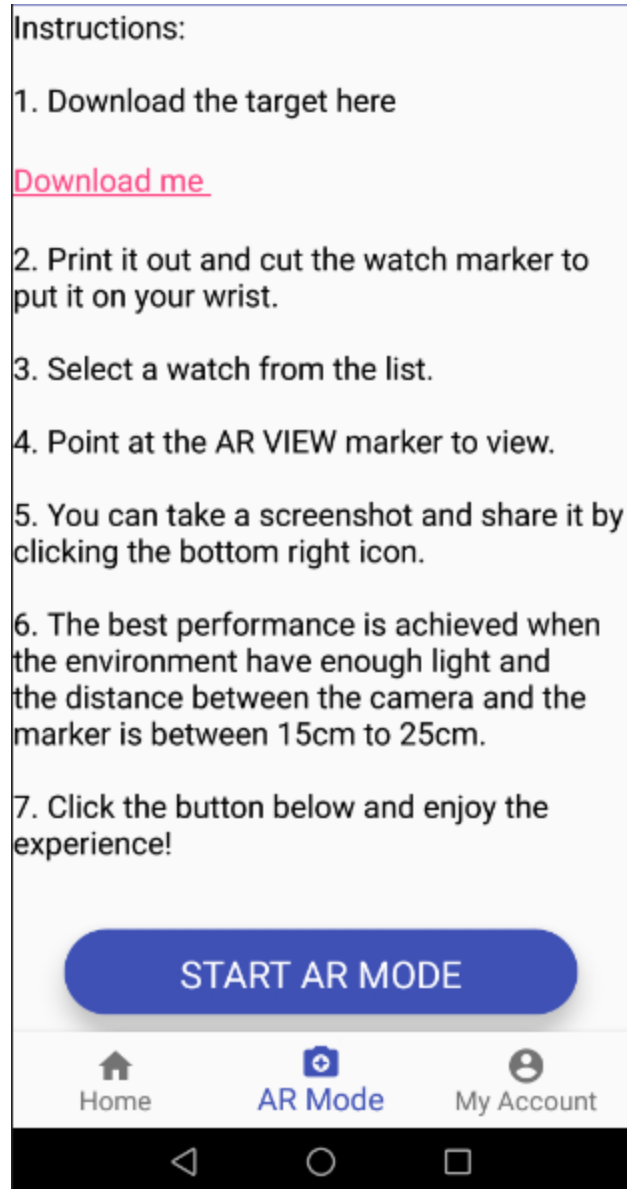


Figure 3.4.7: AR Mode Screen

In AR Mode Screen, instructions to use the AR feature are shown. User can click the “Start AR Mode” button is provided for user to trigger to the AR product view.

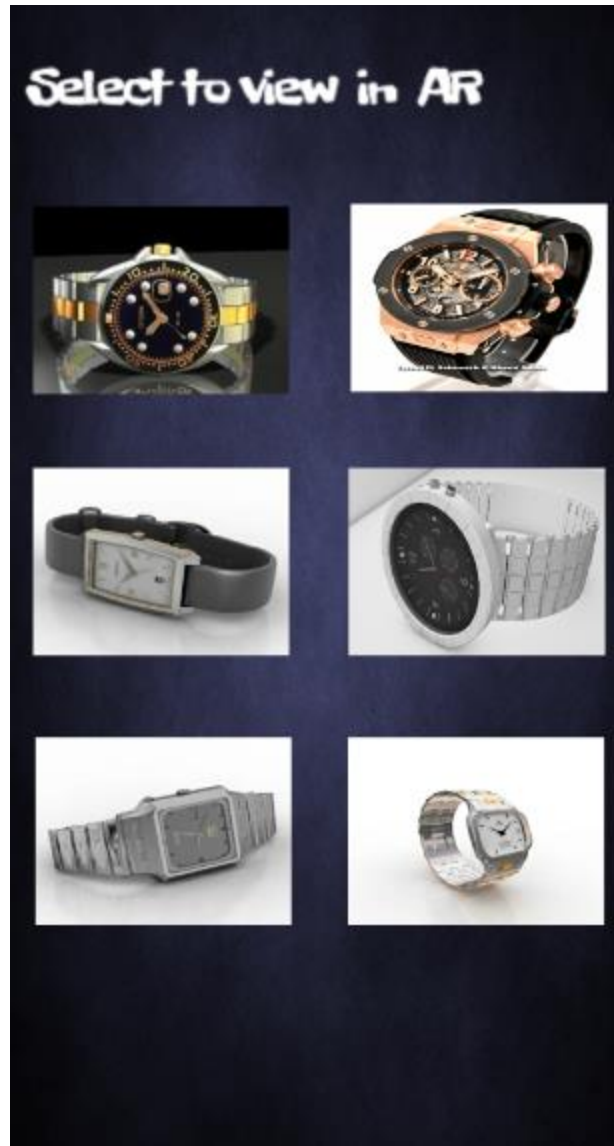


Figure 3.4.8: AR menu screen

The products that support AR view are displayed as shown above. User can click on it and activate the AR camera to view it in real environment.

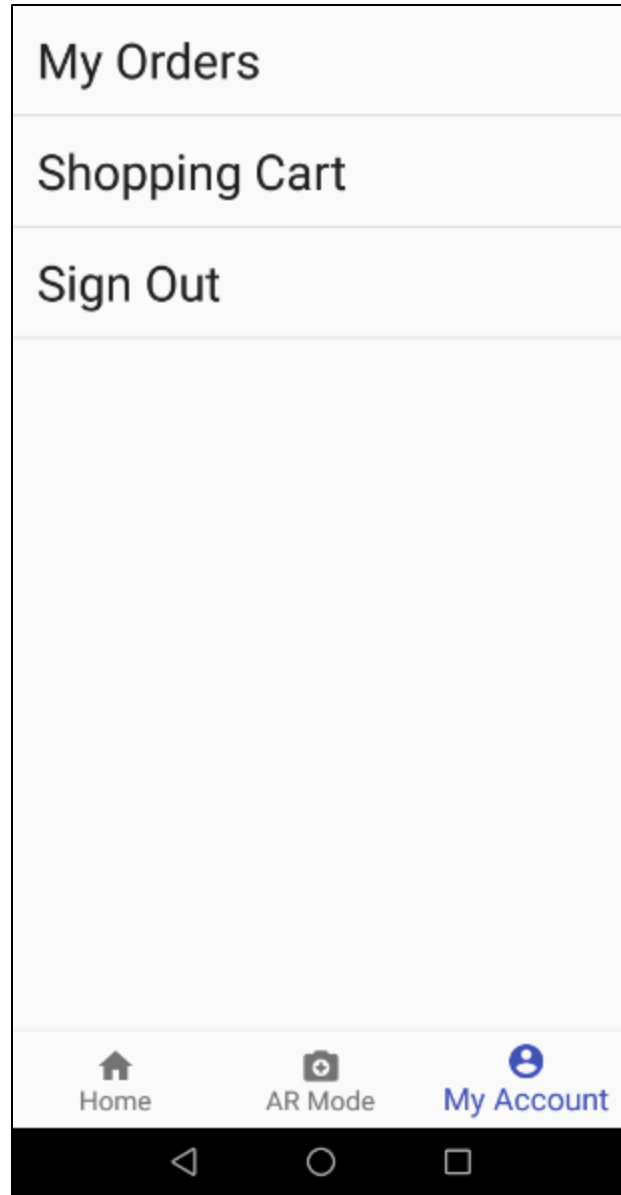


Figure 3.4.9: My Account screen

Figure 3.4.9 shows the My Account screen which enables user to manage their orders, shopping cart and also sign out from the account.

