PERSONALISATION OF POINT OF INTEREST IN AR APPLICATION FOR TOURISM

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This report is submitted in partial fulfilment of the requirements for the Bachelor of Computer Science (Interactive Media) with Honours.

FACULTY OF INFORMATION AND COMMUNICATION TECHNOLOGY UNIVERSITI TEKNIKAL MALAYSIA MELAKA

2024

DECLARATION

I hereby declare that this project report entitled

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STUDENT : Date:29/8/2024
(KRISHNARAJ A/L BALAKRISHNAN).

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

SUPERVISOR: Date: 29/8/2024
(Ts. Dr. Muhammad Haziq Lim bin Abdullah)

DEDICATION

This final project is wholeheartedly dedicated to my beloved parents, who have been my source of inspiration, gave me strength when I thought of giving up, support and help whenever and wherever I need.

In addition, to my supervisor, Ts. Dr. Muhammad Haziq Lim bin Abdullah who always committed, to endless support and guided me while the progress of this final project.

To my evaluator, Dr. Mohammed Nasser Mohammed Al-Andoli who gives feedback and advice on this final year project.

Lastly, to all my beloved friends who always there to help me through anything and shared their words of advice and encouragement to finish my final year project.

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Thank you, God, for the guidance, and strength, and for giving me a healthy life. With your help, and permission I can finish and complete my final year project.

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To wrap things up, I dedicated this final year project to all my friends who always gave a hand and their support during the development of this project.

Thank you.

ABSTRACT

Melaka was designated a World Heritage Tourism City in 2008, highlighting its rich cultural and historical significance. This project seeks to enhance the tourism experience by personalizing Points of Interest (POI) through an Augmented Reality (AR) application specifically designed for the heritage tourism sector in Melaka. The primary objective of this study is to develop an AR-based mobile application that leverages user preferences, historical data, and real-time interactions to offer tailored information about various POIs. The study identified that traditional tourism methods often lack personalisation and fail to engage the diverse interests of tourists. By integrating AR with personalised POIs, the application addresses these limitations, providing a more immersive and engaging experience for users. The study included 53 respondents, revealing a higher interest among males in using the app. The personalised AR application also demonstrated improved tourist satisfaction by offering real-time, relevant information that aligns with individual preferences. Most respondents rated the application's effectiveness highly, with scores above 4 in their survey after used the application. The findings from the testing phase of the AR application involved a sample of 53 respondents, consists of males and females, who provided feedback through a post-usage questionnaire. An Independent Samples t-Test conducted to compare the mean scores between two independent groups (male vs. female). Also, Descriptive Statistics conducted to summarize the basic features of the dataset which contains mean, standard deviation, and frequency distributions for the questionnaire responses, gender, and age ranges. Almost every respondents are are satisficed using the AR application around 93.86%. The application not only enhances the visitor experience but also supports the preservation and promotion of cultural heritage through innovative technology. The implementation of this personalised AR application resulted in a more engaging and informative experience for tourists, leading to increased satisfaction and a deeper understanding of Melaka's cultural and historical sites.

ABSTRAK

Melaka telah ditetapkan sebagai Bandar Pelancongan Warisan Dunia pada 2008, menonjolkan kepentingan budaya dan sejarahnya yang kaya. Projek ini bertujuan untuk meningkatkan pengalaman pelancongan dengan memperibadikan Tempat Menarik (POI) melalui aplikasi Realiti Tertambah (AR) yang direka khusus untuk sektor pelancongan warisan di Melaka. Objektif utama kajian ini adalah untuk membangunkan aplikasi mudah alih berasaskan AR yang memanfaatkan keutamaan pengguna, data sejarah dan interaksi masa nyata untuk menawarkan maklumat yang disesuaikan tentang pelbagai POI. Kajian itu mengenal pasti bahawa kaedah pelancongan tradisional sering kekurangan personalisasi dan gagal menarik minat pelancong yang pelbagai. Dengan menyepadukan AR dengan POI yang diperibadikan, aplikasi menangani batasan ini, memberikan pengalaman yang lebih mengasyikkan dan menarik untuk pengguna. Kajian itu melibatkan 53 responden, mendedahkan minat yang lebih tinggi di kalangan lelaki untuk menggunakan aplikasi itu. Aplikasi AR yang diperibadikan juga menunjukkan kepuasan pelancong yang lebih baik dengan menawarkan maklumat masa nyata yang relevan yang sejajar dengan keutamaan individu. Kebanyakan responden menilai keberkesanan aplikasi dengan tinggi, dengan markah melebihi 4 dalam tinjauan mereka selepas menggunakan aplikasi tersebut. Dapatan daripada fasa ujian aplikasi AR melibatkan sampel seramai 53 orang responden, terdiri daripada lelaki dan perempuan, yang memberikan maklum balas melalui soal selidik pasca penggunaan. Ujian-t Sampel Bebas dijalankan untuk membandingkan skor min antara dua kumpulan bebas (lelaki vs. perempuan). Selain itu, Statistik Deskriptif dijalankan untuk meringkaskan ciri asas set data yang mengandungi min, sisihan piawai dan taburan kekerapan untuk respons soal selidik, jantina dan julat umur. Hampir setiap responden berpuas hati menggunakan aplikasi AR sekitar 93.86%. Aplikasi ini bukan sahaja meningkatkan pengalaman pelawat tetapi juga menyokong pemeliharaan dan promosi warisan budaya melalui teknologi inovatif. Pelaksanaan aplikasi AR yang diperibadikan ini menghasilkan pengalaman yang lebih menarik dan bermaklumat untuk pelancong, yang membawa kepada peningkatan kepuasan dan pemahaman yang lebih mendalam tentang tapak budaya dan sejarah Melaka.

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LIST OF ABBREVIATIONS

APP - Application

AR - Augmented Reality

ARCQ – Augmented Reality Content Quality

ARS – Augmented Reality Satisfaction

ARSQ – Augmented Reality System Quality

ITR – Intention to Recommend

PI – Personal Innovativeness

POI – Point of Interest

CHAPTER 1: INTRODUCTION

1.1 Project Background

The tourism industry has dramatically shifted towards embedding customised experiences using immersive technology. Augmented Reality (AR) is now seen as a tool for enriching tourists' experiences by adding information to the real world. AR has been widely recognized for its potential to create immersive and interactive experiences in various sectors, including tourism (Azuma, 2015). This project focuses on leveraging AR to personalize Points of Interest (POI) within an application specifically designed for the heritage tourism sector in Melaka, Malaysia.

Melaka enjoys the status of a World Heritage Site and is considered a city that has several cultural values and is historically important. However, the current tourism approach applied in Melaka many times cannot deliver a unique experience to the diverse tourism market. More specifically, while static information boards and guided tours seem to make impression on tourists, they are not sufficient in influencing tourists' choices, surviving alone without appealing to tourists' preference satisfaction (Santos, 2017). This gap therefore presents a challenge in a bid to come up with unique approaches that would enable the delivery of entertaining and more effective customized services that would ultimately enable the creation of positive impressions to the visitors leading to improved understanding of cultural experiences.

There are also several drawbacks of conventional tourism methods due to their heavy dependence on them. First, the methods used do not involve personalisation, and, consequently, experiences offered to customers are rather standardized and repetitive. In the argument made by Hudson and Thal (2013), tourists have a great level of attention and interest from service providers, product experiences, and interactive and tourism services that are tailored to meet their needs and preferences. Secondly, what several visitors fail to appreciate when attempting to gather details on sundry POIs is that end up half-baking their brains, and therefore all the fun is eased (Graham, 2018). Finally, accessibility barriers can limit the diversification of tourism experiences in each destination, particularly for the disabled or those with special needs. These are some of the difficulties that require a contemporary strategy that would involve the use of AR and personalisation, as the tourists' requirements vary.

The project aims to revolutionise the heritage tourism sector in Melaka by developing an AR-based application that offers personalised POI recommendations. By utilising advanced personalisation algorithms and location-based services, the application will provide tailored suggestions and immersive content that enhance the overall tourist experience. This approach not only addresses the current limitations but also aligns with global trends towards personalised and technology-driven tourism solutions.

1.2 Problem Statement

The lack of personalised information available to tourists was a crucial aspect of AR applications, especially for heritage tourism (Chung, 2015). Traditional guides and information sources offer generic content that may not align with the diverse interests and preferences of individual tourists (Hudson & Thal, 2013). For example, tourists interested in culinary experiences may not find relevant information about local food markets or eateries in conventional guides, leading to a less engaging travel experience.

The existing informational tools such as brochures, maps, and static information boards provide limited interactivity and often contain outdated information (Graham, 2018). For instance, a tourist relying on a printed map may miss out on newly opened attractions or temporary exhibitions, resulting in a subpar exploration experience. These challenges underscore the need for innovative solutions that leverage technology to offer personalised and real-time information, thereby enhancing the overall tourist experience in Melaka.

1.3 Objective

The objectives of this project are:

a) To analyse the AR requirements for heritage tourism in Melaka.

b) To develop an Augmented Reality (AR) application specifically tailored for the heritage tourism sector in Melaka.

c) To evaluate the features of effectiveness in AR application that allow for the personalisation of POI information especially in language sector based on individual tourist preferences and interests.

1.4 Project Scope

The scope of developing this project are:

1.4.1 Target Audience

This Augmented Reality application targets tourists visiting World Heritage City Melaka, including both local and international travellers.

1.4.2 Content and Modules

The application will include:

a) POI Detection: Using the phone's camera.
b) Personalisation Algorithm: An algorithm that analyses user input (interests, travel style, etc.) and recommends relevant POIs.
c) AR Overlays: Information about POIs will be presented through visually appealing AR overlays, including text, multimedia content, and historical details.
d) User Interface (UI) Design: An intuitive and user-friendly interface that allows for easy interaction and navigation within the application.

1.5 Project Significance

The successful development of this AR application will hold significant value for various stakeholders:

a) **Tourists:** Travellers will benefit from a personalised travel experience that caters to their interests and preferences.

b) **Tourism Industry**: The application can act as a valuable tool for tourism businesses to promote their offerings and attract visitors with tailored recommendations.

1.6 Summary

The goal of this project is to create a stand-alone application that will allow the public to visualise and customise point-of-interest (POI) in augmented reality tourism, thereby increasing public awareness of the industry. Technology related to Augmented Reality is used in the development and design of the application. The problem statements describe the current state of affairs and the reasons behind the need for this project's development. The problem statement makes the objectives very clear. The goals ought to be reachable and reasonable. The precise target user, the framework, and usability are made clear by research interests.

CHAPTER 2: LITERATURE REVIEW AND PROJECT METHODOLOGY

2.1 Introduction

The purpose of the literature review is to present a thorough summary of the current research and advancements concerning augmented reality (AR) applications in tourism, with a particular emphasis on the customisation of points of interest (POIs). The project's foundation is formed by the relevant theories, technologies, and methodologies examined in this chapter.

2.2 Domain

This project's domain includes some important areas, such as augmented reality, types of AR technology, and Marker-Based AR. Every one of these domains is essential to the creation and execution of the augmented reality application for World Heritage City tourism.

2.2.1 Augmented Reality (AR) Definition

The workmanlike innovation that distinguishes between what is real and what is computer-generated is augmented reality. Word Users of augmented reality are accustomed to tangible data, computer-generated audio, 3D models, and a brief, oblique view of the outside world. When the growth continues, augmented reality can create entirely new, amazing experiences by leveraging intuitive and well-thought-out data to improve one's perception of reality. Progressively, augmented reality resolves all conflicts between the real and virtual worlds. Unlike virtual reality (VR), augmented reality (AR) creates a false environment that reflects the actual environment. (Economic Times, February 16, 2016).

2.2.2 Types of Augmented Reality

Marker-based augmented reality, marker-less augmented reality, projection-based augmented reality, and superimposition-based augmented reality are some of the platforms that can be used to view the output of AR.

2.2.2.1 Marker Based Augmented Reality

Recognition of Images or Recognition-Based In the field of augmented reality technology, one of the most widely used methods is augmented reality. This approach is focused on object recognition, which can give the user additional details about nearby physical objects. By using markers including QR coefficient or flyers, Marker-Based AR trends to identify the object presented by the camera and then place the relevant information that concerns it on the interface (Azuma, 2015). For instance, if a user aims the device to a historical image that has QR code at the right side of a historical monument, the AR application will display information about the monument that appears on a screen when a user scans the marker.

Another benefit that comes with the use of Marker-Based AR is the element of interactivity that it offers to the users. In this way, by replacing the marker on the screen with a 3D image of the recognized object users can see the object with much more detail and from different angles (Huang et al., 2019). For instance, visitors who use a device such as smartphone or tablet to tour a museum that has installed Marker-Based AR technology scan QR codes placed beside the exhibits as in Figure 2.1. The 3D marker imagery shown on the screen changes as the user rotates the marker, and this can help them understand the features of the exhibit as they explore the concept from different AR angles.

Figure 2.1 Marker-Based Augmented Reality (Jeffrey, 2016)

2.2.2.2 Marker-less Based Augmented Reality

Because of its easy accessibility and user-friendly interface, marker-less augmented reality, also referred to as location-based augmented reality, is more frequently utilised in the travel industry (Azuma, 2015). Through the use of their smart devices, users can locate nearby points of interest and receive location-based data.

It functions based on using data from the device's accelerometer, GPS, compass, and estimating the user's position and orientation to project data about the environment in front of the camera (Huang et al., 2019) as shown in Figure 2.2 below. For instance, when people are visiting a new city, they can look for Markerless AR to get information on the shops, restaurants, or monuments to visit, throughout their tour.

Figure 2.2 Marker-less Based Augmented (Indiabrillmindz, 2016)

2.2.2.3 Projection Based Augmented Reality

Projection-Based Augmented Reality, a type of AR that projects digital content in the form of virtual objects on physical surfaces that users can manipulate with touch or gestures, is related to this interactive and intuitive nature (Azuma, 2015). This is a common method for projecting virtual objects into the real world in order to enhance the sense of 3D space.

For example, projection AR could be used to project virtual art or architectural designs onto walls, floors, or tables, which users can grow to interact with the digital content as if it were a teapot (Graham, 2018). Another example is the projection-based AR technologies of ARKit, or perhaps some advanced versions like the laser plasma technology where can project our holographic images in physical space, blurring division lines between the virtual and real world as shown in Figure 2.3 below.

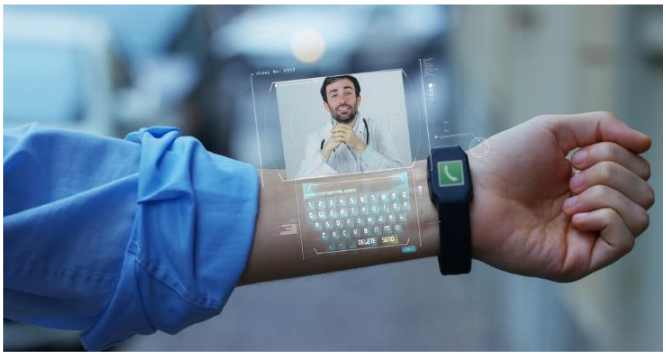


Figure 2.3 Projection-Based Augmented Reality (HDP, 2024)

2.2.2.4 Superimposition Based Augmented Reality

Superimposition-Based Augmented Reality provides a fresh perspective on an object of interest by superimposing digital data on top of real-world objects (Azuma, 2015). As seen in Figure 2.4 below, this technique requires the AR system to accurately identify and track the object in order to properly place the digital information on it.

Figure 2.4 Superimposition Based Augmented Reality (Pranesh, 2020)

For instance, in medicine, this AR method is used to put diagnostic pictures like X-rays or MRI scans over a patient's body during surgery, helping doctors see inside the body and do their work better (Hudson & Thal, 2013).

In the same way, in retail, the Ikea AR furniture catalogue lets people see how virtual furniture would look in their home by putting digital furniture models over what their camera sees, making it easier to decide what to buy (Graham, 2018).

2.2.3 Augmented Reality Application

Applications for augmented reality (AR) combine digital data with the user's physical environment, including sight, sound, and other media (Azuma, 2015). Numerous industries, such as public safety, healthcare, tourism, oil and gas, and trade, can benefit from these applications. The most popular augmented reality software is customer-facing; it improves the user experience by superimposing digital data over real-world objects or settings. For instance, in

the tourism industry, AR apps can provide virtual tours of museums, interactive guides for historic sites, and even travel advice for users. The Pokémon Go game, as seen in Figure 2.5 below, is one instance.