Chapter 4: Design Specification

4.1 Methodologies

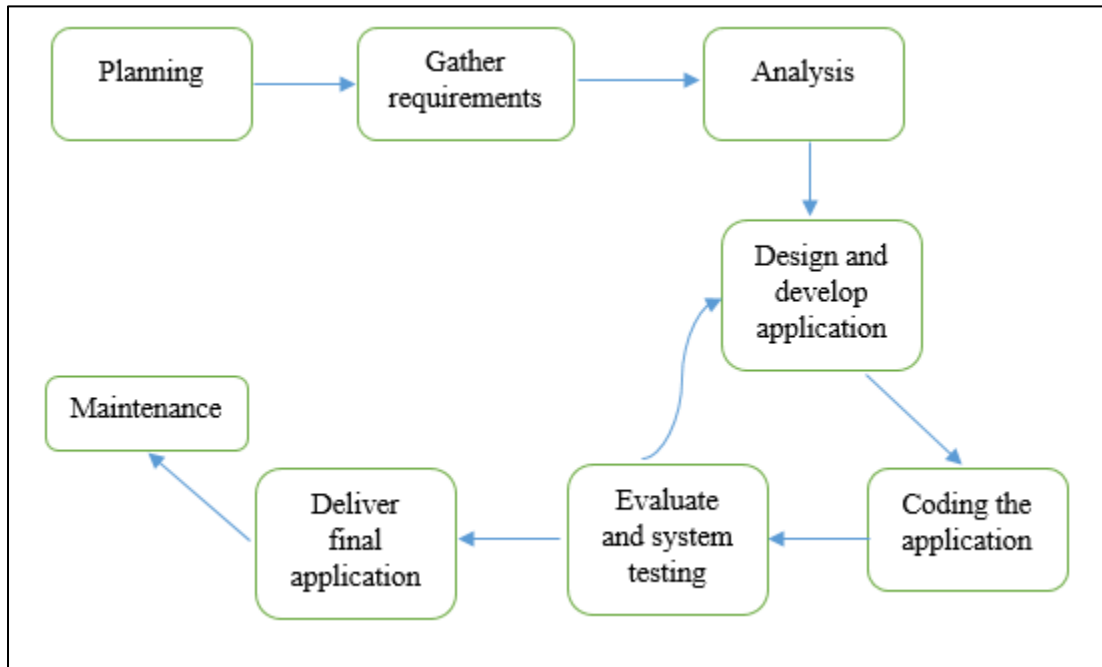


Figure 4.1: Methodology for developing the mobile application

Figure above shows the methodology used to develop the proposed mobile application. In the planning stage, the initial proposal is evaluated to define the problem statement, determine the project scope and to come out with the project objectives.

In the analysis stage, existing similar mobile applications that fit the project scope have been chosen to review as well. In the review process, strengths and weaknesses of those app that have been examined are recorded and analysed. Besides, questionnaires are designed and distributed to target respondents to understand the requirements of the mobile application and develop the app that addresses them. From the information gathered through the survey, important features will be highlighted as a guideline to work on the design of the application. Functional requirements are also determined in this stage. In the design stage, the UML diagrams and the flow of the app are created. Different modules that contains different functionalities will be designed and be implemented by phase. The following stage is the implementation where programming of the prototype will begin. The function of the module specified will be developed and evaluated. If the

prototype does not meet certain requirements or have bugs, the design and implementation for the module will be repeated. This stage is the most difficult and time consuming as coding and improvements often need longer time to discover and apply.

After the implementation stage, the application will undergo several testing's such system test to ensure all classes work together without error and user acceptance test to make sure the application meets the requirement.

Lastly, for system deployment stage, the complete mobile application is built and distributed to users to access on it. At the same time, the feedback received from the users are recorded for the maintenance purpose.

4.2 Tools, Connectivity, Hardware and Software Requirements

4.2.1 Tools Used to Develop the Mobile Application

Unity 3D

Unity 3D is a cross-platform development engine. Unity 3D is used to develop the augmented reality view of the watches.

Vuforia SDK

Vuforia is a free-source software development kit compatible with Unity 3D engine. Vuforia is used for the augmented reality features in tracking the marker and displaying 3D model on top of it.

Android Studio

Android Studio is used to create the mobile application with the graphical user interface and the functions to login, view products, add product to shopping cart, etc.

C#

The programming language being used is C#. C# scripting is needed in Unity to control the behaviour and functionality of the application.

Java

Java programming language is being used in Android Studio. It is used to create classes and methods for the mobile commerce application to work.

Firestore API

Firestore is a Backend-as-a-Service provided by Google. Firestore is selected to work as the database because it has many integrated functions such as realtime database, user authentication, storage, etc.

Autodesk 3DS Max 2018

Autodesk 3DS Max is used to convert the various 3D file format such as .3ds, .3dmax and .obj to the file format that is best supported by Unity, which is the .fbx format.

4.2.2 Connectivity Requirements for Users

Description	Compulsory
Internet connection	YES
GPS	NO
Bluetooth	NO
NFC	NO

Table 4.1: Connectivity requirement for user

Table 4.1 shows the connectivity requirements for user in using the mobile application. Internet connection is needed as the mobile application needs to connect to the Internet for account authentication and retrieval of products information. GPS, Bluetooth and NFC are not needed in this mobile application.

4.2.3 Hardware requirements

Description	Minimum requirement
CPU	2.0 GHz or higher
Camera	5 MP or higher
RAM	2GB or higher
Internal storage	1GB

Table 4.2: User device's hardware requirements

Table 4.2 shows the hardware requirements needed in using the proposed mobile application. The CPU of the mobile device requires with the processing power of at least 2.0 Giga Hertz, a 5 Mega Pixel camera, 2 GB of RAM and 1GB of internal storage.

4.2.4 Software Requirements

Description	Minimum requirement
Android Version	Android 6.0 or higher

Table 4.3 Software requirement for user

Table 4.3 shows that Android Version 6.0 or higher is needed for the mobile application to perform at best.

4.3 Verification Plan

Input	Expected output	Obtained output
User enters user name and password	Display invalid username or password if it's not a valid user	

Table 4.4: Login verification plan

Input	Expected output	Obtained output
User add products to shopping cart	Display message: "Product added" and item appear in shopping cart page	
User remove products from shopping cart	Display confirmation message to remove product. Items removed from the shopping cart page	

Table 4.5: Manage shopping cart verification plan

Table 4.4 and 4.5 shows the initial verification plan that will be used to test the output of the proposed mobile application. Input will be given to test the mobile application in different scenario and use case.

4.4 Survey Analysis

4.4.1 Survey methodology

A questionnaire is designed to gather responses from target participants on the importance of certain functions in mobile commerce application and the application of augmentation reality in mobile commerce application. The targeted respondents are working adults and students. Working adults are chosen because they are financially independent, so they processed purchasing power. Besides, students are chosen because they are keen to performing commerce transactions online and more acceptance to latest technology. Although they might not have strong purchasing power yet, they still remain as the potential customers of mobile commerce.

The questionnaire consists of two parts which are the demographic information and Section A. Section A is regarding the application of augmented reality in mobile commerce application. In the questionnaire, six-point Likert scales is being used. In section A, the Likert scales range from “strongly disagree” to “strongly agree”. The scale is eliminating the opportunity of choice for answering without considering the items of measurement. The respondents cannot choose the moderate value, middle point in this kind of rating scale because the respondents have to choose between one of the two qualifications of the scale to be the answer, with this method, the respondents have to consider for a while or a level (Chomeya, 2010). Different types of questions, namely multiple choice, Likert scale and open-ended responses were used. The questionnaires were distributed online through Google Forms and also by printed copies to target respondents.

4.4.2 Survey Results and Analysis

A total of 204 responses have been collected through online and questionnaire distribution. The demographic information section contains 7 questions to gather basic information of the targeted respondents.

For Likert scales questions, the least favorable option was given the code 1, and increasing by 1 to the most favorable option coded 5 or 6. Then, the mean is calculated. The categories used were level of importance and agreement.

Code	1	2	3	4	5	6
Agreement	Strongly disagree	Disagree	Slightly disagree	Slightly agree	Agree	Strongly agree

Table 4.6: Codes used for Likert Scale questions

Demographic Information

Demographics Factor	Factors	No. of respondents	Percentage
Age	18 – 24	111	54
	> 24	93	46
Total		204	100
Gender	Male	104	51
	Female	100	49
Total		204	100
Highest education level	Primary education	8	3.9
	Secondary education	20	9.8
	Tertiary education	176	86.3
Total		204	100
Monthly income	< RM 2000	74	36.3
	RM 2000 – RM 3500	68	33.3
	> RM 3500	62	30.4
Total		204	100

Use m-commerce apps before?	Yes	162	79.4
	No	42	20.6
Total		204	100
Frequency of m-commerce app usage in a week	< 3 times	141	69.1
	3 – 5 times	31	15.2
	> 5 times	32	15.7
Total		204	100
Occupation	Student	55	27.0
	Lecturer	21	10.3
	Engineer	8	3.9
	Auditor	7	3.4
	Banker	5	2.4
	IT Specialist	5	2.4
	Hairstylist	4	2.0
	Accountant	4	2.0
	Assistant Manager	3	1.5
	Clerk	3	1.5
	Others	89	43.6
Total		204	100

Table 4.7: Results of respondent's demographic information

Section A

Question: Have you heard of Augmented Reality (AR) before?