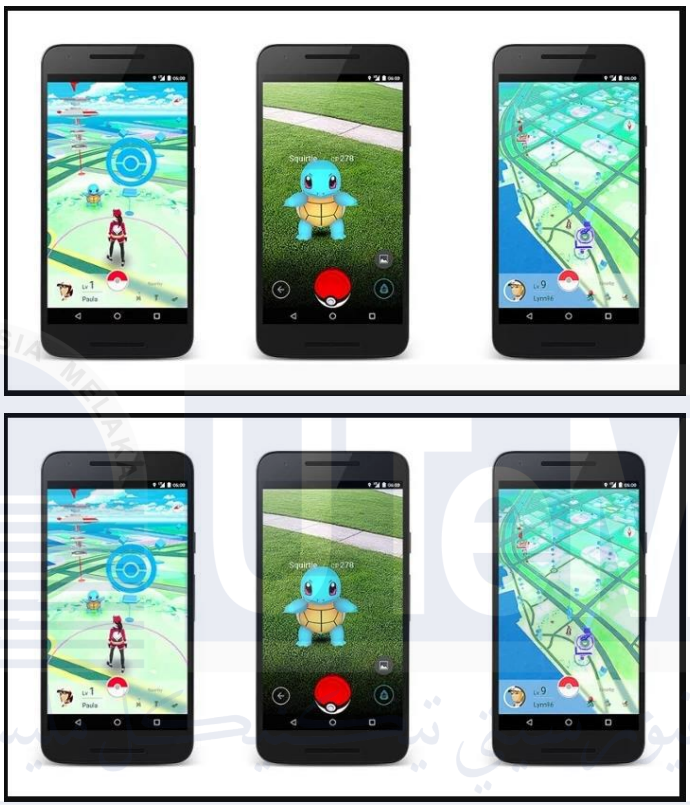


Figure 2.5 Example of Augmented Reality Application (Bernie, 2016)

2.2.4 Personalisation

Personalisation means making services, apps, or content fit the unique needs and likes of each user (Hudson & Thal, 2013). It uses special computer apps and data studies to change the user's experience based on things like what they've done before, what they like, and details about their life. In the travel business, personalisation is important because it helps make the visitor's time better by giving them suggestions and content that match what they like. For instance, travel websites and apps can use these personalisation apps to recommend places to go, where to stay, and things to do that fit with a user's past trips, what they enjoy, and how much they can spend.

2.2.5 Point of Interest (POI)

Point of interest (POI) refers to a place of special interest, especially in the context of tourism (Graham, 2018). POIs include city monuments, historic buildings, museums, parks, as well as restaurants, and other landmarks These places are vital in mapping and navigation planning as they show users where it is fun to go. Metadata for POIs often consists of things like descriptions, tags, research, historical facts, and other relevant information. POIs in tourism help travellers make better trip plans discover new sites or attractions and learn more about their destinations thereby enhancing their overall travel experiences e.g., while exploring a city like a tourist one would use a navigation app that will locate nearby POIs such as landmarks or restaurants or shopping districts This thing can promote exploration and enjoyment in the destination.

2.2.6 Usage of Augmented Reality in Tourism

The travel industry has been thought to have a lot of potential for augmented reality (Fritz et al., 2005). According to McKercher and du Cros (2003), a tourist is someone who usually has "little or no knowledge of the environment." Accordingly, this industry would greatly benefit from an area-based device that could be used to access data in a timely manner.

Present AR implementations in the travel sector require the user's compelling commitment and provide tourists with an enhanced understanding. Additionally, it hasn't been perfected yet and has a lot of bugs that need to be fixed before making it available to the public. An additional assessment concerns the acceptance and preference of these devices among tourists, with the same proportion of visitors gravitating towards conventional sources, such as travel guides and various media outlets (Pang et al., 2006). In any case, as Figure 2.6 and 2.7 illustrates, Augmented Reality has a great chance of quickly becoming a standard mechanical device in the travel industry

due to its practical convenience, which can be used both indoors and outdoors (Fritz et al., 2005).

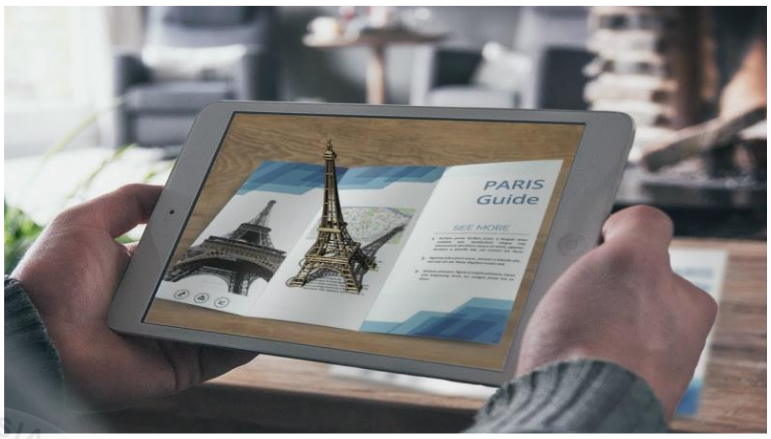


Figure 2.6: Example of Augmented Reality in Tourism (Fritz et al., 2005)

Figure 2.7 Example of Augmented Reality in Tourism (McKercher and du Cros, 2003)

2.2.7 Personalisation of Point of Interest (POI) in AR Application for Tourism

In contemporary tourism, the personalisation of Points of Interest (POI) within Augmented Reality (AR) applications consists of matching AR contents and suggestions with individuals. This concept enhances the proactive assessment and presentation of tourist destinations, ensuring that all information and attractions available are relevant to each user's preferences (Hudson & Thal,

2013). By filtering and customizing content according to users' choices, AR applications can provide a more engaging and relevant experience.

For example, AR apps might examine the internet history as well as stated preferences and current circumstances to suggest particular sites that would be of interest to the user (Graham, 2018). In complex tourism destinations like Melaka, such customization could weave together historical events or cultural features that match the visitor's specific preferences for instance particular eras in history, architectural patterns, or local stories encompassing myths. Consequently, if one is fascinated by colonial times; one may be recommended to visit Dutch architecture at Melaka displaying historical facts through AR overlays.

AR technology integration with personalisation algorithms can result in a great experience for visitors to heritage sites. It is a common practice that offers packages that can extend the time of stay and develop the desire to go deep into tourist destinations. (Tussyadiah and Fesenmaier, 2009) argue that personalised tourism experiences significantly enhance user engagement and satisfaction, leading to more meaningful and memorable visitation.

To sum up, advanced algorithms and user data are utilised by POIs personalisation in AR applications for tourism to provide recommendations and content on an individual basis. This technique enriches tourists' experiences as well as supplies them with relevant information thereby fostering a greater appreciation of cultural landmarks and heritage sites.

2.3 Existing System

When developing our very own AR app for heritage tourism in Melaka, one of the important aspects of the research is to identify the existing systems that have utilised similar technology and approach in implementing their system. Thus, this chapter will explore three of such systems which are the AR Smart Heritage, GuidiGo, and Smartify. The features provided by each of the apps, their respective technology and approach as well as the relevancy of each of the apps to the ongoing project will also be discussed in this chapter.

2.3.1 AR Smart Heritage

Azuma (2015) states that AR Smart Heritage is an application that overlays virtual objects on top of real-world ones to facilitate the exploration of cultural heritage sites. It makes use of augmented reality (AR) technology to pull historical experiences closer to the public, enabling them to create replicas and learn more about artefacts and statues discovered at historical sites. It allows for variable content interaction on mobile devices and AR headsets.

An illustration of the AR Smart Heritage app's augmented reality is provided in Figure 2.8 below. The AR Smart Heritage is engaging, but it lacks sufficient personalised features. Thus, there is an opportunity to enhance the idea of heritage tourism in Melaka by implementing a contemporary recommendation system that takes into account the individual preferences of each visitor.

Figure 2.8 Example of Augmented Reality in AR Smart Heritage (Manibro, 2024)

2.3.2 GuidiGo

GuidiGo is an app that uses AR technology for tourism. It gives tourists personalised tours and extra details about places they visit. According to Santos (2017), GuidiGo lets travellers pick routes or sights based on what they like, and it also has audio and visual stuff like stories, photos, and videos. The app

works on phones and tablets, which makes it popular. Below is Figure 2.9 below shows an example of the interface of Augmented Reality in the GuidoGo app.

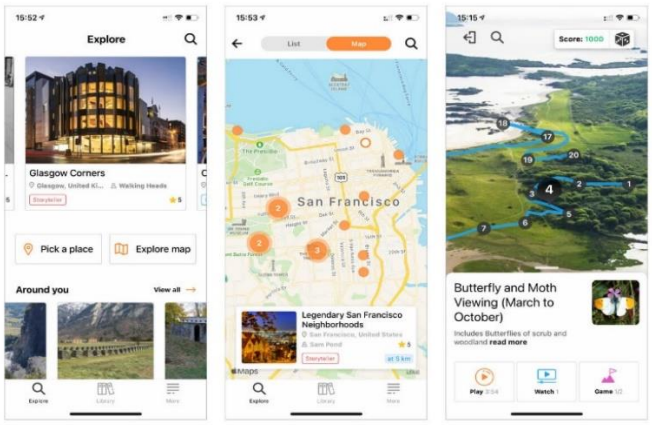


Figure 2.9 Example interface of Augmented Reality in GuidoGo app

2.3.3 Smartify

Smartify, an application designed for museums, lets users scan artifacts with their phones to read small descriptions of the exhibits. According to Graham (2018), Smartify involves the recognition of images to search for information in databases which creates an interesting experience for museums. Interestingly, the application enables users to mark items of relevance so that users can bookmark them, which also permits users to develop folders that keep the cultural engagement ongoing. Figure 2.10 below shows an example of the usage of Augmented Reality in Smartify app.

In the context of Melaka, heritage tourism it may be useful to change some aspects of how Smartify approaches content optimization and engages its community through curated preferences.

Figure 2.10 Example usage of Augmented Reality in Smartify app (Anon, 2018)

2.3.4 Comparison of Existing System

Table 2.1 explains the summary of comparison of existing AR apps in the tourism industry. There are nine (9) features stated in the AR tourism application. Below is the summary of each feature for AR Smart Heritage, GuidiGo, and Smartify apps.

Table 2.1 Summary of Comparison of existing AR apps

Feature	AR Smart Heritage	GuidoGo	Smartify
Interface	High-quality images, 3D models Informative text overlays, and interactive buttons	High-resolution images, AR overlays Having descriptive text for POIs, tour information	High-quality images of artworks, AR overlays Interactive buttons for exploring contents
Sound	Includes ambient sounds, audio guides, and sound effects	Professional audio narration	Having audio guides
Animation	Smooth transitions, animated overlays	High-quality animations	Animated transitions, interactive 3D models
Interaction	Touch-based gestures. Possible use for exploring 3D models	Touch-based interaction User profiles for personalised content	Possible use for interactive models Touch-based interactions,

Feature	AR Smart Heritage	GuidoGo	Smartify
			scanning for additional content
Information gathering	Utilises user feedback	Gathers user input through feedback and interactions	Collects data on user preferences
User experience & satisfaction	Utilises user feedback	Gathers user input through feedback and interactions	Having personalised content
User Registration	Optional	Yes	Optional
Location Data Collection	Uses GPS for location-based content	GPS-based tours	Utilises location data for relevant content suggestions
Navigation	AR-based navigation	Guided tour paths	AR-based navigation

Based on Table 2.1, AR Smart Heritage provides images and 3D models with visible forming buttons and textual annotations, extending the possibilities for engaging with historical content in a meaningful way. Through this feature, GuidiGo also has a provision for high–resolution images an augmented reality layer and additional textual information in the form of expanded descriptions of the POIs and tour information which makes it a good tool for learning. Currently, Smartify specializes in artworks, providing users with scans of the pieces featuring AR markers and interactive buttons to facilitate better comprehension of the exhibit.

AR Smart Heritage has dynamic sound, an audio guide, and sound to amplify sensory information. The following benefits are evident while using the product GuideGo it offers a professional audio guide for smooth and informative tours. Similarly to, Smartify helps the users to avail audio guide services which provide the users with detailed insight into the artwork or any exhibition.

AR Smart Heritage features transition animations with a decorating overlay for an engaging experience. This tour provides an enriched and lively experience because GuidiGo has high-quality animations that explain tour information. Smartify uses animated and interactive transitions plus 3D models of objects, which keeps the users engaged and offers a unique way of viewing images.

AR Smart Heritage contains special features that allow students to move around and explore 3D models using their hands. Similar to touch interactions, GuidiGo also provides the function of enabling the profile of users to be set so that the contents to be provided are those that meet the user's preference. Smartify also has a touch-based aspect.

The collection of feedback and data relating to the application is commendable for enhancing AR applications. AR learned from the user's feedback to help improve and develop AR Smart Heritage. GuidiGo learns from feedback and the ways users interact allowing the tweaking of their ways. Smartify targets getting information on user's choice of content to be posted to meet or match the user's preferences.

AR Smart Heritage also utilises feedback to increase satisfaction with the continuous advancement in content and optimisation of features. More importantly, GuidiGo incorporates user feedback into the design of the product to try to develop a custom experience. Smartify guarantees its satisfaction since the content they get is individualized hence make the experience unique.

AR Smart Heritage does not require users to register, being a setting that can be trusted with optional sign-ups, for those who don't need to use the application frequently. GuidiGo is a registered site which in my opinion is a plus since users are offered a profile, but it might demoralize other users into using the site. Smartify does not require users to register; though, they have the option to do so if they choose.

AR Smart Heritage incorporates GPS, thus offering the content about the user's geographical location. For easy navigation, GuidiGo offers GPS based tour that exhibits the tourist attractions in due course. Smartify is location-based, and it recommends users content according to the GPS location of the user.

AR Smart Heritage has implemented native AR navigation for a convenient search at heritage sites. GuidiGo offers various kinds of suggested paths for more convenient moving within the designated area. Smartify employs augmented reality navigation to help users find their way around museums and exhibitions.

2.3.5 Personalise AR application

Below is Figure 2.11 shows the flowchart of how the personalised mobile application works.

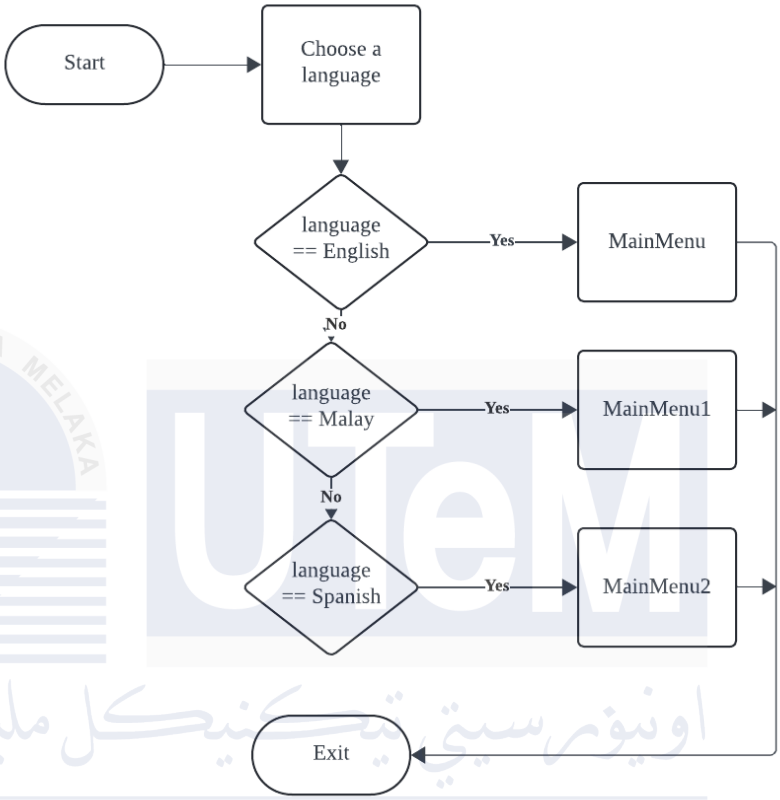


Figure 2.11 Flowchart about the Personalise Mobile AR Application

2.4 Project Methodology

The development of the AR application for personalised points of interest (POI) in tourism will follow the SDLC methodology as in Figure 2.12. This structured approach provides a systematic process for planning, creating, testing, and deploying the application, ensuring that the project meets its objectives efficiently and effectively. The SDLC methodology includes several stages: Planning, Analysis, Design, Implementation, Testing, and Maintenance.

Figure 2.12 The SDLC phases

2.4.1 Planning

In this first stage, the main objectives of the project are determined, for example, by providing customized point-of-interest information to visitors. A feasibility study is then carried out to evaluate the project's technical, financial, and operational viability. The next step is to create a thorough project plan that includes the resources, schedule, and important checkpoints (Hughes & Cotterell, 2002).