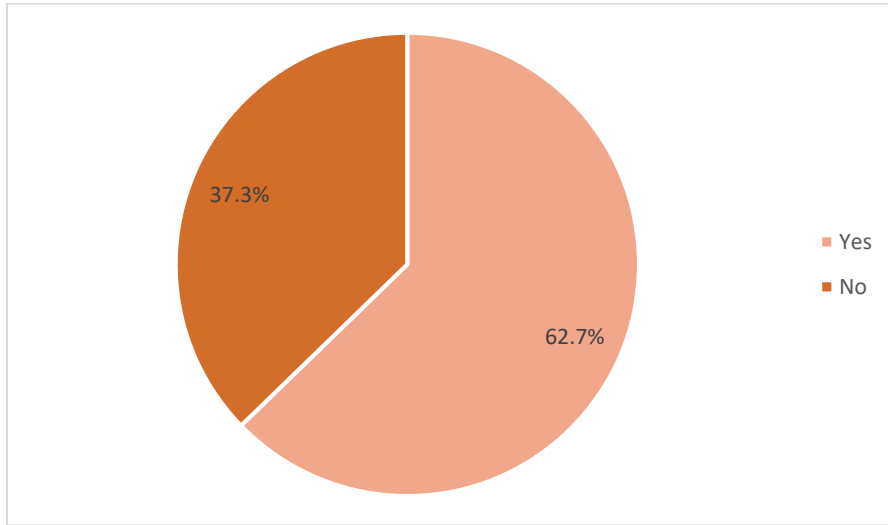


Figure 4.2: Respondents knowledge of AR technology

From the results shown, 62.7% which represents 128 respondents have heard of Augmented Reality before while 37.3% which represents 76 respondents have not heard of it. This is probably because AR is still new in mobile applications development and some people are not aware of it.

Question: If Augmented Reality is implemented in mobile online shopping, do you accept this concept? Eg: You can see yourself "wearing" a watch on your wrist through the app.

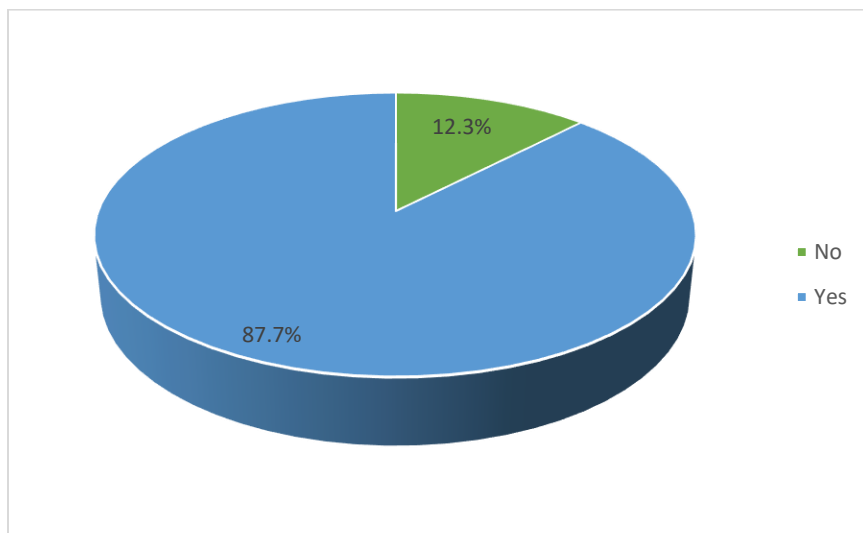


Figure 4.3: Respondents acceptance of AR technology in mobile shopping

The results have shown that 87.7% or 179 of the total 204 respondents accept the concept of AR in mobile shopping. There is only 12.3% (25 respondents) who did not accept the concept. It can be seen that large majority are accepting this concept in their mobile shopping experience.

Next, respondents are asked to give rating on the following statements in terms of level of agreement which best reflects their opinion on Augmented Reality in mobile shopping.

Question 1: Augmented Reality (AR) is able to give a more detail visualization of the product.

Question 2: AR helps in making decision of purchasing the product.

Question 3: AR creates a more satisfy feeling when doing online window shopping.

Question 4: AR gives a reality feeling of the product.

Question 5: AR enhances online shopping experience.

Question 6: AR helps to reduce the uncertainty and dissatisfaction of the product appearance.

Question 7: AR feature will make me to visit the mobile shopping app more.

Question 8: AR creates an engaging buying experience.

Question 9: AR can help in reduce the return rate of product by having an early perceive of how the product looks.

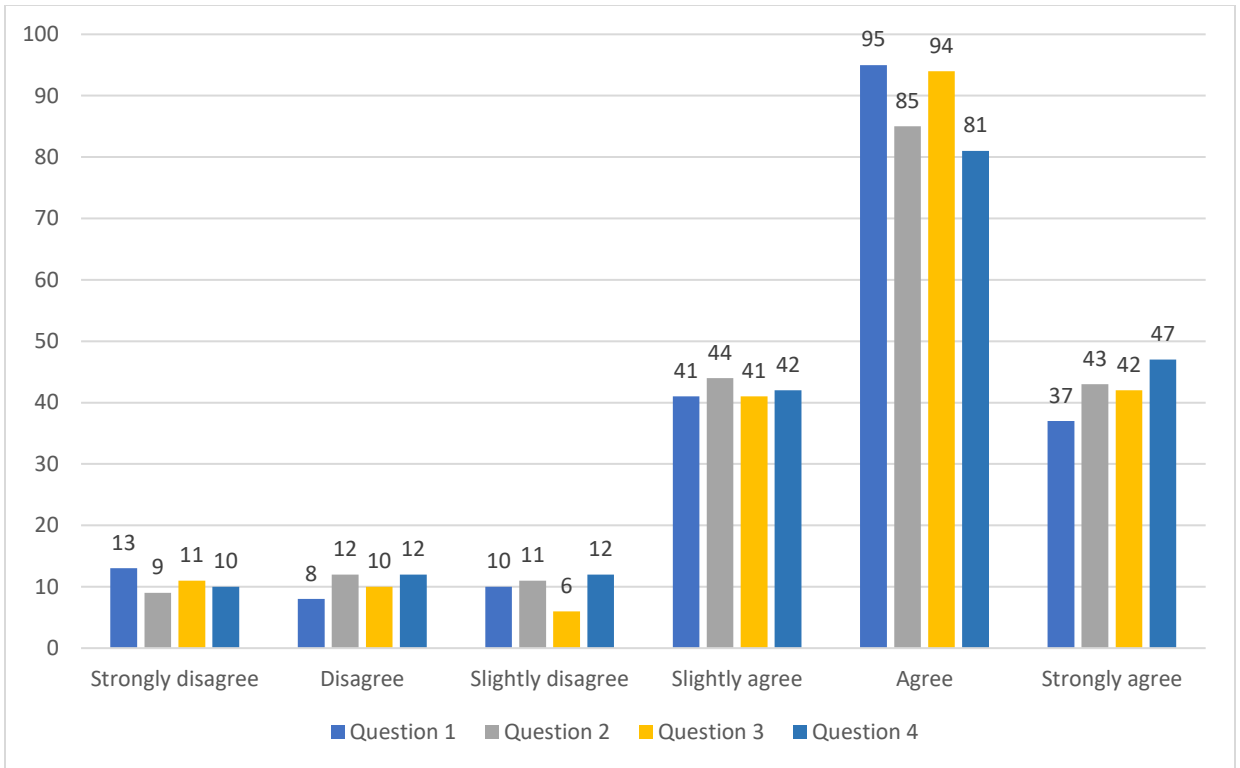


Figure 4.4: Results of respondents' agreement on question 1, 2, 3 and 4.

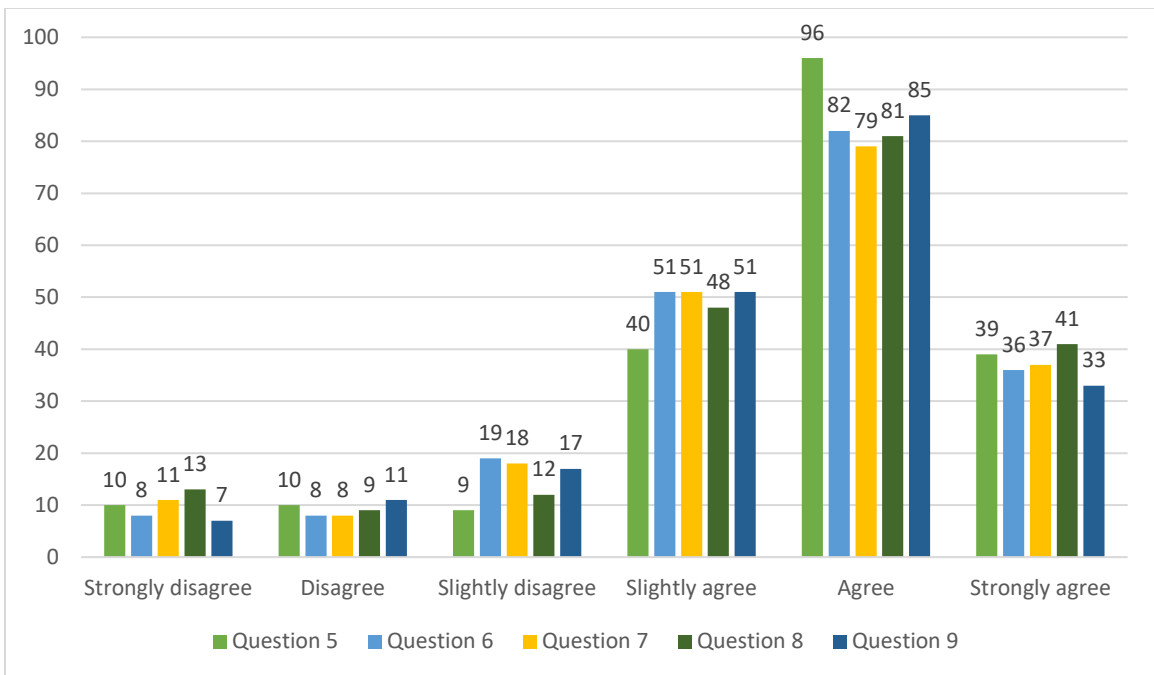


Figure 4.5: Results of respondents' agreement on question 5, 6, 7, 8 and 9.

Discussion on question 1: As seen from the results gathered, most of the respondents (95 respondents) had chosen “agree” that AR is able to give a more detail visualization of the

product. It is then followed by “slightly agree” (41 respondents) and “strongly agree” (37 respondents). The mean is calculated as follow:

$$\begin{aligned}\text{Mean, } \bar{x} &= \frac{\Sigma fx}{\Sigma f} \\ &= [13*1 + 8*2 + 10*3 + 41*4 + 95*5 + 37*6] / 204 \\ &= 4.510\end{aligned}$$

Discussion on question 2: As seen from the results gathered, most of the respondents (85 respondents) had chosen “agree” that AR helps in making decision of purchasing the product. It is then followed by “slightly agree” (44 respondents) and “strongly agree” (43 respondents). The mean is calculated as follow:

$$\begin{aligned}\text{Mean, } \bar{x} &= \frac{\Sigma fx}{\Sigma f} \\ &= [9*1 + 12*2 + 11*3 + 44*4 + 85*5 + 43*6] / 204 \\ &= 4.534\end{aligned}$$

Discussion on question 3: As seen from the results gathered, most of the respondents (94 respondents) had chosen “agree” that AR creates a more satisfy feeling when doing online window shopping. It is then followed by “strongly agree” (42 respondents) and “slightly agree” (41 respondents). The mean is calculated as follow:

$$\begin{aligned}\text{Mean, } \bar{x} &= \frac{\Sigma fx}{\Sigma f} \\ &= [11*1 + 10*2 + 6*3 + 41*4 + 94*5 + 42*6] / 204 \\ &= 4.583\end{aligned}$$

Discussion on question 4: As seen from the results gathered, most of the respondents (81 respondents) had chosen “agree” that AR gives a reality feeling of the product. It is then followed by “strongly agree” (47 respondents) and “slightly agree” (42 respondents). The mean is calculated as follow:

$$\begin{aligned}\text{Mean, } \bar{x} &= \frac{\Sigma fx}{\Sigma f} \\ &= [10*1 + 12*2 + 12*3 + 42*4 + 81*5 + 47*6] / 204 \\ &= 4.534\end{aligned}$$

Discussion on question 5: As seen from the results gathered, most of the respondents (96 respondents) had chosen “agree” that AR enhances online shopping experience. It is then followed by “slightly agree” (40 respondents) and “strongly agree” (39 respondents). The mean is calculated as follow:

$$\begin{aligned}\text{Mean, } \bar{x} &= \frac{\Sigma fx}{\Sigma f} \\ &= [10*1 + 10*2 + 9*3 + 40*4 + 96*5 + 39*6] / 204 \\ &= 4.564\end{aligned}$$

Discussion on question 6: As seen from the results gathered, most of the respondents (82 respondents) had chosen “agree” that AR helps to reduce the uncertainty and dissatisfaction of the product appearance. It is then followed by “slightly agree” (51 respondents) and “strongly agree” (36 respondents). The mean is calculated as follow:

$$\begin{aligned}\text{Mean, } \bar{x} &= \frac{\Sigma fx}{\Sigma f} \\ &= [8*1 + 8*2 + 19*3 + 51*4 + 82*5 + 36*6] / 204 \\ &= 4.466\end{aligned}$$

Discussion on question 7: As seen from the results gathered, most of the respondents (79 respondents) had chosen “agree” that AR feature will make me visit the shopping app more. It is then followed by “slightly agree” (51 respondents) and “strongly agree” (37 respondents). The mean is calculated as follow:

$$\text{Mean, } \bar{x} = \frac{\Sigma fx}{\Sigma f}$$

$$\begin{aligned} &= [11*1 + 8*2 + 18*3 + 51*4 + 79*5 + 37*6] / 204 \\ &= 4.422 \end{aligned}$$

Discussion on question 8: As seen from the results gathered, most of the respondents (81 respondents) had chosen “agree” that AR creates an engaging buying experience. It is then followed by “slightly agree” (48 respondents) and “strongly agree” (41 respondents). The mean is calculated as follow:

$$\begin{aligned} \text{Mean, } \bar{x} &= \frac{\Sigma fx}{\Sigma f} \\ &= [13*1 + 9*2 + 12*3 + 48*4 + 81*5 + 41*6] / 204 \\ &= 4.460 \end{aligned}$$

Discussion on question 9: As seen from the results gathered, most of the respondents (85 respondents) had chosen “agree” that AR can help in reduce the return rate of product by having an early perceive of how the product looks. It is then followed by “slightly agree” (51 respondents) and “strongly agree” (33 respondents). The mean is calculated as follow:

$$\begin{aligned} \text{Mean, } \bar{x} &= \frac{\Sigma fx}{\Sigma f} \\ &= [7*1 + 11*2 + 17*3 + 51*4 + 85*5 + 33*6] / 204 \\ &= 4.446 \end{aligned}$$