2.4.2 Analysis Stage

At this stage, detailed requirements through surveys, interviews and surveys gathered. Then, proceed to examine existing systems such as AR Smart Heritage, GuidiGo, and Smartify to find gaps and opportunities for improvement (Sommerville, 2011). This helps us understand what users need and how users can enhance their experience (Rese et al., 2014).

2.4.3 Design

In the Design phase, the system architecture was created, including diagrams and models. Wireframes, prototypes, and design of the user interface

(UI) and user experience (UX) were developed. This ensures that the app is easy to use and enjoyable (Pressman, 2014).

2.4.4 Implementation

During implementation, the application is built by developing the frontend (UI/UX) and backend (server, database, personalisation algorithm). Ensure that all parts work together seamlessly. It involves writing codes and putting different things together (Sommerville, 2011).

2.4.5 Testing

The test phase has several tests to make sure everything is working properly. Unit testing of individual components was performed, system testing for the entire application, and user acceptance testing (UAT) to gain feedback from users. Rigorous testing helps identify and prevent problems before the application is launched (Kaner et al., 1999).

2.4.6 Maintenance

Once the application is launched, the maintenance stage means providing continuous support to fix problems and make necessary updates. By gathering user feedback and adding improvements, the application stays useful and works well over time. Pressman (2014) says that maintenance is a key part of the software development process, helping the application last longer and meet changing user needs. For example, regular updates and adding new features can make the application more competitive and easier to use (Schach, 2007).

By following the SDLC methodology, this project will systematically develop an AR application that enhances the tourist experience in Malaysia through personalised and interactive POI information, ensuring each phase is meticulously planned and executed for a high-quality, user-centric product.

2.5 Project Requirements

The project requirements are the software and hardware needs that must be used to ensure the project's success. It provides a greats AR that need to be finish on the time by using the tools that needed.

2.5.1 Software Requirements

The software requirements for this project are:

i. Unity 3D: For developing the AR application and integrating various multimedia components.
ii. Vuforia: AR development kit to enable image recognition and tracking within Unity.
iii. Visual Studio: Integrated development environment (IDE) for coding and debugging.
iv. Figma: This software is used to design a low and high-fidelity prototype of the product to help in the process of the development platform.
v. Adobe illustrator: For editing and creating logo.

2.5.2 Hardware Requirements

The software requirement for this project are

i. High-performance laptop: Asus TUF Gaming laptop
ii. 11th Gen Intel(R) Core (TM) i5-11400H @ 2.70GHz 2.69 GHz
iii. RAM: 16 GB
iv. Smartphones: For testing the application on devices

2.6 Summary

In this chapter, the literature and methodologies related to developing an AR application for personalised points of interest (POI) in tourism in Malaysia reviewed. The three existing apps have strengths and weaknesses. As the project's framework, I have described the steps involved in each stage of the Software Development Life Cycle (SDLC) methodology, from planning to maintenance. Additionally, I listed the software

and hardware requirements necessary for the development and deployment of the application.

CHAPTER 3: ANALYSIS

3.1 Introduction

In the majority of the strategies currently in use, the analysis stage is crucial. In essence, the investigation calls for an issue analysis of the assets, conveyance stage, prerequisite investigation, and employed investigation procedures. This section will review the problem and the task's necessary investigation. Characterising contrasts is a means of identifying problems; the cycle of critical thinking is the means of determining how to reduce the distinctions.

Functional, non-functional, and other requirements are also included in requirement analysis. Each requirement used in the development process will be listed along with a description of how it will be used. The requirements for the software and hardware are crucial to the system's development. In the event that the requirements are not clearly defined, the system will encounter issues and perform improperly in an actual setting.

3.2 Current Scenario Analysis

Existing systems such as AR Heritage Tourism, GuidiGo, and Smartify apps are the most popular apps for visiting tourist places. This is because they are focusing on points of interest for every tourism destination.

3.2.1 Literature Review

The literature review for the personalisation of points of interest (POI) in augmented reality (AR) applications highlights several key components and elements necessary for an effective user experience in tourism. As mentioned by Rimaniza Zainal Abidin (2018), interactive buttons and high-quality images are important to offer a comprehensible visual representation of POIs. The said functionality helps the user to click on the specific buttons of POI to be able to see the actual location, thus having a high level of interactivity.

User interaction is another significant aspect. Haslina Arshad (2018) highlights that it is possible to manipulate content within an augmented reality environment by touching it or using touch motions such as tapping, swiping,

and pinching. Also, there can be speech recognition, where the users can command some desired locations via their microphones, which improves usability and smoothness. Motion gestures expand some additional facilities, e.g., pointing the camera at a particular zone to look for points of interest (POI).

Another aspect that requires a lot of attention is the issue of personalisation because AR can be tailored for each user. The system can subjectively filter information and adapt interactions within web applications based on users' preferences and favorite topics (Rimaniza Zainal Abidin, 2018). This is done by gathering information on the users' preferences, inputs, and behaviours about the content to enhance it. The way that information about the attractions is collected, using publicly available APIs, and some data is manually collected guarantees the fact-checking policy and the data relevance (Felix Yang, 2022).

There is a need to register and categorise users is also defined in the literature review. According to Saikishore Kalloori (2023), a combination of short registrations and personality trait identification will improve personalisation. This can feature options where users may register for more personalised content if they desire to.

3.2.2 Existing Systems

Several existing AR applications in the tourism industry provide a foundation for developing personalised POI AR applications. The analysis includes AR Smart Heritage, GuidiGo, and Smartify, each offering unique features and technologies.

AR Smart Heritage is an example of an app that implements AR to place virtual objects at cultural heritage sites to provide visitors with an enriched experience in terms of understanding the architectural and historic representation of the sites and the artifacts (Azuma, 2015). It is compatible with mobile devices and AR headsets, which also add versatility to DR content engagement. Nonetheless, in AR Smart Heritage, there are not many considerations made about the user, and thus there is a possibility for further development in the current project.

It also has features such as user preferences for screen headings and navigation including the choice of self-guided tour and recommended tour routes, audio/visual materials such as guide/narrator, pictures, and videos (Santos, 2017). For this reason, it is obtainable on several occasions, thus getting extensive coverage by many people. In the case of GuidiGo, it is noted that even though it is successful in filtering content and receiving feedback from users, there is no distinct concern with the cultural norms of the place, thus, the current project is undertaken by focusing its Melaka on the history and heritage.

The implementation of image recognition allows Smartify to share detailed information about the artworks displayed in museums through a swipe of the phone across them (Graham, 2018). It provides the feature of saving favorites and bookmarks that further keeps the user updated with regular sharing of content of cultures. Nevertheless, Smartify is focused primarily on interior spaces in museums while the current project will complement historical outdoor spaces with engaging and context-aware AR content.

In summary, while existing systems like AR Smart Heritage, GuidiGo, and Smartify provide valuable insights and features, the current project aims to enhance personalisation and cater specifically to the rich historical and cultural heritage of Melaka. This involves integrating advanced personalisation algorithms and providing an engaging, user-friendly AR experience tailored to individual preferences and behaviours.

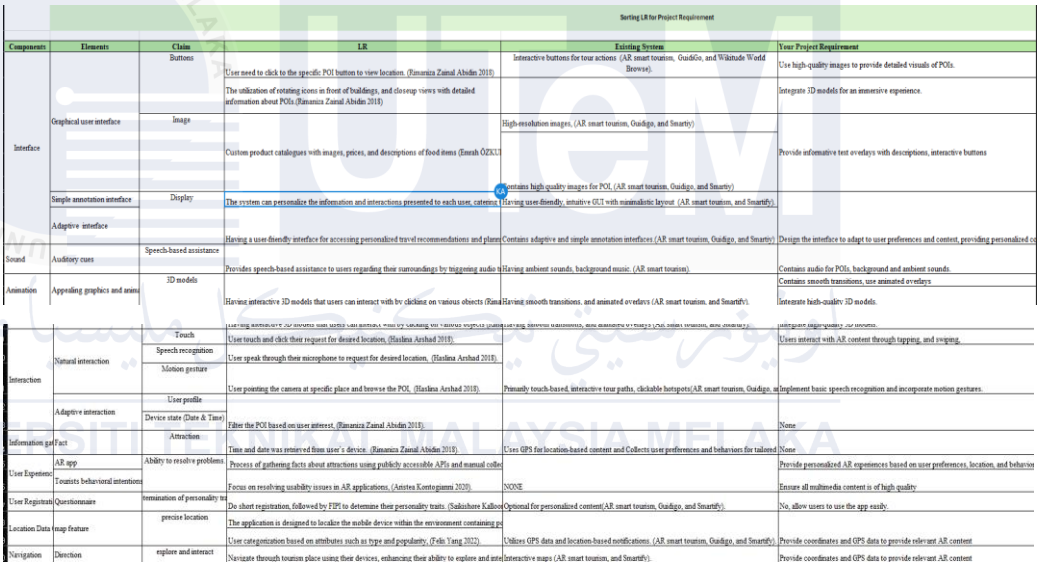
3.3 Requirement Analysis

3.3.1 Project Requirement - Analysis of the system to be developed

Several essential parts and components are needed to develop an Augmented Reality (AR) application for personalised Points of Interest (POI) in tourism, with a focus on Melaka's heritage sites. The actions and factors that must be taken into account in order to successfully create an interesting and educational augmented reality experience for travellers are described in this requirement analysis.

3.3.1.1 Requirement Gathering

The main purpose of the AR application is to help tourists navigate and better understand POI by providing informative and engaging content in the form of 3D models and high-definition images. The system must enable the users to select options related to the location by depressing the POI buttons, rotating them, and zooming in on the close-up screen. This approach makes a point of availing a complete touristic information-gathering service that is personalised based on the interests of the tourist and his or her geo graphical. Figure3.1 shows the Sorting LR for Project Requirement for the literature review vs existing system.



Sorting LR for Project Requirement

Components	Elements	Claim	LR	Existing System	Your Project Requirement
Interface	Graphical user interface	Buttons	User need to click to the specific POI button to view location. (Rananiza Zainal Abidin 2018)	Interactive buttons for tour actions (AR smart tourism, GuidiGo, and Wikitude World Browse).	Use high-quality images to provide detailed visuals of POIs.
			The utilization of rotating icons in front of buildings, and closeup views with detailed information about POIs (Rananiza Zainal Abidin 2018)		Integrate 3D models for an immersive experience.
		Image		High-resolution images, (AR smart tourism, Guidigo, and Smartiy)	
			Custom product catalogues with images, prices, and descriptions of food items (Emrah ÖZKUL		Provide informative text overlays with descriptions, interactive buttons
				Contains high quality images for POI, (AR smart tourism, Guidigo, and Smartiy)	
	Simple annotation interface	Display	The system can personalize the information and interactions presented to each user, catering	Having user-friendly, intuitive GUI with minimalistic layout (AR smart tourism, and Smartify).	
	Adaptive interface		Having a user-friendly interface for accessing personalized travel recommendations and plans	Contains adaptive and simple annotation interfaces (AR smart tourism, Guidigo, and Smartiy)	Design the interface to adapt to user preferences and context, providing personalized co
Sound	Auditory cues	Speech-based assistance	Provides speech-based assistance to users regarding their surroundings by triggering audio n	Having ambient sounds, background music. (AR smart tourism).	Contains audio for POIs, background and ambient sounds.
Animation	Appealing graphics and anim	3D models	Having interactive 3D models that users can interact with by clicking on various objects (Rana	Having smooth transitions, and animated overlays (AR smart tourism, and Smartify).	Contains smooth transitions, use animated overlays Integrate high-quality 3D models.
Interaction	Natural interaction	Touch	User touch and click their request for desired location, (Hasliza Arshad 2018).		Users interact with AR content through tapping, and swiping.
		Speech recognition	User speak through their microphone to request for desired location, (Hasliza Arshad 2018).		
		Motion gesture	User pointing the camera at specific place and browse the POI, (Hasliza Arshad 2018).	Primarily touch-based, interactive tour paths, clickable hotspots(AR smart tourism, Guidigo, a	Implement basic speech recognition and incorporate motion gestures.
	Adaptive interaction	User profile			
		Device state (Date & Time)	Filter the POI based on user interest, (Rananiza Zainal Abidin 2018).		None
Information ga	Fact	Attraction	Time and date was retrieved from user's device. (Rananiza Zainal Abidin 2018).	Uses GPS for location-based content and Collects user preferences and behaviors for tailored	None
User Experienc	AR app	Ability to resolve problems	Process of gathering facts about attractions using publicly accessible APIs and manual colle		Provide personalized AR experiences based on user preferences, location, and behavior
	Tourists behavioral intentions		Focus on resolving usability issues in AR applications, (Aristea Kontogianni 2020).	NONE	Ensure all multimedia content is of high quality
User Registrati	Questionnaire	termination of personality tra	Do short registration, followed by FIPI to determine their personality traits. (Sakishore Kallou	Optional for personalized content(AR smart tourism, Guidigo, and Smartify).	No, allow users to use the app easily.
Location Data	map feature	precise location	The application is designed to localize the mobile device within the environment containing po		
			User categorization based on attributes such as type and popularity, (Felix Yang 2022).	Utilizes GPS data and location-based notifications. (AR smart tourism, Guidigo, and Smartify).	Provide coordinates and GPS data to provide relevant AR content
Navigation	Direction	explore and interact	Navigate through tourism place using their devices, enhancing their ability to explore and inte	Interactive maps (AR smart tourism, and Smartify).	Provide coordinates and GPS data to provide relevant AR content

Figure 3.1 Sorting LR for Project Requirement for the literature review vs existing system.

The animation part of the project requires careful planning and presentation. Animations should be of high quality, with smooth transitions and adequate frame rates to ensure an enjoyable user experience. The project will include 2D and 3D graphics and animated overlays to enhance AR environments.

In summary, the requirement analysis for the AR application in tourism focuses on creating a personalised and interactive experience for users. By leveraging advanced AR techniques, high-quality

animations, and user-centric mobile application design, the project aims to enhance the way tourists explore and engage with heritage sites in Melaka.

3.3.2 Software Requirement

3.3.2.1 Vuforia Engine

The creation of Augmented Reality applications is made possible with Vuforia, an Augmented Reality Software Development Kit (SDK) for mobile devices. It tracks and recognises simple 3D objects, like boxes, in real time, as well as planar images (Image Targets) using computer vision technology. An example of the Vuforia Engine interface is shown in Figure 3.2.

Figure 3.2 Example of Vuforia Engine interface (Simran, 2023)

3.3.2.2 Unity 3D

Unity is the developer of the cross-platform Unity game engine, which is mostly used to create two- and three-dimensional video games and simulations for PCs, gaming consoles, and mobile devices. The

Unity 3D page's example interface is displayed below and is seen in Figure 3.3.

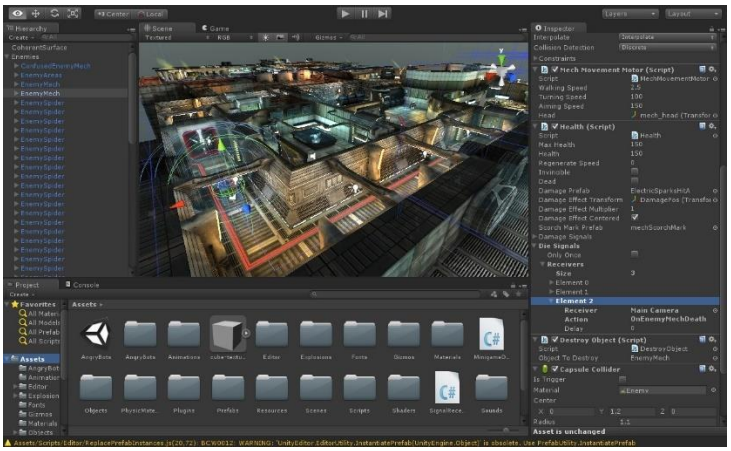


Figure 3.3 Example interface of the Unity 3D (Nick, 2013)

3.3.2.3 Blender

Blender is a BlenderKit-developed 3D computer graphics program. Blender is an extremely powerful program that can manage intricate 3D designs. You can sculpt objects and characters, make intricate 3D models, add special effects, make animations, and much more with Blender. An illustration of a Blender 3D interface is shown in Figure 3.4.

Figure 3.4 Example of Blender 3D interface (Arphita, 2023)

3.3.2.4 Microsoft Word

Both the proposal and the documentation are created in Microsoft Word. As seen in Figure 3.5, Microsoft Word will be used for all documentation. Typing, editing, and creating all the formats required for the project documentation have all been done with it.

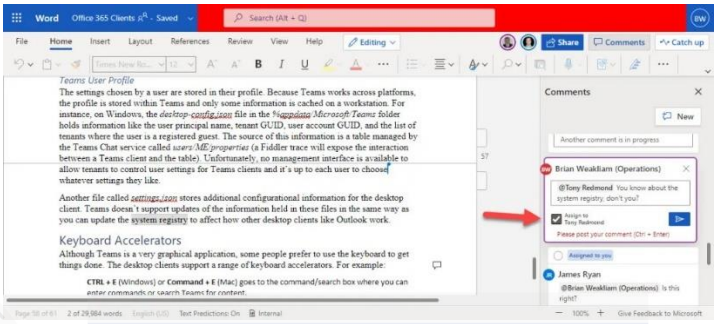


Figure 3.5 Example of Microsoft Word (Tony, 2023)

3.3.2.5 Visual Studio 2022

This software will help integrate a development environment (IDE) for coding and debugging. Below is the Figure 3.6 that show the interface of Microsoft Visual 2022.

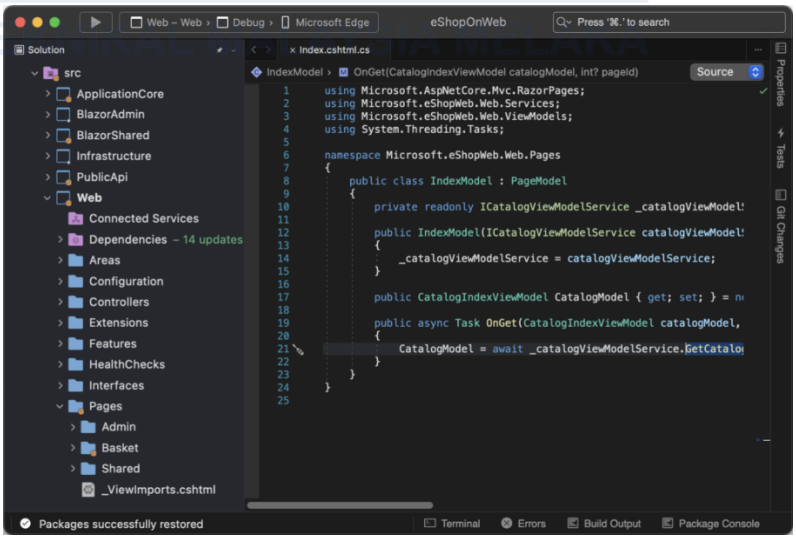


Figure 3.6 Example interface of Microsoft Visual 2022 (Jordan, 2021)

3.3.2.6 Figma

This software is used to design a low and high-fidelity prototype of the product to help in the process of the development platform. Below is Figure 3.7 which shows the interface of Figma app.

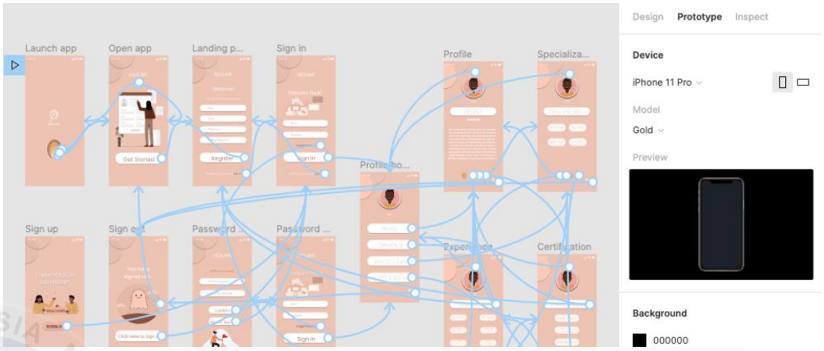


Figure 3.7 Example interface of Figma app (Kathryn, 2022)

3.3.2.7 Adobe Illustrator

This program is used to design and produce the logo during the platform's development process. Figure 3.8, which displays the Adobe Illustrator application's interface, is shown below.

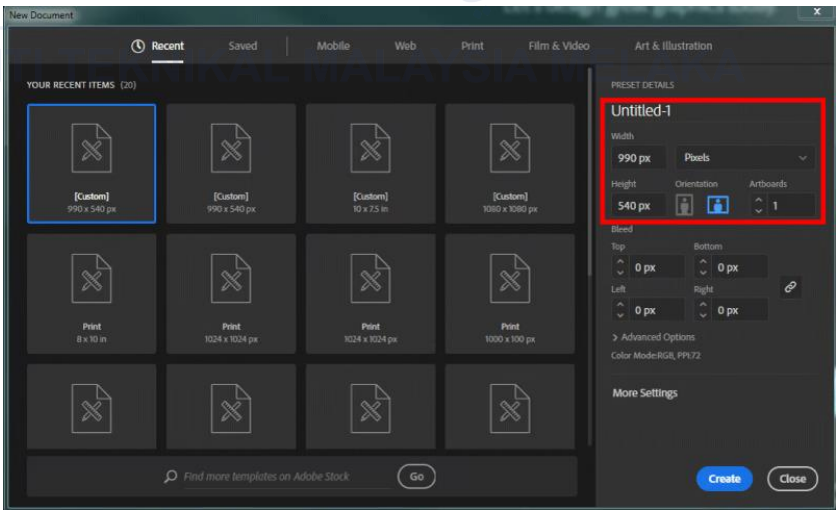


Figure 3.8 Example interface of the Adobe Illustrator app. (Gaius, 2024)

3.3.3 Hardware Requirement

Hardware also is an important part of developing the application. It will be the supporting tool for the software. Hardware is chosen based on the

software being used. If the hardware can support the requirement of software, it will be chosen. Hardware is important as it will be the platform and the functionality will determine the fastest to deliver the project. Below is the list of the hardware, its specifications, and its function.

3.3.3.1 Laptop

This project used an Asus TUF Gaming laptop, a high-performance laptop with a 64-bit Windows 10 operating system, an 11th generation Intel(R) Core (TM) i5-11400H @ 2.70GHz 2.69 GHz processor, and 16.0 GB of RAM. It is selected to advance the project and support the software utilised.

3.3.3.2 Mobile Device

The operating system for a mobile device is it must be an Android phone that needs Android 10.0 and higher and OpenGL ES 3.2 to support the augmented reality application. Besides, the mobile device has a camera function to scan and access the AR virtual object. The mobile device is used to run the application.

3.4 Project Schedule and Milestone

The venture timeline and achievement will be made clear in this section. The assignment is completed in a semester that lasts for fourteen (14) weeks. Establishing a timeline and achieving it are important and crucial, and they need to be well-intentioned to ensure the task achieves its objective. The project schedule and milestones are displayed in Table 3.1 below.

Table 3.1 Description of Project Schedule and Milestone

Activity Description	Duration (Working days only)	Start Date	End Date
1. Brainstorming	**7 days**	**3/3/24**	**10/3/24**
1.1 Select project title	2 days	5/3/34	7/4/24
1.2 Find the information related to the title	3 days	7/3/24	10/3/24
2. Proposal	**13 days**	**11/3/24**	**24/3/24**
3. Project Preparation	**13 days**	**25/3/24**	**7/4/24**
3.1 Install the needed software	4 days	25/3/24	28/3/24
3.2 Learn how to use the software	9 days	29/3/24	7/4/24
3.1. Analysis	**14 days**	**8/4/24**	**21/4/20**
3.1.1 Describe project background	2 days	8/4/24	9/4/24
3.1.2 Identify target user	1 day	10/4/24	10/4/24
3.1.3 Identify project significance	1 day	11/4/24	11/4/24
3.1.4 Define literature review	5 days	12/4/24	16/4/24
3.1.5 Identify project methodology	2 days	17/4/24	18/4/24
3.1.6 Analysis Project Requirement	2 days	19/4/24	20/4/24
3.1.7 Review project plan	1 day	21/4/24	21/4/24
4. Development	**35 days**	**22/4/24**	**26/5/24**

3.5 Summary

This section summarises all of the assessments completed prior to starting the new phase, organises the research, and outlines the current and future frameworks that will be needed. In general, this step is carried out to assess client needs and the need to handle, enhance, and implement user needs modifications. The developer can learn what features users want and what needs to be developed for the application through the requirement analysis. To enhance the development experience, certain requirements must be met, including hardware, software, and instances. The project can be completed on schedule with the help of the milestones and schedule. The project design and project progress will be covered in the upcoming chapter.

CHAPTER 4: DESIGN

4.1 Introduction

The results of the review conducted in the show are elaborated upon in this chapter. The design phase includes various advancements related to learning objectives, assessment tools, planning, and exercises. The developer will create the application's structure and design during the design phase. It is predicated on the project's concept and idea. To provide the developer with a basic layout of the elements to be added to the project interface, the idea, layout, and design will be sketched. In the chapter, the steps involved in this design application will be covered in further detail.

4.2 System Architecture

The overall application is briefly explained by the system architecture. This Augmented Reality's system architecture is composed of multiple components. An application for augmented reality that uses markers is called "Personalised Augmented Reality." The historical locations in heritage tourism serve as the application's marker. In order to render AR models from the Vuforia Engine database in accordance with the marker ID, the user must use the phone camera to scan the heritage tourism. After users are allowed permission to access the camera, the application will process the visual rendering and load the 3D models. Then, the user can see the 3D models loaded. The act of 3D models is to perform the application content. Besides, to improve the user experience some buttons will be had in the application. Users can customize the language and listen to the point of interest (POI) through the phone screen. Figure 4.1 shows the System and The Process Architecture of Augmented Reality.

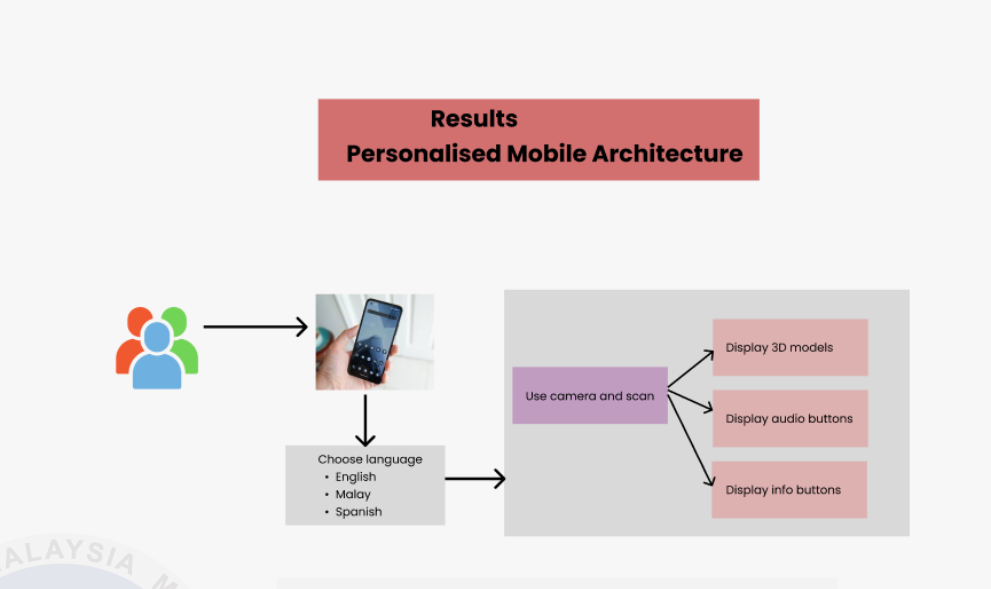


Figure 4.1 The System Architecture of Augmented Reality

4.2.1 Marker for Personalise Mobile Application

Figure 4.2 marker AFamosa below is the image designed as a marker for this project. The usage of the marker for this project enables the user or audience to scan the poster and experience the augmented reality technology.

A'Famosa

Figure 4.2 Marker AFamosa for Personalise Mobile Application

Marker in Figure 4.3 below, the logo created for this project is the image of Christ Church, which is below. The audience or user can interact with the augmented reality technology by scanning the poster thanks to the project's use of a marker.

Figure 4.3 Marker Christ Church for Personalise Mobile Application

Figure 4.4 Marker Melaka Sultanate Palace below is the image designed as a marker for this project. The usage of the marker for this project enables the user or audience to scan the poster and experience the augmented reality technology.

Sultanate Palace Museum

Figure 4.4 Marker Melaka Sultanate Palace for Personalise Mobile Application

Figure 4.5 Marker the Stadthuys below is the image designed as a marker for this project. The usage of the marker for this project enables the user or audience to scan the poster and experience the augmented reality technology.

The Stadthuys

Figure 4.5 Marker the Stadthuys for Personalise Mobile Application

Figure 4.6 Marker Youth Museum below is the image designed as a marker for this project. The usage of the marker for this project enables the user or audience to scan the poster and experience the augmented reality technology.

Figure 4.6 Marker Youth Museum for Personalise Mobile Application

4.3 Preliminary Design

An application's high-level architectural design is represented by the preliminary design. One of the most crucial components of interface design implementation for developers is user interface design, which will be explained along with interactive storyboarding, navigation design, logo design, and app design.

4.3.1 Storyboard Design

This customised mobile application's interactive storyboard will be broken up into multiple sections. First, the user can view the application's cover. By clicking the AR, as indicated in Figure 4.7, the user can navigate to the application's main menu. Next, as shown in Figure 4.8, users can select the module or language they wish to view from the main menu list.

The four modules that make up this application's main page are Play, About, Language, and Exit. The application will direct the user to the module language page, when they select the module language on the main menu page. The next step is for the user to select a language, as indicated in Table 4.8. A new page will appear when the user selects the Malay language, as seen in Figure 4.9, and for the Spanish language, as shown in Figure 4.10.

After selecting the Malay language, the user will open the mobile app and scan the historical tourist destinations. Following marker tracking, the 3D model will show up on the screen as Figure 4.11 illustrates. Next, the Point of Interest (POI) for that location is displayed and reviewed by pressing the info button on the model. In order to leave the AR scene, users can also click the back button.

Users can view the Point of Interest (POI) information by clicking the About button (INFO). It will proceed to Figure 4.11's following page. There is a play and pause button in addition to the Point of Interest (POI) information that users can read. Clicking it will allow them to hear the Point of Interest (POI) details as displayed in Figure 4.12.