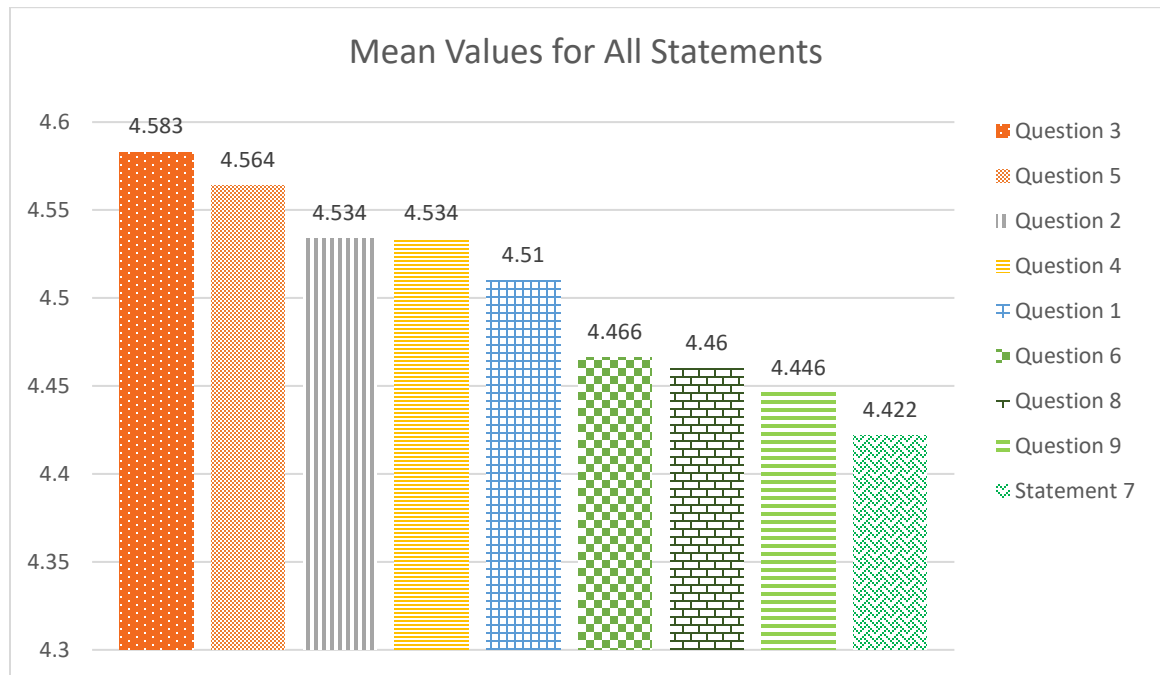


Figure 4.6: The mean of the questions.

The findings above have shown that the mean value of all the questions have exceeded the value of 4.0, and thus fall into the category of “agree”. It can be seen that majority of the respondents agreed to all the questions related to the implementation of AR in mobile shopping.

4.5 Implementation Issues and Challenges

The development of augmented reality mobile shopping application do not have much support from the online community. This is because augmented reality technology is still new and haven't reach a mature stage in the mobile application yet. Besides, the augmented reality development requires certain software development kit (SDK) such as Vuforia, Wikitude and Kudan which are not totally free and have limited access to all the features. There is also a free SDK available which is the Google's ARCore introduced not more than a year. However, ARCore requires physical devices to have Android API 26 or above, which my Android device cannot support up to that Android version, and ARCore cannot run on Android emulator. Thus, it is not possible for me to adopt this SDK. The Vuforia SDK chosen for this project however has limitation such as limited number of scans and Vuforia VuMark.

Besides, the display of augmented reality model requires the rendering of 3D graphics. However, not all 3D graphics resources are available on the internet. This is another challenge in the implementation of this mobile application because I do not have any experiencing in creating or handling 3D models before. Moreover, the development of augmented reality mobile application in Unity 3D is resource intensive and will take up much storage space of the device, so it is not suitable to be implemented in device which has low storage space.

Lastly, the designing of UI in Unity 3D for the developing of Android application requires a lot of time efforts. This is because Unity 3D itself is a game engine, not an Android native development tool which is good at simple and appealing UI design.

4.6 Timeline

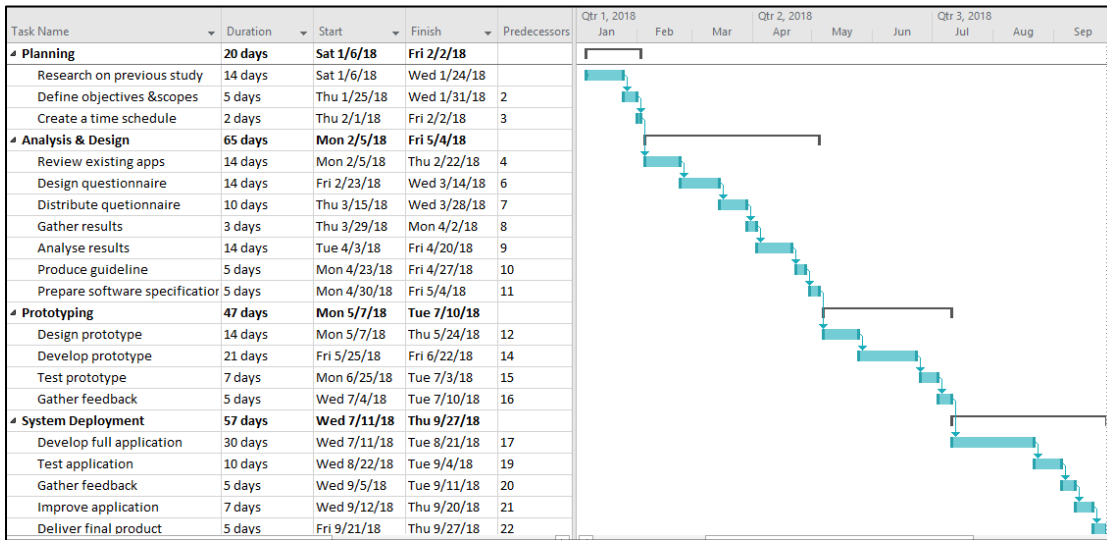


Figure 4.7: Gantt chart for the development of the mobile application (6 January 2018 – 27 September 2018)

Figure 4.7 above shows the Gantt chart of the development for the augmented reality m-commerce shopping application. In planning, the project starts with some study on previous work and comes out with a project plan with the problem statement, objectives and scopes defined. A time schedule is also set. In analysis and design stage, similar apps are reviewed and questionnaire is designed and distributed to respondents to gather information on mobile shopping functions and augmented reality. The design diagrams such as use case, flowchart and block diagram of the application are then created. Next, the prototype of different modules will be developed and evaluated for improvement. A final version of the mobile application will be developed from the refinement and integration of the prototypes. The mobile application is deployed for testing to check for their functionalities, user acceptance and requirements meet. Lastly, the final documentation will be produced and presentation for the project will be done

Chapter 5: System Testing

5.1 System Testing

5.1.1 Test Objective: Validate required fields when sign in

Input	Expected Output	Actual Output
Press Sign in without giving any details	System will generate error message of empty fields.	System displayed message: “Field cannot be empty” and wait for next action from user.

Table 5.1.1: System validate empty field test plan

From the test plan shown in the table above, system is able to validate empty field when Sign In. The message “Field cannot be empty” will be displayed to remind user to key in the credential needed to sign in to their account.

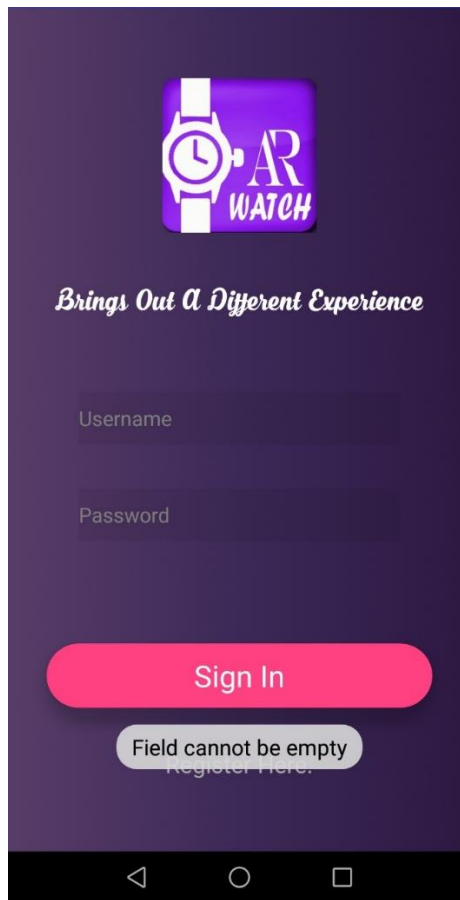


Figure 5.1.1: Systems check for empty fields during Sign In

5.1.2 Test Objective: Validate required fields when register account

Input	Expected Output	Actual Output
Press Register without giving any details	System will generate error message of empty fields.	System displayed message: “All fields are required” and wait for next action from user.