Figure 4.7 Main interface of the personalise mobile application

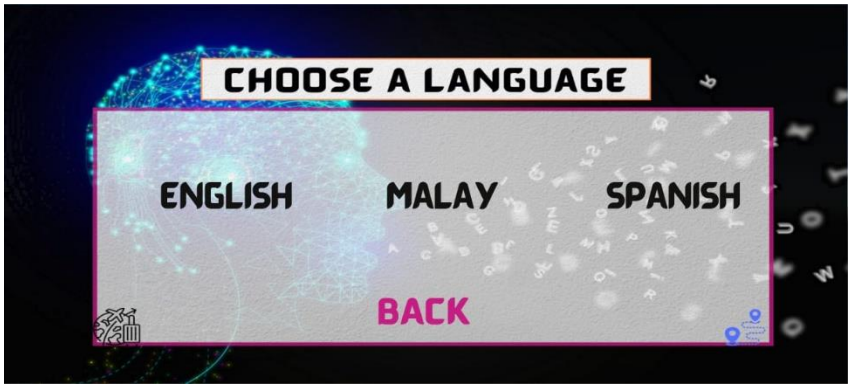


Figure 4.8 The language available on the personalise mobile application

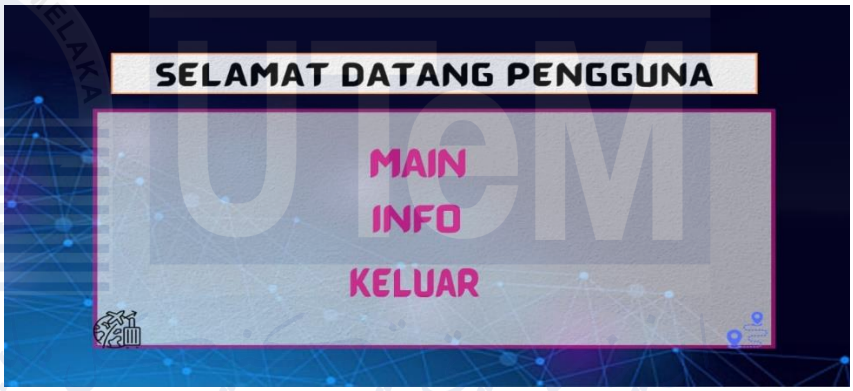


Figure 4.9 After the user chooses the Malay language

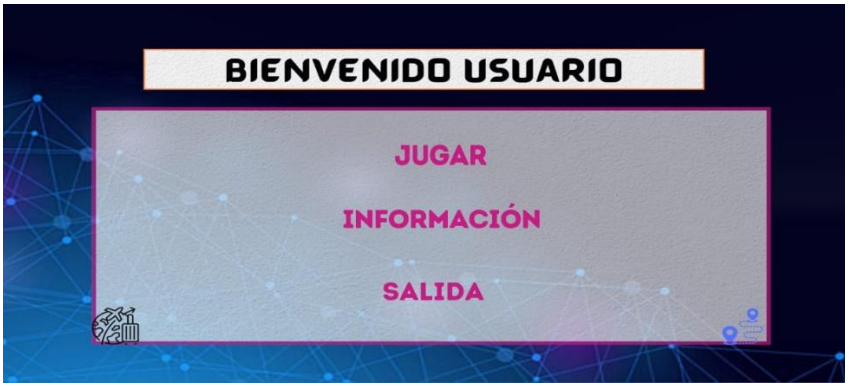


Figure 4.10 After the user chooses the Spanish language

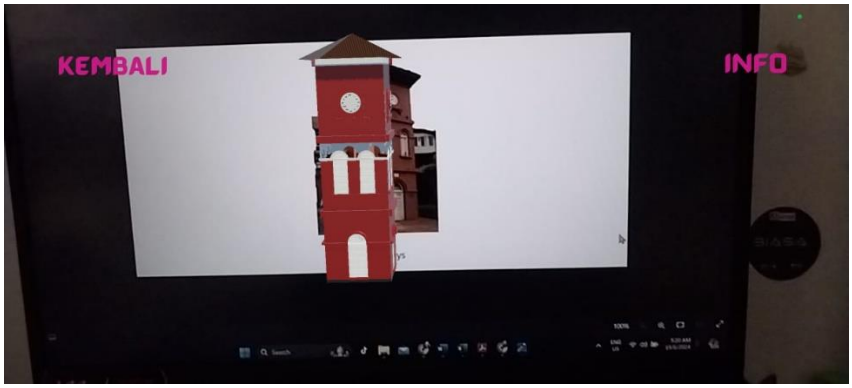


Figure 4.11 After scanning the marker, a 3D model will pop out

Figure 4.12 After clicking the About button, it will move to the next page

4.4 User Interface Design

The user interface serves as a conduit through which the user can interact with the expanded reality. It is noteworthy because the majority of the vastly expanded truth depends on how many clients are able to make use of the application for augmented reality. To make the communication between the client and the enhanced reality compelling, the approach to designing the user interface must be valid. The three primary components of a user interface are the design of the navigation, the logo, and the 3D model.

4.4.1 Navigation Design

The goal of navigation design is to develop a system that is simple for users to operate and interact with. The system's navigation design can make it

easier for users to use. Figure 4.13, which displays the navigation design flowchart, is below.

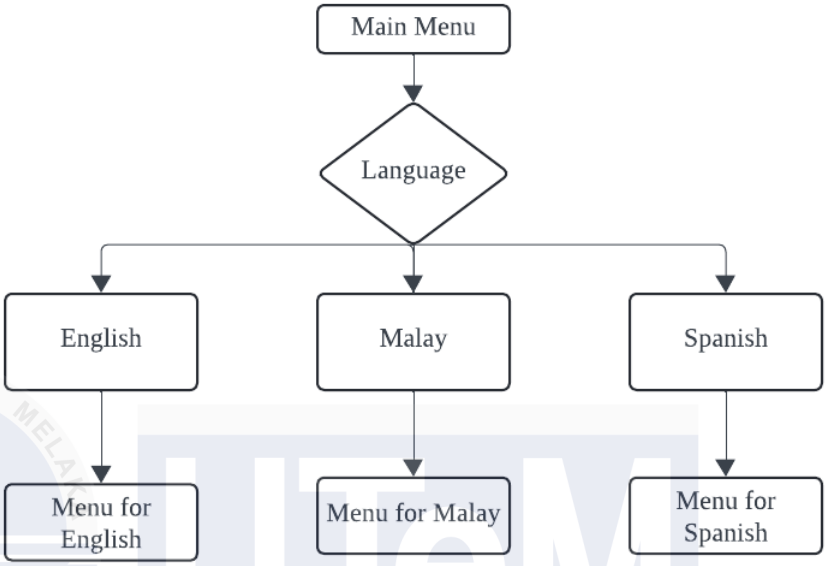


Figure 4.13 Flowchart for navigation design

4.4.2 Logo Design

The logo of this mobile application has been designed by including the pattern of Batik in Augmented Reality. Figure 4.14 shows the logo of the Personalise mobile application.

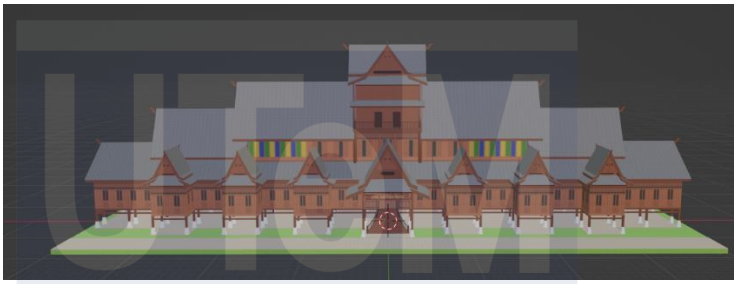
Figure 4.14 The logo of the Personalise mobile application

4.4.3 Three-Dimensional Model Design

The 3D model is specifically designed for each process in making a Personalise mobile application. Table 4.1 shows the 3D modeling design phase that is conducted to personalise the mobile app. The purpose is to let users understand and visualize the tools that are used in each of process. For example, people only watch the process of AR on YouTube, but they cannot visualize and tools.

Table 4.1 3D Modelling Design

Object	3D Model
AFamosa	
The Stadthuys	

Object	3D Model
Christ Church	
Melaka Sultanate Musuem	
Youth Museum Melaka	

4.4.4 Metaphor

The design for this application is based on the illustrated image. The design of this application has only one theme. The theme chosen was the heritage tourism place in Malaysia.

4.4.5 Template Design

This application interface does not have a specific template. The design was produced by adhering to the decisions made. Furthermore, the developer alone was responsible for creating the poster's templates.

4.5 Summary

Since the developer will get the idea to design the application during this phase, the design phase is crucial to the development process. Subsequently, the application development phase will proceed in accordance with the storyboard sketch. In terms of user interface design, the navigation design aids in the user's ability to follow the system's flow. Finally, this phase will result in the system's design. The phase of implementation that includes the project's advancement as well as the implementation process and activities will be covered in the upcoming chapter.

CHAPTER 5: IMPLEMENTATION

5.1 Introduction

The design phase is essential to the development process because it is during this phase that the developer will get the idea to design the application. Following that, the storyboard sketch will guide the application development phase. The navigation design of the user interface facilitates the user's ability to follow the flow of the system. The system's design will be the final product of this phase. The next chapter will cover the phase of implementation that encompasses the project's advancement along with the activities and processes involved.

5.2 Media Creation

The formation of content in any field of correspondence, diversion, or data is referred to as media creation. The age of substance, text, animation, realistic games, sound, and video segments will be understood by media creators. Any process and technique that the parts are anticipated to undergo will be taken into account for the full cycle, allowing for an even more comprehensive and lucid recording. To make the final practical item, the entire part will be gathered.

5.2.1 Production of Text

Textual information in the context of the given AR application focuses on the communication of the Points of Interest (POI), the provision of historical details about a location, or user guidelines and local navigation instructions. Font choices carefully and style chosen are critical in as much as the readability and style are crucial determinants of the look and feel of the application.

The element of application focuses on the use of different kinds of texts; the main heading, body text, caption, as well as texts that are embedded in interactive objects as shown in Figure 5.1. Of course, each type of text has its purpose. They have the aim to grab user attention and guide them through the content and are placed for titles and section titles. Similarly, body text is used to describe the POIs with more information and grasp the essential data for interaction with the content. The icon text is for buttons and links as it allows for its interaction with the application hence improved usability.

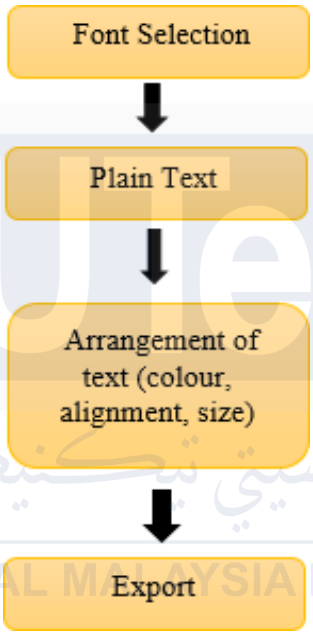


Figure 5.1 The Process of the Elements

As for the fonts, the application uses Barbar a Latin typeface, Libre Baskerville a non-commercial typeface, and Intro Rust a display typeface sized at normal. These fonts were used to offer maximum readability and get the overall aesthetic of the text that is divided into separate tiers in terms of readability. For headings and interactive text, in particular, Barbara's minimalistic and clear style which doesn't overload the text and is easy to navigate, is perfect. The public face, Libre Baskerville, which has a classical and somewhat, elegant appearance, is used for body text to ensure easy reading and general homeliness, as well as the provision of sufficient professionalism

that the sections, at times informative in their essence, require. Intro Rust, having bright and original design most nicely, is used for captions/remarkable text which can call attention or for the key buttons.

5.2.2 Production of Graphic

For this app, which uses graphics or images, editing and design are done during the graphic production process. The Adobe illustration used for the cover topics and logo is available in PNG and JPG formats. The logo's colours are grey (#737373), orange (#FF914D), and black (#000000).

In Adobe Illustrator, the realistic used, textual style, and logo shading will all be changed and adjusted. Throughout the entire project, which is created with Adobe Illustrator, this task is rendered in two dimensions with realism. After creating a creative logo, the sketch will be used as a basis for a vector arrangement in Adobe Illustrator to digitalise the structure. Only minor adjustments and changes are made in Adobe Illustrator to complete the plan. Figure 5.2 below illustrates the creation of a graphic logo.

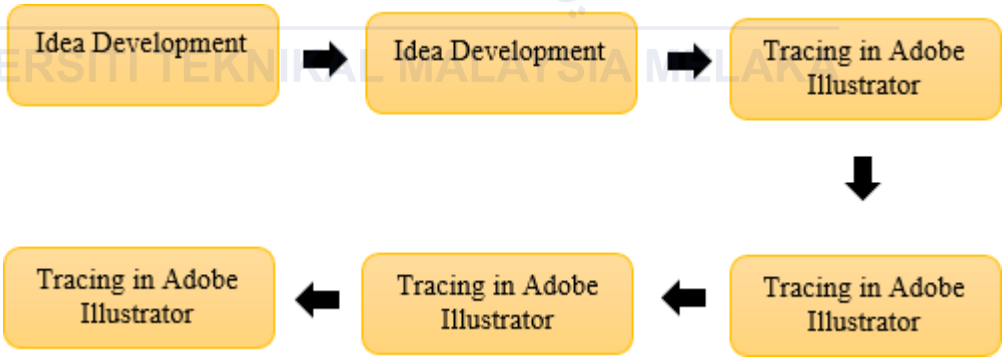


Figure 5.2 Production of Graphic for Logo for Personalise mobile app

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5.2.3 Production of Animation

Animation is used with the intention of drawing viewers in and delivering information to them. The use of animated movement is a means of drawing viewers in and delivering information to them. Animation is useful because it can effectively integrate the audience and simplify complex

information. In addition, it can improve the memorability of message deliverables. Blender and Unity are being used in the animation production process for this project. Making a storyboard and developing an idea are the first steps. The asset will be designed in Blender using a vector base format after the storyboard has been sketched. After that, every vector asset is prepared to be exported into Unity and used for animation.

Blender and Unity are used to create all of the animation. following the import of each vector base asset into the Unity library. The animation creation process is depicted in Figure 5.3 below.

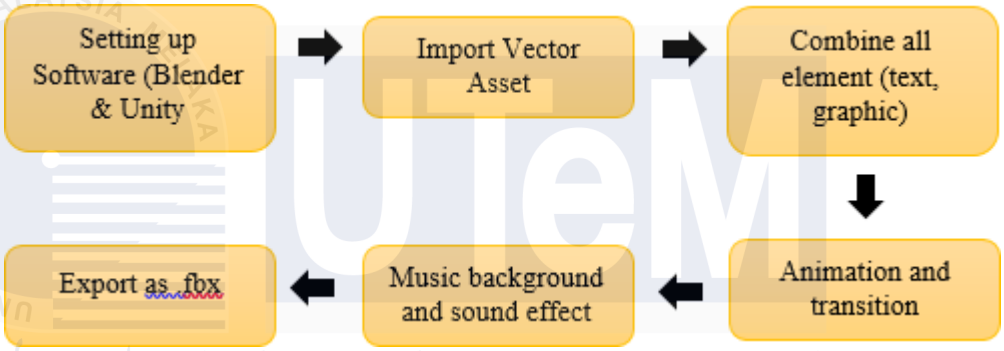


Figure 5.3 Production of Animation

5.3 Media Integration

Every piece of augmented reality content is integrated with Vuforia Engine and Unity. Before it's prepared for publication, Unity must import and set up 3D modelling. The target heritage tourism location's image is imported into Vuforia for setup. The same Unity setup is used by all heritage tourism targets. This application will be exported into a.apk file and installed on the smartphone once all the processes have completed. Users can therefore run and utilise it.

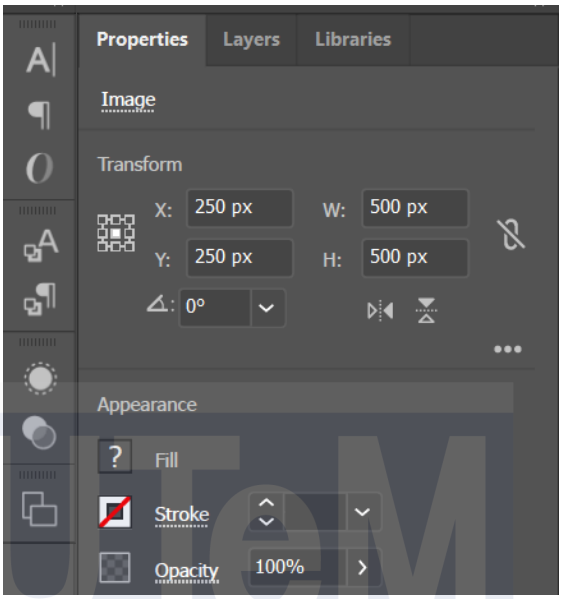
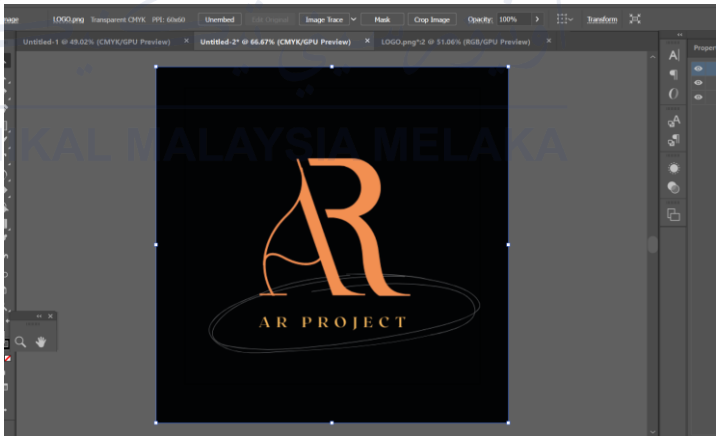
5.4 Product Configuration Management

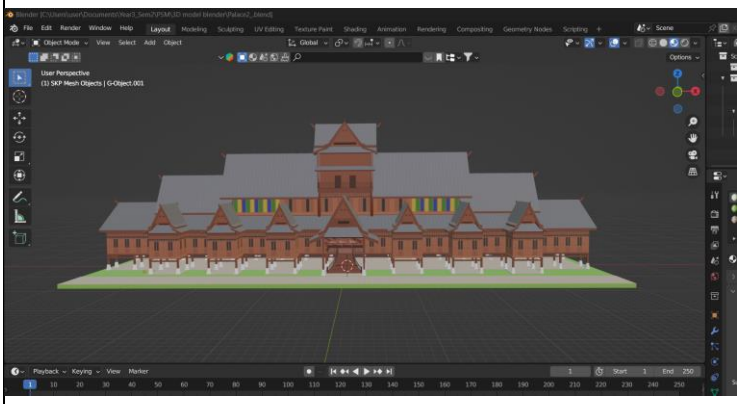
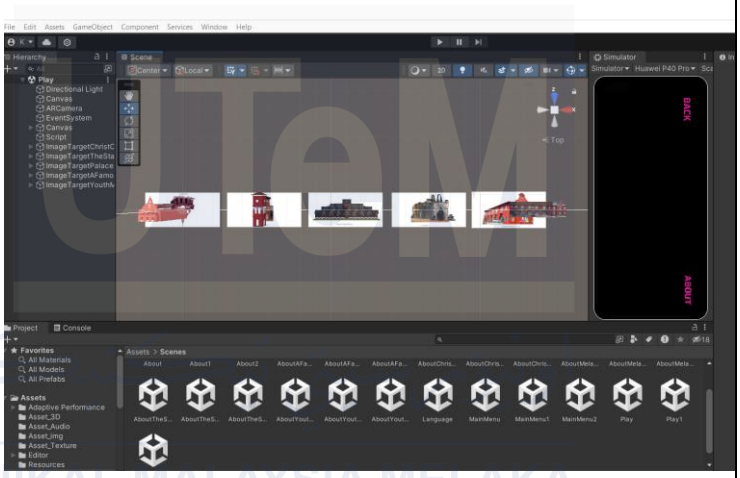
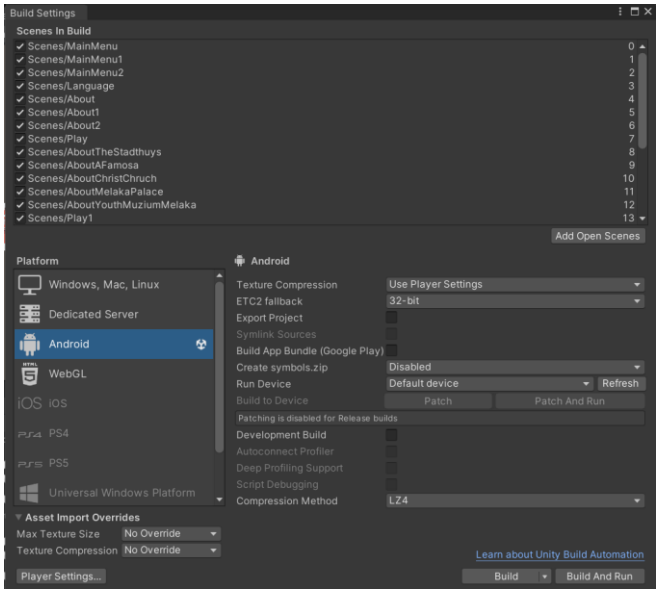
Product configuration management is the place where the item's setup should have been completed in its entirety to achieve the desired outcome. It also clarified the design condition arrangement and provided adaptation control.

5.4.1 Configuration Environment Setup

Setting up the configuration environment makes clear the settings needed in the software that produces and creates the material. Thus, in order to create Augmented Reality content, a variety of software programs, such as Adobe Illustrator, Unity, and Vuforia Engine, are needed to create all the content for this project. Before beginning any development or undertaking, a few designs should be ready. To ensure that the outcome is accurate and functional, this setup is essential. The project's setup configuration is displayed in Table 5.1.

Table 5.1 Environment Setup

Application Software	Setting
Adobe Illustrator	 **Properties Setting**  **Designing Logo**

Blender	 **3D Modelling**
Unity	 **Sample Scene**  **Build Settings**

5.4.2 Version Control Procedure

During the implementation phase, requirement needs are one of the factors that contribute to the changes that have been made in this project. The changes are made depending on the feedback from the project supervisor. Table 5.2 shows the version control procedure.

Table 5.2 Version Control Procedure

Version	Module	Modification
Ver1	Target tourism	Asks to change to heritage tourism places in Melaka
Ver1.1	Target Heritage Tourism Places	Check the heritage tourism places
Ver1.2	Target Heritage Tourism Places	Add the number of heritage tourism places and the marker
Ver1.3	Target Heritage Tourism Places	Add the sound effects and audio
Ver2	Final Touch Up	Improve augmented reality interaction

5.5 Implementation Process Status

The status of the implementation process is occasionally used to display the development's progress. To understand the version and specifics of the progress that has been made, as indicated in table 5.3, this progress must be documented.

Table 5.3 Status of Component Implementation

Component/Module	Description	Status
Module 1 (Research and explore)	Gathering information related to this project includes the media elements to be applied	Completed
Module 2 (Create a Development Plan)	Sketching the design concept and storyboard as a guideline	Completed
Module 3 (Design content)	Process of designing all media elements in the project.	Completed
Module 4 (Development of multimedia element)	Combination of all multimedia elements such as text, graphics, interaction, and sound.	Completed
Module 5 (Implementation of Augmented Reality)	Process of combining essential elements to produce the product.	Completed

5.6 Summary

This section provides insights into the media component that is used during the execution stage to produce the final product. In addition, it guaranteed the utilisation progress using the most effective way to synchronise the final yield and status of each module according to the Gantt Chart. It provides clarification on the following topics: media integration, configuration management, text, animation, video, and graphic creation; and implementation status. All of the testing will take place in the section that follows. The following section contains some requirements for case framework testing and item quality, such as target customers, manufacturers, partners, and coworkers. We'll determine the necessary improvement later, taking the outcome into account.

CHAPTER 6: TESTING

6.1 Introduction

After the implementation phase is complete, testing remains to be completed. The testing phase will make testing and evaluating the project's output clear, completing all cycle and process development stages. Doing this testing and evaluation is essential in order to measure and compare the real data and ensure that it can achieve the goal stated in Chapter 1. All of the project's functionalities must be tested to ensure that it operates smoothly and according to plan before it can be taken over. The testing phase's goal is to determine whether or not the project objective has been met. In order to collect actual data and analyse the outcome, this chapter also covers the test user, test schedule, and test strategy. The goals of the project will determine whether or not it is successful.

6.2 Test Plan

The user, test schedule, and test strategy are the three sections that make up the test plan. This section will provide a concise explanation of the entire test plan for this testing phase. This plan outlines how the testing stage will get started. The test plan is simple because it will cover the important topics in testing to ensure that it will persuade to achieve the goal of the current task. The developer and designer should determine the appropriate test with the aim of making it work for the target user. The test plan will document and preserve all item testing ranges, the project to be tested, time testing, and the testers for the project. Ensuring that the project stream is on track and follows the plan exactly as needed is essential and crucial.

A test plan must be created in order to inspect and test the product before it is put into full operation in order to identify any deficiencies. Before the product can be considered fully operational, it must function to its maximum potential during testing in a smooth, effective, and efficient manner. To guarantee the efficacy of the testing phase, all information regarding the testing module, the testing aspect that must be taken into consideration, the person who will conduct the test, and the length of the test will be explicitly specified in the test plan.

The entirety of the significant angle for the testing will be distinguish, for example, the test environment and platform for testing so the testing can run admirably. Test strategy will be the rules to complete the testing easily. A selection of user to test the project is significant because their criticism will be entirely important data to improvise and update the project.

6.2.1 Test User

The test user, who is also the project's tester, will indicate how many participants were involved in the testing. One specific group of tourists—tourists themselves—will administer the test in ubiquitous mode for this Heritage AR application during the testing phase.

6.2.1.1 Tourist

This category will include people of all genders who enjoy heritage tourism travel, whether it be in real time or on a broader scale. The primary target user for this project is this traveler. 53 respondents will select the product at random and test it on their own. Their acceptance and comprehension of the project have been the basis for their testing. It is carried out to get input from actual users in order to lower the risk of product failure and improve the actual product's quality. Before the actual product is made available to consumers, this is the last test. The purpose of user acceptance testing is to evaluate the target user's comprehension and efficacy with this application. In addition to answering a questionnaire about the project's efficacy and content, respondents must test the application.

Table 6.1 Test User for testing

Testing	**Student**
Instrument	Questionnaire
General Information	Tourists are those who travel to World Heritage City whether in real time or in ubiquitous.

Description	The testing is to determine the effectiveness of AR app that allow for the personalisation of POI information especially in the language sector
Number of Respondents	53

6.2.2 Test Schedule

It is challenging to run tests among testers if there is no time management in place. Following a demonstration of how to use the Heritage AR application that has been suggested to the tourists, user testing of the application's functionality will take place. Real-time or online testing will be done in this environment. The Heritage AR app's.apk file will be sent to the user, who will use it to conduct testing and provide feedback via a Google form that will serve as a record of the test results. Throughout the entire testing process, an Android smartphone running Android 5 or later and equipped with a camera is the necessary hardware and software. The Heritage AR application is installed on the smartphone.

Table 6.2 Test schedule for testing

Tester	Number of Tester	Testing Date	Testing Venue	Platform (Online)
Tourist	53	1/8/2024 – 7/8/2024	Anywhere	Google Form

6.2.3 Test Strategy

To Setting up the right test strategy is crucial to achieving the project's objectives. The test plan will address how the testing will be conducted, directed, and what kind of testing will be done depending on the item. The application's target user base consists of travellers. The testing has a specific goal, and a well-planned test strategy is necessary to ensure that the goals are met. Each tester will be assigned to a particular kind of test. On their perspective, there are five scoring levels for this question, ranging from one to

five, which represents strongly disagreeing to strongly agreeing. The questionnaire's scoring details are displayed in Table 6.3.

Table 6.3 Scoring Details for User Testing

1	2	3	4	5
STRONGLY DISAGREE	**DISAGREE**	**NEUTRAL**	**AGREE**	**STRONGLY AGREE**

6.3 Test Implementation

Test implementation is the way to create and organising test systems, make test information, and alternatively get ready test hardness and compose automated test contents.

Test implementation will describe how the testing will be implemented to a specific target user during the testing phase. The related part between test description and test data is conducted based on test strategy. Throughout test implementation, the designer needs to guarantee that all the essentials are handled before beginning the testing session relies upon the test reason, so the developer is ready to gather the normal outcome from the testing.

6.3.1 Test Description

Surveys have been distributed to the designated target user in preparation for testing during the meeting. 53 complete respondents were chosen at random and with enthusiasm to participate in the testing phase. After receiving a brief explanation about the project from the developer, each respondent will conduct the testing on their own. To achieve the third goal of the project, they must try out every objective. At that point, each respondent must complete a questionnaire that the developer has sent them. The survey can be found in Appendix B.

6.3.2 Test Data

The evaluation will be recorded once the testing session is completed. All the test result is documented to be evaluated. Both functionality testing and user acceptance testing purposes are to determine whether this project meets its

objective stated in the first chapter. All the test result is gathered and analysed. The average ranking has been analysed to spot the average ranking of each question. Each question has a different level of satisfaction based on the question.

Table 6.4 Test data for user testing

Tester	Number of respondents
Tourists	53

6.4 Test Results and Analysis

The collected data will be assessed in this section for test analysis and results. Whether the animation meets the project's goal will be determined by the questionnaire's results. It will determine whether an AR application is appropriate for the intended user and assess its efficaciousness. The responses provided by tourists or target users will be utilised to gather data for the project's analysis. According to the survey results, tourists are happy with the augmented reality application, despite the fact that some of them continue to use traditional methods.

Table 6.5 Scoring Details or Scale for Questionnaire

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

Table 6.6 Students Questionnaire and Testing Results for Tourists

No	**Question**	**1**	**2**	**3**	**4**	**5**
	AR Content Quality					
1.	The Marker-based AR application provides relevant information of traditional tales.			4(7.5%)	8(15.1%)	41(77.4%)

2.	The Marker-based AR application provides easy to understand information of traditional tales.			2(3.8%)	8(15.1%)	43(81.1%)
3.	The information of traditional tales from the marker-based AR application is clear.	1(1.9%)		3(5.7%)	5(9.4%)	44(83.0%)
	AR System Quality					
1.	The Marker-based AR application is easy to use.		2(3.8%)	1(1.9%)	10(18.9%)	40(75.5%)
2.	The Marker-based AR application is convenient to see.			3(5.7%)	10(18.9%)	40(75.5%)
3.	The Marker-based AR application has visually appealing materials			3(5.7%)	25(47.2%)	25(47.2%)
4.	The Marker-based AR application allows access to relevant information.			2(3.8%)	11(20.8%)	40(75.5%)
	AR Satisfaction					
1.	I am satisfied with using the marker-based AR application.	1(1.9%)		3(5.7%)	8(15.1%)	41(77.4%)
2.	I am satisfied with using the marker-based AR application functions.		1(1.9%)	2(3.8%)	16(30.2%)	34(64.2%)
3.	I am satisfied with the contents of the marker-based AR application.			3(5.7%)	10(18.9%)	40(75.5%)
4.	Overall, I am satisfied with the marker-based AR application.		1(1.9%)	2(3.8%)	9(17.0%)	41(77.4%)

	Intention to Recommend					
1.	I will recommend this marker-based AR application to my friends and relatives.			2(3.8%)	5(9.4%)	46(86.8%)
2.	When I return home, I will positively promote this marker-based AR application.	1(1.9%)		1(1.9%)	10(18.9%)	41(77.4%)
3.	I will strongly recommend others to use this marker-based AR application.		1(1.9%)	2(3.8%)	8(15.1%)	42(19.2%)
	Personal Innovativeness					
1.	I like to experiment with new information technologies.			3(5.7%)	9(17.0%)	41(77.4%)
2.	If I heard about a new information technology, I would look for ways to experiment with it.			4(7.5%)	8(15.1%)	41(77.4%)
3.	Among my peers, I am usually the first to try out new information technologies.			4(7.5%)	7(13.2%)	42(79.2%)

The results of the questionnaire show that visitors' opinions of the marker-based augmented reality application are overwhelmingly positive. The majority of respondents agreed that the application offers pertinent, understandable, and clear information about traditional tales in terms of AR content quality; clarity received the highest level of approval (83.0% rated it a 5). For AR System Quality, the application was praised for its ease of use and visual appeal, with 75.5% of respondents finding it both easy to use and convenient to see. Satisfaction levels were high, with the majority of participants expressing strong satisfaction across all aspects of the application, particularly with overall satisfaction (77.4% rated it 5). Regarding Intention to

Recommend, a significant portion of respondents (86.8%) would recommend the application to friends and relatives, indicating strong word-of-mouth potential. Finally, in the Personal Innovativeness category, a large majority of users (77.4%) were keen to experiment with new information technologies, suggesting that the application appeals to a tech-savvy audience who are likely early adopters of innovative tools. These results underline the application's effectiveness in meeting user expectations and enhancing their tourism experience.

6.5 Analysis Testing

Charts and diagrams will be displayed in this analysis based on the results obtained from the overview and testing measure. This is the assessment test examination diagram that was completed. A few charts that summarise the assessment's consequences have been created using the data from the test results.

6.5.1 Tourist

There are 53 participants in this testing, which was conducted in ubiquitous mode. After they test the AR application, they receive the questionnaire. They will be questioned about the application's efficacy, efficiency, and user interface. Charts will be created after the data has been analysed and compiled.

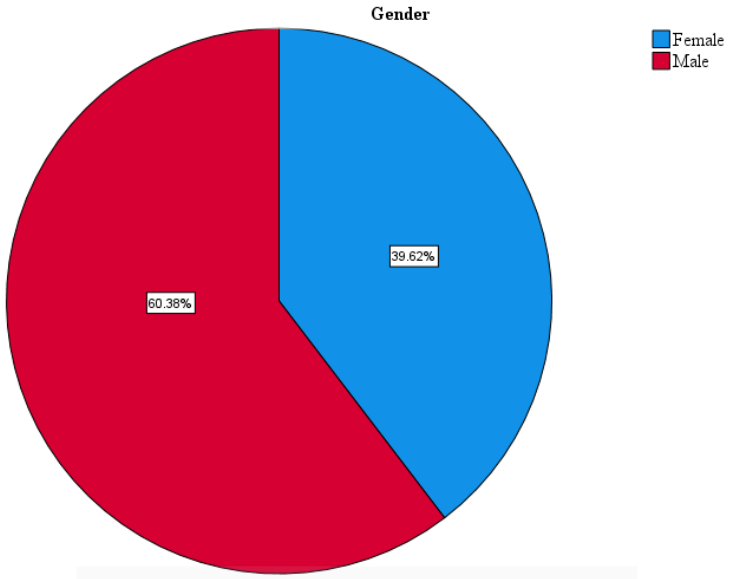


Figure 6.1 Gender of Respondents

Following developer AR's demonstration, the respondent receives the survey. While test selection and assignment were done at random in this study, the percentage of male respondents is marginally higher than that of female respondents. The gender of the user chosen to test this augmented reality application is depicted in the diagram, or figure 6.1 above. Of the 53 respondents, 32 (or 60.4%) are men, and the remaining 21 (or 39.6%) are women.