Table 5.1.2: System validate empty registration details test plan

From the test plan shown in the table above, system is able to validate empty registration details when user register for an account. The message “All fields are required” will be displayed when user left out any of the field during registration.

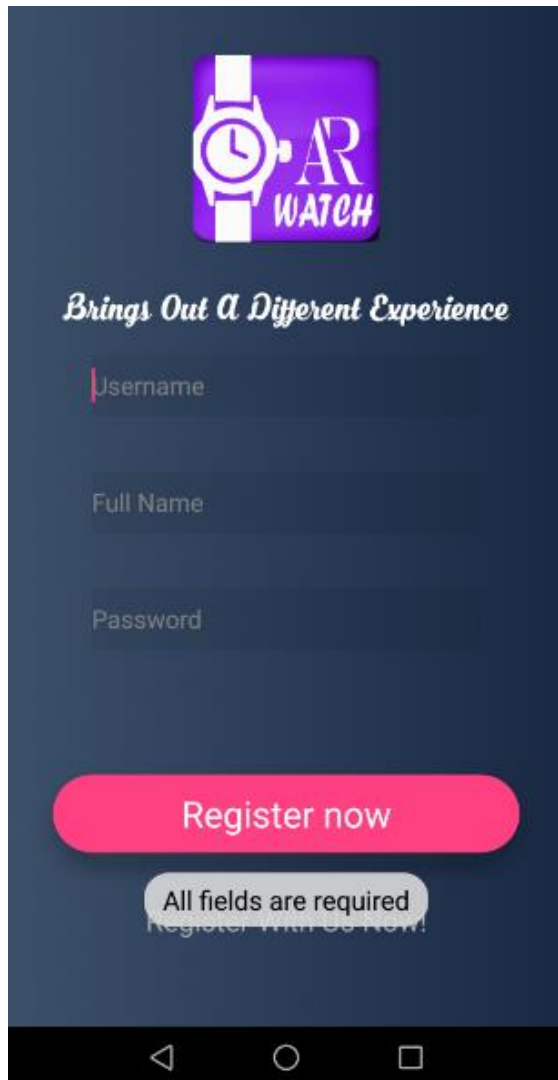


Figure 5.1.2: Systems check for empty fields during Register

5.1.3 Test Objective: Login with valid account information

Input	Expected Output	Actual Output
User login with correct username and password	System will generate message login successful	System displayed message: “Sign in successful!” and change to screen to product home page.

Table 5.1.3: System login with valid account information

From the test plan shown in the table above, system receives valid username and password for sign in. The system will output with a message “Sign in successful!” and bring user to the product home page.



Figure 5.1.3: Sign in successful with correct username and password

5.1.4 Test Objective: Register account with an existing username

Input	Expected Output	Actual Output
Register account with an existing username with the username: Test2	System will generate error message of account already existed.	System displayed message: “User already registered” and wait for next action from the user.

Table 5.1.4: Account registration with existing username

From the test plan shown in the table above, an attempt to register account with the existing username: “Test2” failed as system can detect existing account and generate message “User already registered”.

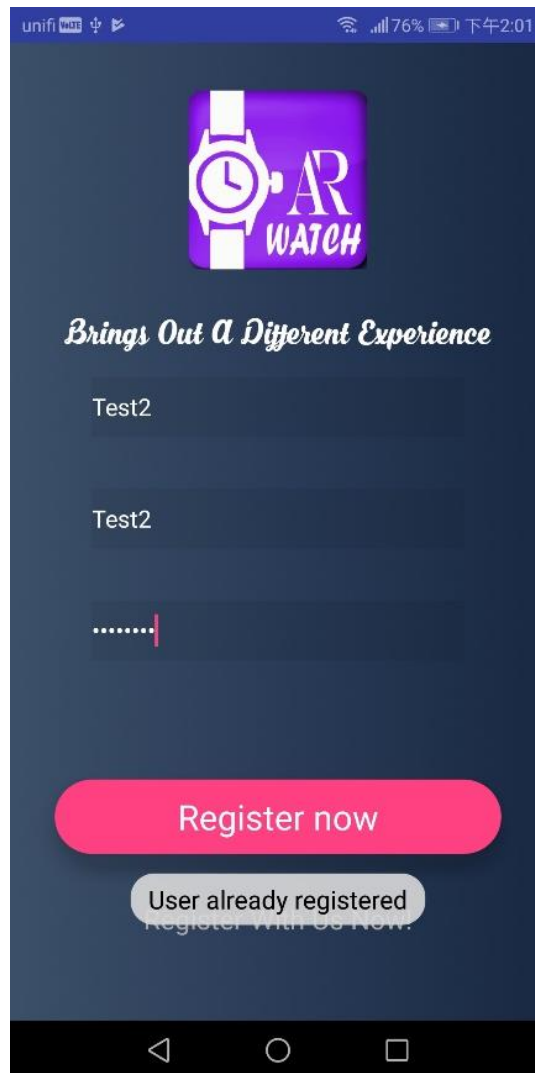


Figure 5.1.4: Register account with an existing username

5.1.5 Test Objective: View product in AR mode

Input	Expected Output	Actual Output
Select Fossil Handwatch W to be display in AR from the menu	AR Camera will start and display the 3D model of the watch on top of the wrist marker.	AR Camera started and the watch is displayed on top of the wrist marker along with the product name.

Table 5.1.5: View product in AR mode

From the test plan shown in the table above, a watch is selected to be viewed in AR view from the menu. The AR Camera started and the watch is displayed on top of the wrist marker along with the product name.



Figure 5.1.5: Display watch in AR mode

5.1.6 Test Objective: Add product into shopping cart

Input	Expected Output	Actual Output
Select Citizen Mens Eco-Drive watch with the quantity of 1 to put into shopping cart.	System will generate message that the product is added to cart.	System display message: “Added to cart” and the product appears in shopping cart.

Table 5.1.6: Add product into shopping cart

From the test plan shown in the table above, the cart button for Citizen Mens Eco-Drive watch is clicked to put the watch into shopping cart. The message “Added to cart” is displayed on screen and the watch appeared in shopping cart with total price shown.

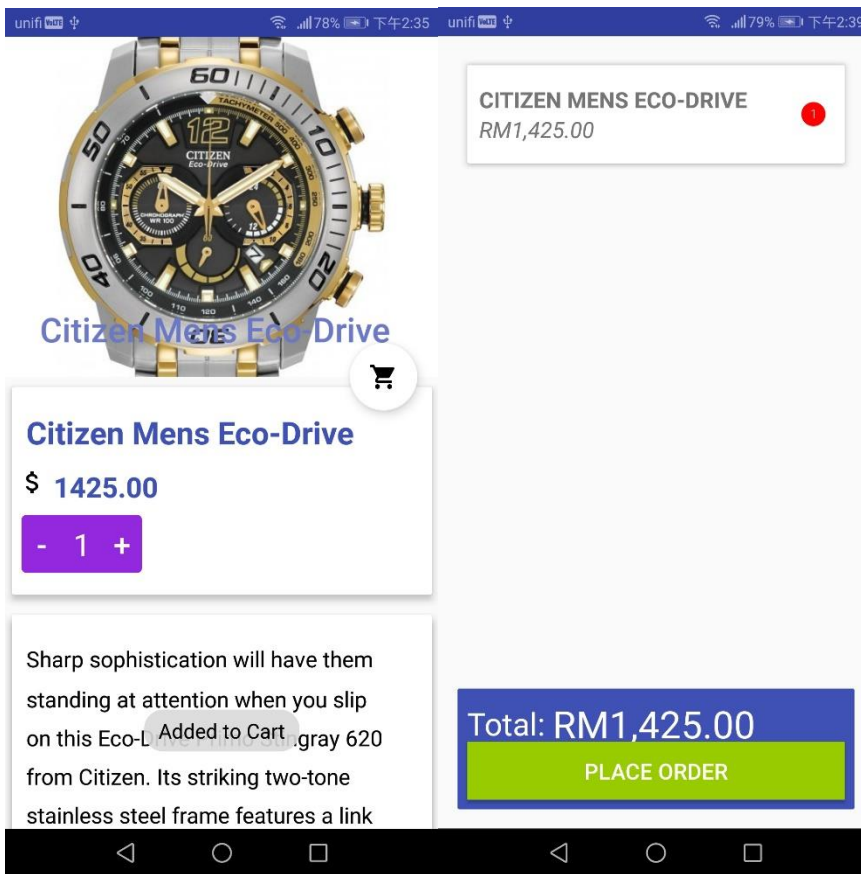


Figure 5.1.6: Product added into shopping cart

5.2 User Acceptance Testing

Acceptance testing by users is the process whereby actual users test a completed information system, the end result of which is the users' acceptance of it (Valacich & George, 2017). This test is also often called as beta testing, where it involves some testing by a group of end users who use the system in their own environment and own data. The mobile commerce application is tested with end users which are the current users of mobile shopping application. The purpose of this test is for users to determine whether the mobile commerce application meets their requirements. In the User Acceptance Testing (UAT), users are given task such as register and sign in, view products, add products to shopping cart and try the AR mode in the mobile application.

The concept of "Think Aloud" protocol was being utilised where users were encourage to say out loudly both their negative comments and positive comments. Feedbacks and reactions from the users are recorded during the test was being carried out.

Participants	Summary of Emotions and Feedbacks
User 1	<ul style="list-style-type: none"> • Appeared calm while using the app • Curious when using the AR feature • Able to complete the tasks without guidance • Likes the concept of AR in mobile shopping
User 2	<ul style="list-style-type: none"> • Was very curious and feel excited to try the watch in AR Mode • Comment that the watch can be scale at a better position to the marker • Able to complete all the tasks with least guidance • Overall satisfy with the app • Agreed with the concept of AR in mobile shopping
User 3	<ul style="list-style-type: none"> • Looks amazed in using the AR feature • Able to navigate within the app at ease • Able to complete all the tasks without guidance • Likes the concept of the app
User 4	<ul style="list-style-type: none"> • Facial expression looks relax while using the app • Able to complete all the tasks without guidance • Comment that some of the 3D models look less realistic • Will visit the app more if AR is implemented

User 5	<ul style="list-style-type: none"> • Looks calm and confident while using the app • Able to complete all tasks without guidance • Navigate within the app at ease • Comment that the 3D models doesn't look realistic
User 6	<ul style="list-style-type: none"> • Appeared confident while using the app • Able to complete all tasks without guidance • Impressed with the AR feature • Comment that the UI is simple and attractive • Likes the concept of AR in mobile shopping

Table 5.2: Users' emotions and feedbacks

Discussion on the User Acceptance Testing (UAT)

Among the 6 users that performed the UAT, 5 of them shows great interest in having augmented reality feature in mobile shopping application. They also agreed that with this enhanced shopping experience, they will have the intention to visit and use the application more in the future. Feedback for improvement such as displaying better quality of 3D models was given by them. Overall, majority of the users accept the concept of augmented reality in mobile shopping application as shown to them through the AR Watch mobile application of this project.

Chapter 6: Discussion and Conclusion

6.1 Project Review

Mobile commerce application stays as an essential component in modern day's commerce transaction given its ability to deliver electronic commerce capabilities directly into consumer's hand almost on anytime and anywhere. In most of the mobile commerce application specializing in mobile shopping available in Malaysia, users can only view the products in photo images and lacking of a more detailed and realistic visual representation of the products. In this case, augmented reality technology can be taken advantage of to enhance the view of the physical world through the overlay of digital data such as images and graphics on top of it.

The first objective which is to study user perception of augmented reality in mobile commerce has been carried out through distribution of questionnaire. The findings from the questionnaire has shown that respondents are giving positive feedback on the implementation of augmented reality in mobile shopping. Thus, a mobile shopping application with augmented reality technology, called the AR Watch is developed to let users have a hands on experience and a detailed representation of the watch. The mobile application is developed using Android Studio, Unity 3D and Vuforia SDK. In the application, shoppers are able to display the 3D model of the watch on their wrist marker through the AR camera of the application. Shoppers can screenshot and share the 3D model of the watch at their wrist and also purchase the watch through the mobile application. User acceptance testing is carried out to let user have a better understanding of the experience and the feedback shows positive results. Overall, the objectives that are being stated have been achieved.

6.2 System Strengths and Limitations

The strength of this mobile application is that it can be integrated with augmented reality technology to display the product in real-world environment. Users can have a better visual understanding and interaction with the mobile application. Besides, the screenshot and share function in the AR mode enables user to effortlessly share the screen and ask for opinions from friends in social media. Moreover, it can perform the functions of m-commerce purchase transactions. Users can easily view the products and manage their shopping carts and check out procedure. The retrieval of information from the web server is also efficient in terms of time needed.

However, to be honest, there are also limitations in this mobile commerce application. Some of the 3D model displayed in the AR mode are not very realistic due to the rendering format of the graphic in Unity3D engine. Unity 3D engine works well with the .fbx format and the 3D models obtained are mostly in .3ds and .obj format. Thus, 3D modelling and rendering software, Autodesk 3DS Max is being used to convert them to .fbx format. Nevertheless, the converted .fbx format 3D file has lost some textures and colors, making them not as realistic as how they are supposed to look. Besides, the AR camera will lose track of the marker if the distance of the camera to the marker is more than 30cm.

Obtaining the 3D model is a challenge in the implementation of this project. This is because high quality 3D models usually requires money to purchase and use. Furthermore, the free 3D models obtained from the internet doesn't necessary represent the real watch available in the market. Thus, there are some differences between the watch model in the AR Watch product page and those in AR mode.

6.3 Future Work

A detailed and more realistic visual representation of the product are essential in mobile commerce specifically for shopping products such as watch, jewelry, furniture and other decorative items. The application of augmented reality in mobile shopping application is useful in this case. Future improvement such as producing a higher quality and close to real product 3D models to be displayed can be made so that users can get the real scale and better view of the product. Further developments can also be done in terms of augmenting the image without having to scan the marker.

6.4 Conclusion

In this project, the problem with lacking of a more detailed and visual representation of the products in current mobile shopping application is being identified. To improve this situation, mobile shopping application integrated with the augmented reality can be a game changer. By integrating the augmented reality technology in mobile shopping, shoppers will have a more enhance shopping experience which can lead to a higher rate of purchasing an item. Besides, it can let shoppers to understand more and even try the product before purchasing. The objectives stated in the earlier part has been achieved through distributing and analysis of questionnaire, developing an Android mobile shopping application with augmented reality features, called the AR Watch and performing user acceptance test based on it. It can be seen that this project shown to have gained user acceptance of the concept of application of augmented reality in mobile commerce. Lastly, this project can benefit both the seller and customers, while having an impact in the m-commerce industry.

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Appendix A: Questionnaire

Mobile Commerce with Augmented Reality (AR)

Dear respondents,

I am a final year undergraduate student from the Faculty of Information and Communication Technology at Universiti Tunku Abdul Rahman majoring in Information Systems Engineering. The purpose of this questionnaire is to gather data regarding mobile commerce platform and also to investigate the acceptance of augmented reality (AR) in mobile commerce. Your response is of utmost important for me as a part of my Final Year Project research. This questionnaire consists of THREE (3) sections which include demographic information and will take about 5 - 10 minutes to complete.

The response from this questionnaire is solely for academic purpose and will be kept confidential. Your precious time and cooperation is very much appreciated. If you encounter any problems or questions, please feel free to contact me at jackwei318@utar.my. Thank you.

Wan Jack Wei

Bachelor of Information Systems (Hons) Information Systems Engineering
Faculty of Information and Communication Technology (Perak Campus)
Universiti Tunku Abdul Rahman

Demographic Information

1. Age *

18 - 24

> 24

2. Gender *

Female

Male

3. Highest education level *

- Primary education
 Secondary education
 Tertiary education

4. Occupation *

5. Monthly income *

- < RM2000
 RM 2000 - 3500
 > RM3500

6. Have you ever used mobile commerce apps before? Eg: Lazada app, Shopee app, 11 street app, Zalora, etc. *

- Yes
 No

7. Frequency of mobile commerce apps usage in a week. It can be browsing items or making purchase. (eg: Lazada, Shopee, 11Street, Zalora, etc) *

- < 3 times
 3 - 5 times
 > 5 times

Please read the following.