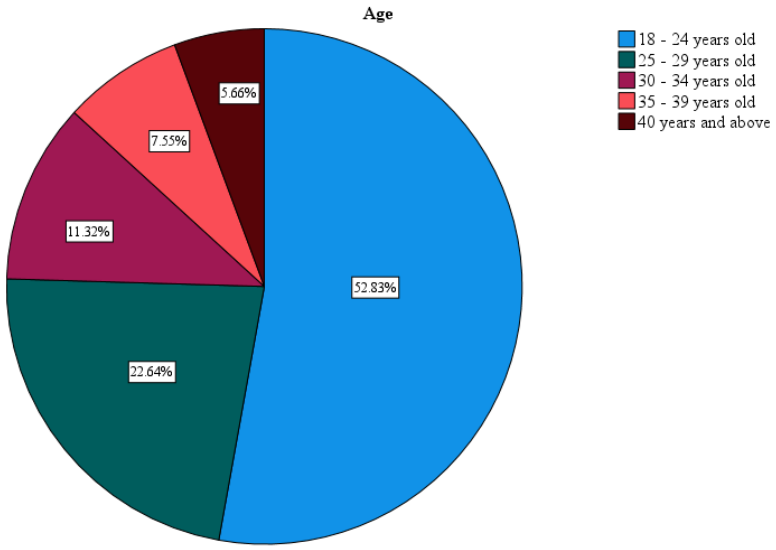


Figure 6.2 Result of Age for Tourist

Then, the other general information to be collected is about age, with 28 respondents mostly at around 18-24 years of age (52.83%), 12 respondents from 25-29 years of age (22.64%) 6 respondents from 30-34 years of age (11.32%) and 4 respondents are from 35-39 years of age (7.5%) and the rest 3 respondents with fewer percentage is around 40 above years old (5.66%). All the data and percentages are shown in Figure 6.2 above.

6.5.1.1 Questionnaire AR Content Quality Test

This section will test the content quality of the AR application on tourist. This questionnaire was adopted from The Determinants of Recommendations to Use Augmented Reality Technologies: The case of a Korean theme park (Timothy Jung, 2023) to create the survey question after the testing was done. There are 3 questions consists in section which is focused on the Content Quality of the AR application such as relevant information from traditional tales, easy-to-understand information, and clear information.

The analysis indicates that most participants (77.4%) are content and firmly agree about how good the material presented in AR is as shown in Table 6.7 below. This means that this app functions according

to users' anticipations when it comes to supplying precise and useful details about classic stories.

Table 6.7 Graph of Content Quality of AR Application

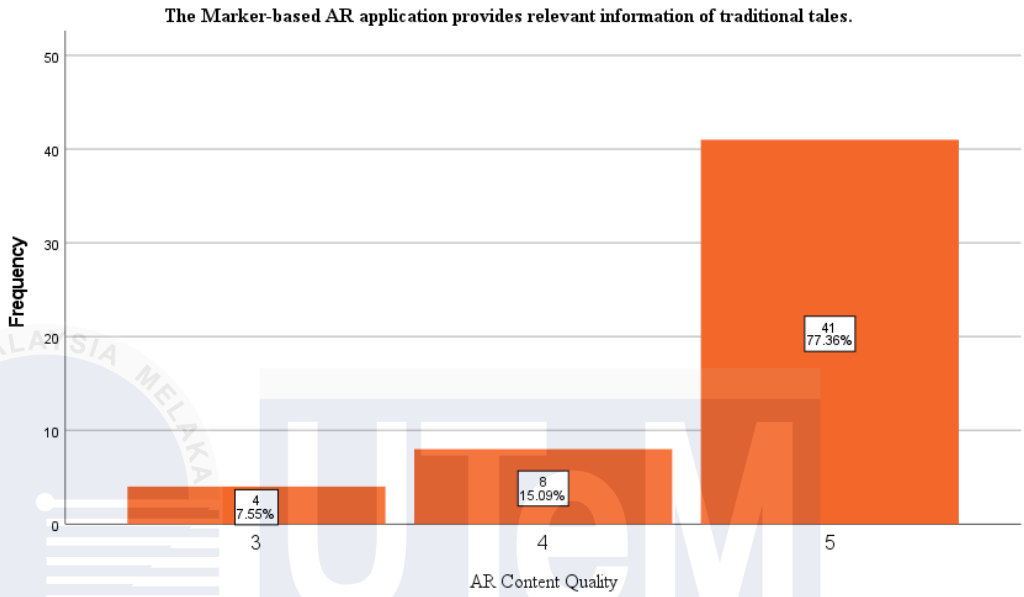
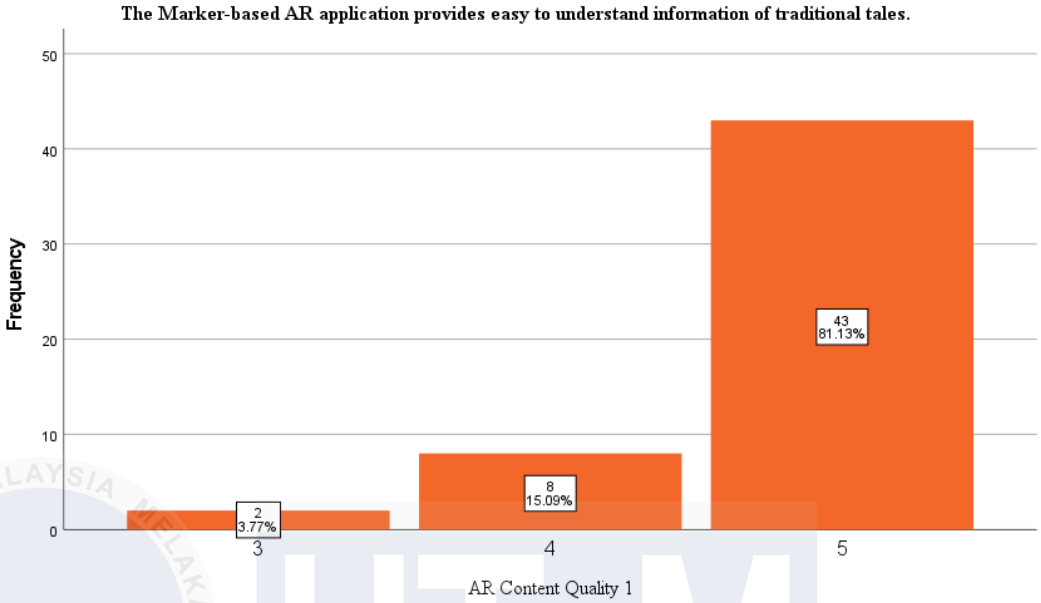


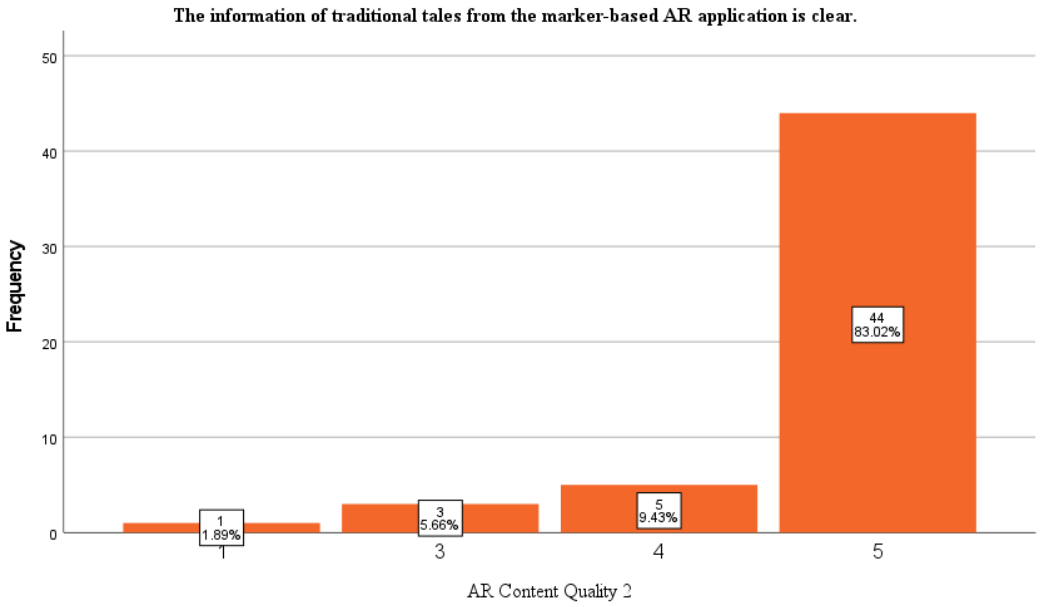
Table 6.8 below shows that 81.13% of respondents are satisfied and strongly agree that the AR application provides clear, concise, and understandable information. This implies that the application successfully conveys intricate traditional stories in an understandable manner. Although four tourists, or 3.77 percent of respondents, selected the neutral option, their opinions of the application's usability may differ depending on how familiar they are with AR technology or traditional stories.

Table 6.8 Graph of Content Quality 1 of AR application



Based on Table 6.9 below, 44% of the tourists strongly agree with the clarity of the information indicates a substantial positive reception. Nearly half of the respondents are highly satisfied with how the traditional tales are presented. This high percentage suggests that the application successfully delivers content in a clear and accessible manner. The single tourist who strongly disagreed might have had specific preferences or expectations that were not met.

Table 6.9 Graph of Content Quality 1 of AR application



The results presented in Table 6.10 and Figure 6.3 below clearly demonstrate how effective the marker-based augmented reality application is at providing pertinent, comprehensible, and clear information about traditional tales. Its effectiveness is highly agreed upon by the vast majority of respondents, who also praised its relevance (77.4%), ease of understanding (81.1%), and clarity (83.0%). The low percentage of agreeing and neutral replies highlights the application's overwhelmingly positive reception even more. This suggests that the app lives up to user expectations and is a useful tool for interacting with classic stories in augmented reality.

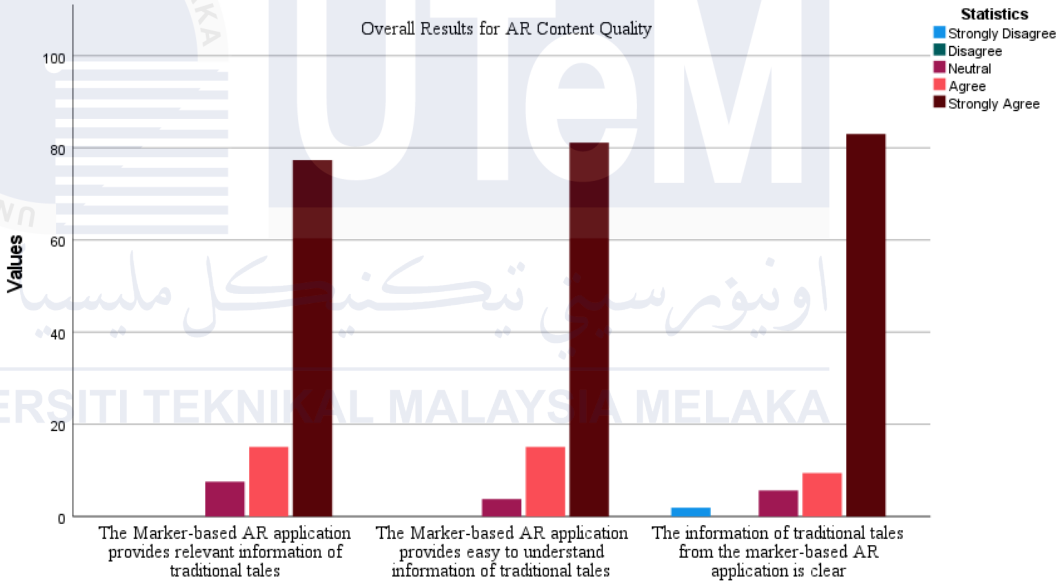


Figure 6.3 Overall Results for AR Content Quality

Table 6.10 Overall Results AR Content Quality

	The Marker-based AR application provides relevant information of traditional tales.	The Marker-based AR application provides easy to understand information of traditional tales.	The information of traditional tales from the marker-based AR application is clear.
Strongly Disagree	0.0%	0.0%	1.9%
Disagree	0.0%	0.0%	0.0%
Neutral	7.5%	3.8%	5.7%
Agree	15.1%	15.1%	9.4%
Strongly Agree	77.4%	81.1%	83.0%

The ratings for AR content quality (ARCQ) of the AR Tourism application, which are displayed in Table 6.11 below, were compared between male and female users using the independent t-test. The findings showed that there isn't a statistically significant difference in gender-specific ARCQ ratings. With 51 degrees of freedom (df), the t-value was -1.109, and the corresponding p-value was 0.273, both of which are above the traditional significance threshold of 0.05. This shows that there is no discernible difference between the mean ARCQ ratings given by male and female respondents.

According to the analysis, there is no discernible difference between respondents' perceptions of the quality of the augmented reality content in the tourism application based on gender. The quality of the AR content was rated similarly by both genders, suggesting that all users, regardless of gender, find the application to be equally useful and appreciated. This finding bolsters the hypothesis that the AR Tourism

application has received generally positive feedback because the content quality is high across a range of demographic groups.

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Table 6.11 Summary of Independent T-Test for ARCQ

Independent Samples Test

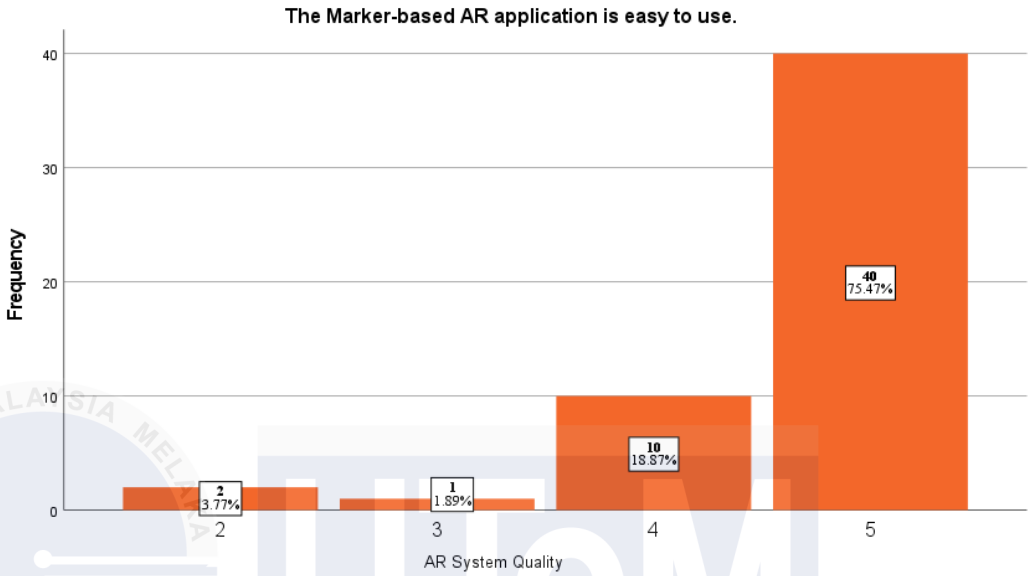
			MeanForARCQ	
			Equal variances assumed	Equal variances not assumed
Levene's Test for Equality of Variances	F		1.057	
	Sig.		.309	
t-test for Equality of Means	t		-1.109	-1.189
	df		51	50.625
	Sig. (2-tailed)		.273	.240
	Mean Difference		-.15873	-.15873
	Std. Error Difference		.14314	.13348
	95% Confidence Interval of the Difference	Lower	-.44609	-.42674
		Upper	.12863	.10928

6.5.1.2 Questionnaire AR System Quality Test

Respondents to the AR System Quality questionnaire are required to provide answers to four questions concerning the project's system or interface. It indicates that this product is highly efficient and that adding multimedia components to the content and information delivery greatly benefits users. Furthermore, almost all of the respondents strongly agree that an effective understanding of AR application on a mobile device anywhere at any time is possible because this product is a mobile application.