Augmented Reality (AR) is a technology that allows digital content to be overlaid and mixed into the real world through electronic devices. With mobile AR apps, we can view the world through smartphone cameras in order to see digital content mixed with the real environment. A famous application that uses AR technology is Pokemon Go, where the pokemon will appear in front of us in the outdoor environment as if it is really there.

Examples of AR technology in mobile apps.





1. Have you heard of Augmented Reality (AR) before? * Mark only one oval.

- Yes
- No

2. If Augmented Reality is implemented in mobile online shopping, do you accept this concept? Eg: You can see yourself "wearing" a watch on your wrist through the app.

* Mark only one oval.

- Yes
- No

3. Based on the following, please give a rating which best reflects your opinion on Augmented Reality in mobile shopping. * Mark only one oval per row.

Appendix A: Questionnaire

	Strongly disagree	Disagree	Slightly disagree	Slightly agree	Agree	Strongly agree
Augmented reality(AR) is able to give a more detail visualization of the product.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
AR helps in making decision of purchasing the product.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
AR creates a more satisfy feeling when doing online window shopping.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
AR gives a reality feeling of the product.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
AR enhances online shopping experience.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
AR helps to reduce the uncertainty and dissatisfaction of the product appearance.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
AR feature will make me to visit the mobile shopping app more.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
AR creates an engaging buying experience.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
AR can help in reduce the return rate of product by having an early perceive of how the product looks.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

4. What is your expectation of Augmented Reality that can bring in mobile commerce?

-End

Appendix B: AR Watch marker and instructions



AR WATCH

INSTRUCTIONS:

CUT THE MARKER, AND BEND IT. PUT IT ON YOUR WRIST. YOU CAN HOLD IT WITH SCOTCH TAPE, OR JOINING THE TWO FLAPS. MARKER ZONE SHOULD REMAIN FLAT, AND THE ENVIRONMENT MUST HAVE ENOUGH LIGHT.

RUN THE AR WATCH APP, POINT TO YOUR MARKER, AND ENJOY!

BRINGS OUT A **DIFFERENT**
EXPERIENCE

INTRODUCTION

Current m-commerce users are facing problems of lacking a detailed visual representation of the product they are viewing. Users cannot view the products in the real-world environment. By integrating augmented reality technology in the m-commerce application, users can enhance their view of the physical real-world through the generated product image over users' view of the real world. The implementation of AR technology in m-commerce will increase the interaction and engagement of users, leading to a higher conversion rate of purchase.

OBJECTIVES

The objectives of this project are:

1. To study user perception on the application of augmented reality in mobile commerce.
2. To develop a mobile shopping application with augmented reality technology.
3. To perform user testing with the mobile application.

PROJECT DEVELOPER

WAN JACK WEI
Bachelor of Information Systems (Hons)
Information Systems Engineering

METHODOLOGY

Prototyping Development

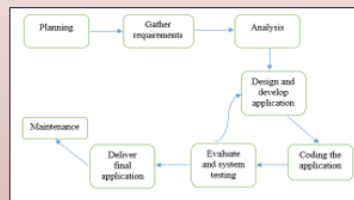


Figure 1

TECHNOLOGIES USED

- UNITY 3D
- VUFORIA SDK
- ANDROID STUDIO
- JAVA
- C# PROGRAMMING LANGUAGE
- FIREBASE

PROJECT SUPERVISOR

DR. MANORANJITHAM A/P MUNIANDY

USER INTERFACE



CONCLUSION

This project will be able to address the problem of a more realistic visualization of the product. Mobile shopping application with augmented reality feature was developed. User acceptance of this concept will bring positive effects in m-commerce.

Figure 7.1: Poster of the project

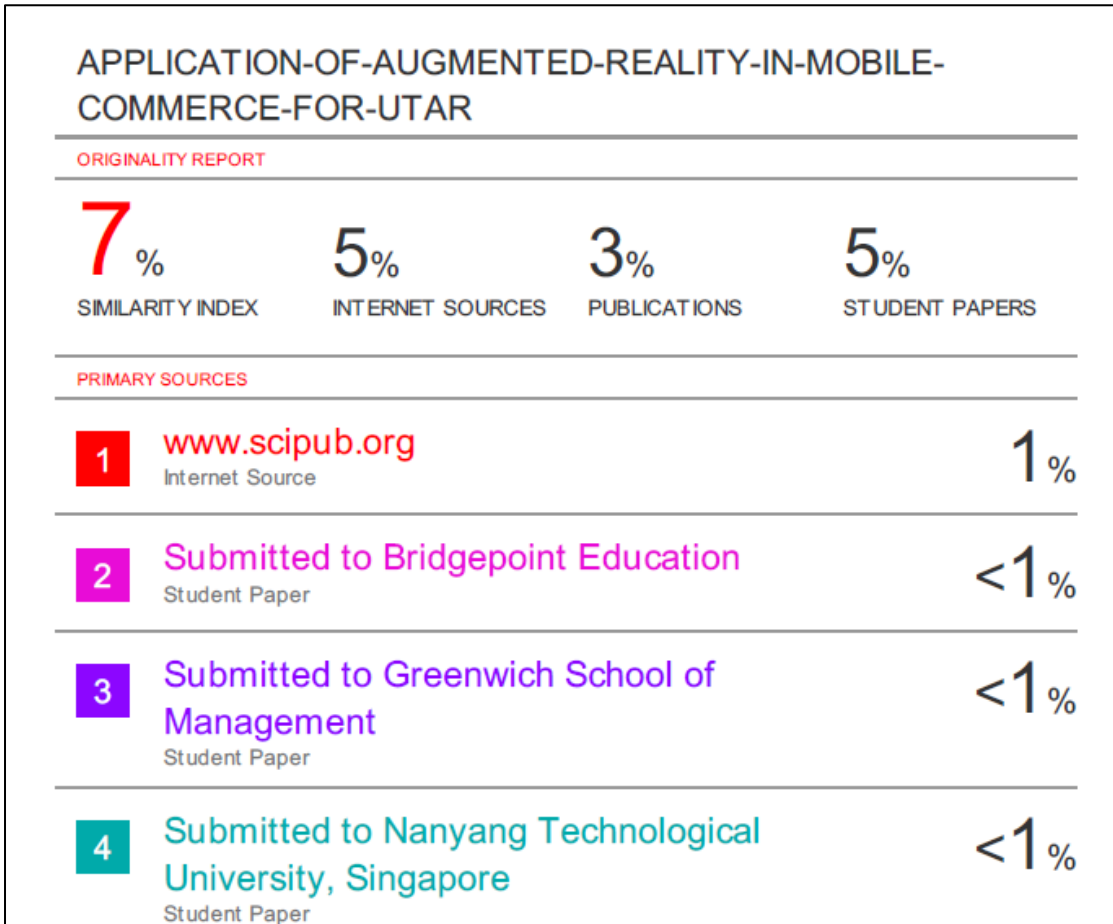


Figure 7.2: Plagiarism check result

Universiti Tunku Abdul Rahman			
Form Title: Supervisor's Comments on Originality Report Generated by Turnitin for Submission of Final Year Project Report (for Undergraduate Programmes)			
Form Number: FM-IAD-005	Rev No.: 0	Effective Date: 01/10/2013	Page No.: 1 of 1



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Full Name(s) of Candidate(s)	
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Similarity	Supervisor's Comments (Compulsory if parameters of originality exceeds the limits approved by UTAR)
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Note Supervisor/Candidate(s) is/are required to provide softcopy of full set of the originality report to Faculty/Institute

Based on the above results, I hereby declare that I am satisfied with the originality of the Final Year Project Report submitted by my student(s) as named above.

Signature of Supervisor
Name: _____

Signature of Co-Supervisor
Name: _____

Date: _____

Date: _____



UNIVERSITI TUNKU ABDUL RAHMAN

**FACULTY OF INFORMATION & COMMUNICATION TECHNOLOGY (PERAK
CAMPUS)**

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	List of Symbols (if applicable)
	List of Abbreviations (if applicable)
	Chapters / Content
	Bibliography (or References)
	All references in bibliography are cited in the thesis, especially in the chapter of literature review
	Appendices (if applicable)
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