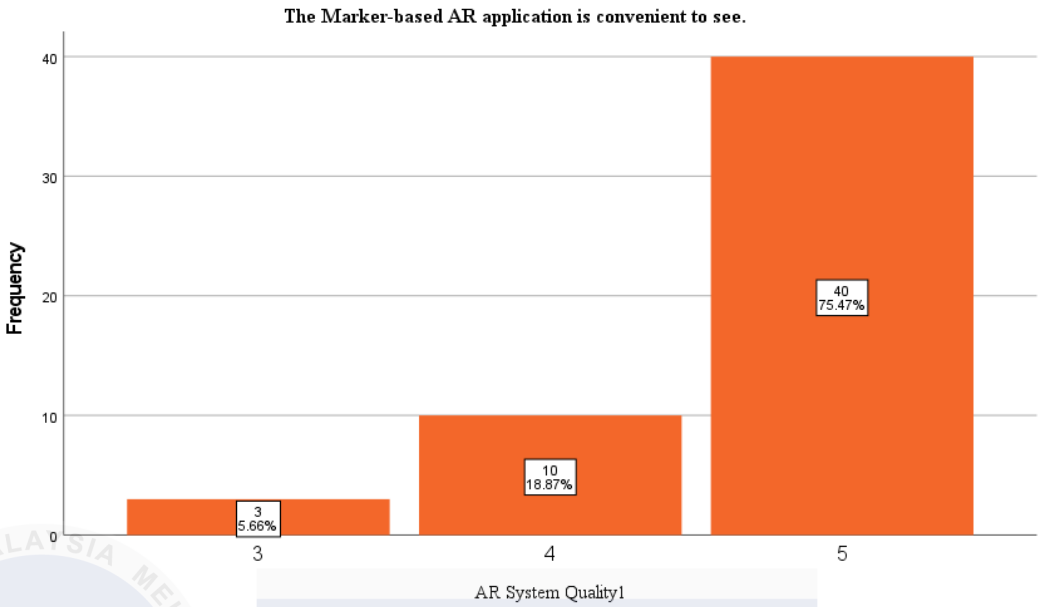
Additionally, given that the focus of this augmented reality application is heritage tourism, the data indicates that respondents have a moderate level of agreement with the application's ability to pique their interest in using AR and improve their understanding of heritage tourism destinations. In conclusion, respondents strongly agree that this augmented reality application is more effective and can aid in visualising the process of creating heritage tourism.

Table 6.12 Graph of System Quality of AR application



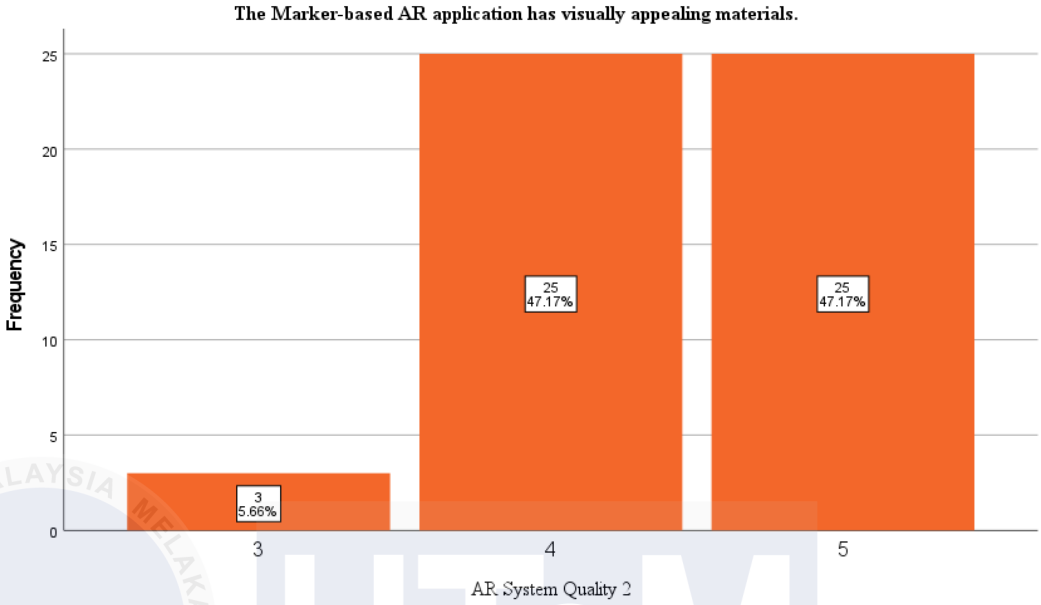
A sizable percentage of users found the application to be intuitive and user-friendly, as evidenced by the graph in Table 6.12 above, which shows that 40 out of 53 tourists (75.47%) strongly agree that the application is easy to use. This proves that a sizable user base can effectively utilise the application at a high degree of usability. The two respondents who didn't agree could have faced different difficulties or had different expectations about how user-friendly the application was.

Table 6.13 Graph of System Quality 1 of AR application



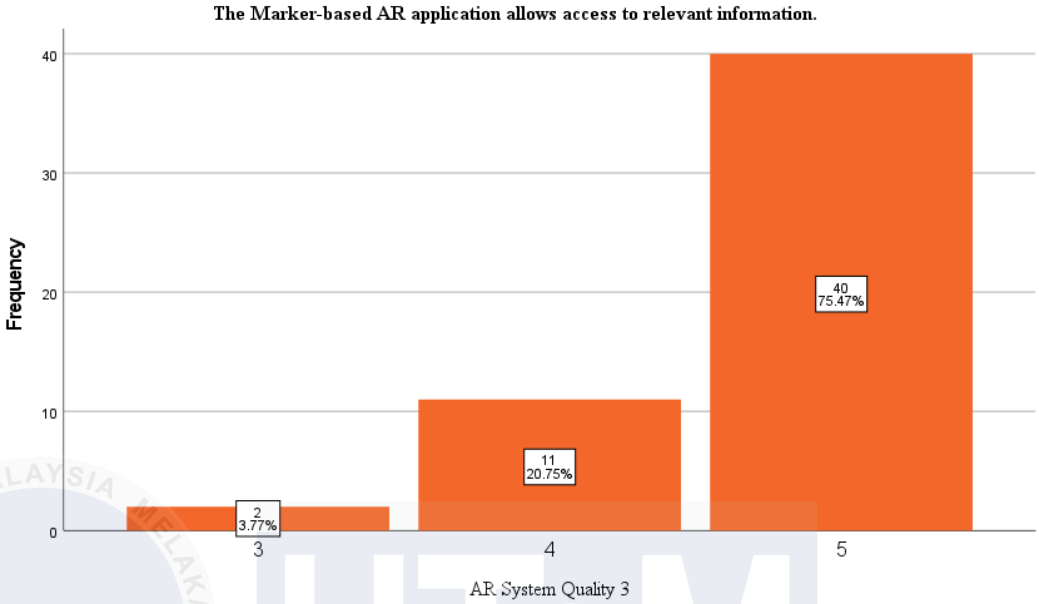
Based on the Table 6.13 graph above, 40 out of 53 tourists (75.47%) strongly agree that the AR application is convenient to see indicating a high level of satisfaction among the users. This suggests that the application effectively meets their needs in terms of ease of access and convenience. The 3 tourists who chose to be neutral may have had a satisfactory experience but did not find the application exceptionally convenient. This indicates that while the application performs well, there may still be some room for enhancement.

Table 6.14 Graph of System Quality 2 of AR application



The Table 6.14 graph above, shows that 25 of 53 tourists (47.17%) agree and strongly agree that the application has visually appealing materials, this indicates a substantial level of satisfaction with the visual design of the AR application. It suggests that the visual elements, such as graphics, animations, and overall design, are engaging and well-received by a notable portion of users. The 3% of tourists who chose neutral might have different preferences or expectations regarding the visual appeal of the application. This indicates that while the majority find the visuals appealing, there is a small segment of users who may not have been as impressed.

Table 6.15 Graph of System Quality 3 of AR application



The above Table 6.15 graph shows that 75.47% of tourists strongly agree that the AR application allows access to relevant information indicating a high level of satisfaction with the application's ability to provide valuable and pertinent content. This suggests that the application effectively meets the users' needs for accessing relevant information during their experience. The 2 tourists who chose to be neutral may have had varying experiences or expectations regarding the relevance of the information provided.

Figure 6.4 below, shows the chart of the AR System Quality collected and tested in the system.

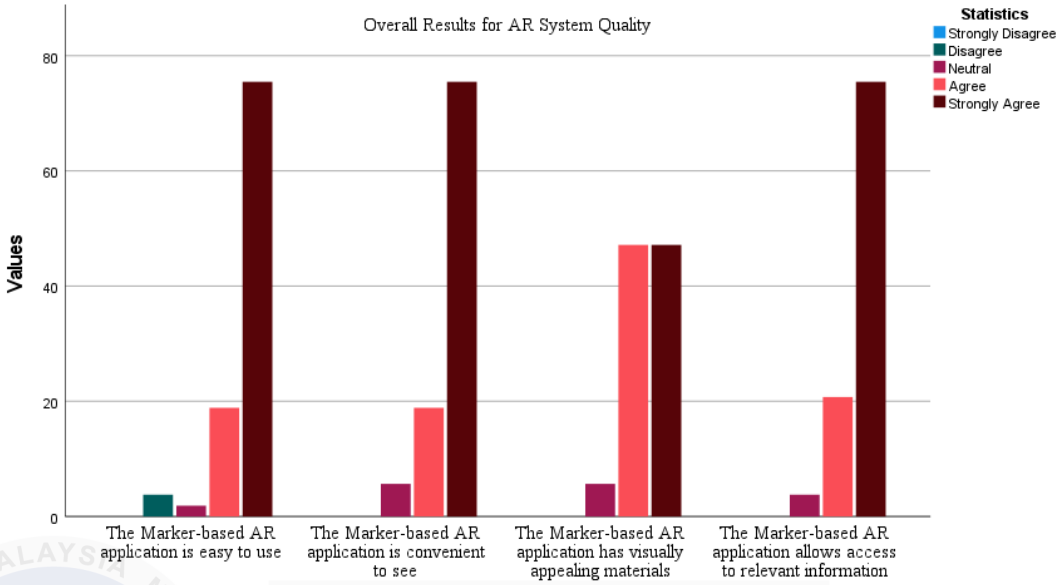


Figure 6.4 Overall Results for AR System Quality

The survey results highlight the marker-based AR application's high usability and effectiveness based on Table 6.16. A significant majority of respondents strongly agree that the application is easy to use (75.5%), convenient to see (75.5%), and allows access to relevant information (75.5%). Additionally, 47.2% of respondents appreciate its visually appealing materials. The minimal neutral and disagreeing responses underscore the application's strong positive reception.

Table 6.16 Overall Results for AR System Quality

	The Marker-based AR application is easy to use	The Marker-based AR application is convenient to see	The Marker-based AR application has visually appealing materials	The Marker-based AR application allows access to relevant information
Strongly Disagree	0.0%	0.0%	0.0%	0.0%
Disagree	3.8%	0.0%	0.0%	0.0%
Neutral	1.9%	5.7%	5.7%	3.8%
Agree	18.9%	18.9%	47.2%	20.8%
Strongly Agree	75.5%	75.5%	47.2%	75.5%

The independent samples t-test was used to compare the AR system quality scores between the two gender groups between ARSQ, as shown in Table 6.17 below. When equal variances were assumed, the t-test for equality of means revealed no statistically significant difference in the quality of the AR systems between the two groups, with a t-value of -1.435 (df = 51) and a p-value of.158. The results (t = -1.622, p =.111) remained non-significant when equal variances were not assumed. The 95% confidence interval for the mean difference was -.45882 to.07638 when equal variances were assumed, and -.42812 to.04568 when they weren't. The difference was -.19122.

Given that the p-values in both situations are higher than 0.05, it appears unlikely that the mean ARSQ score difference between respondents who are male and female is statistically significant. The t-test results show that the quality of the AR system is perceived similarly by various user groups, even though Levene's test results are borderline significant. Regardless of the group being evaluated, this finding suggests that the AR system performs consistently and reliably.

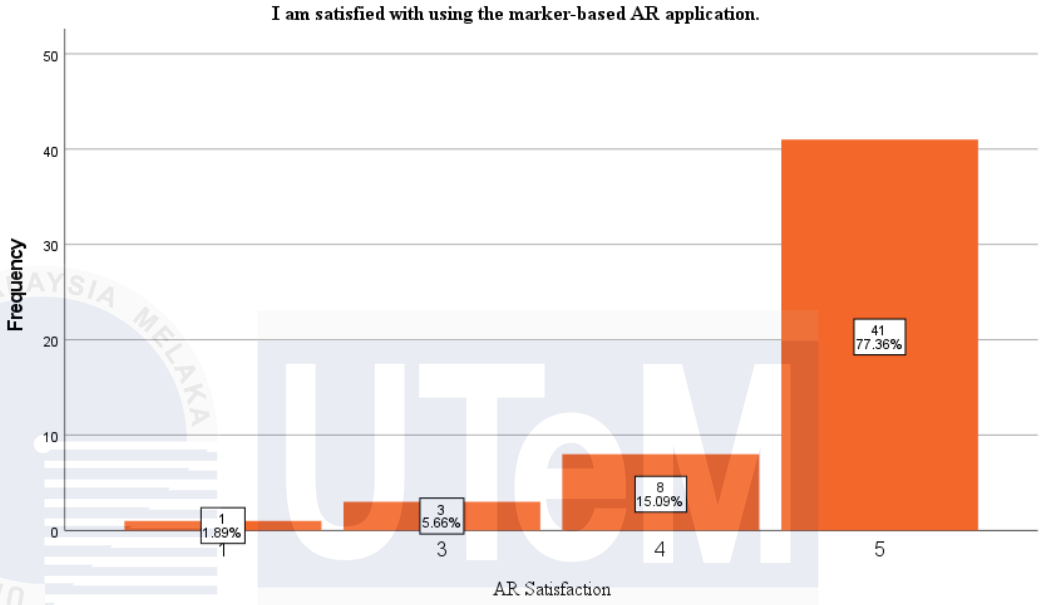
Table 6.17 Summary of Independent T-Test for ARSQ

Independent Samples Test

			MeanForARSQ	
			Equal variances assumed	Equal variances not assumed
Levene's Test for Equality of Variances	F		3.995	
	Sig.		.051	
t-test for Equality of Means	t		-1.435	-1.622
	df		51	48.807
	Sig. (2-tailed)		.158	.111
	Mean Difference		-.19122	-.19122
	Std. Error Difference		.13329	.11788
	95% Confidence Interval of the Difference	Lower	-.45882	-.42812
		Upper	.07638	.04568

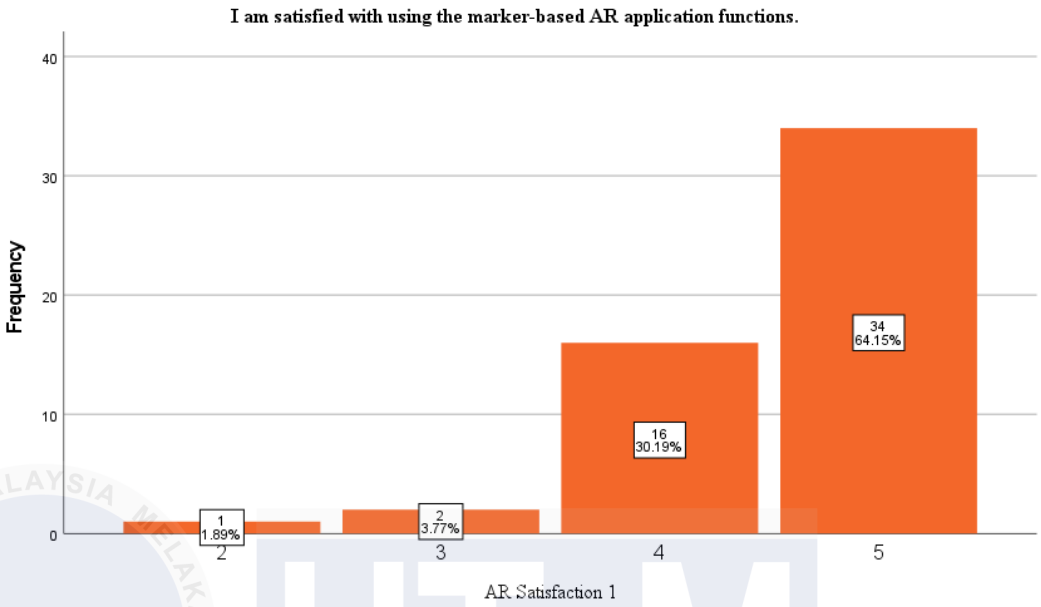
6.5.1.3 Questionnaire AR Satisfaction Test

Table 6.18 Graph of Satisfaction of AR Application



The data indicates that 41 out of 53 tourists (77.36%) strongly agree that they feel satisfied using the AR application, indicating a strong overall positive response, according to the Table 6.18 chart above. This implies that the majority of users have found the application to be very satisfying. The lone traveler who was vehemently opposed might have had a particular problem that made a big difference in their experience. This particular user's feedback demonstrates that there can be notable differences in user satisfaction even with the generally positive response.

Table 6.19 Graph of Satisfaction 1 of AR application

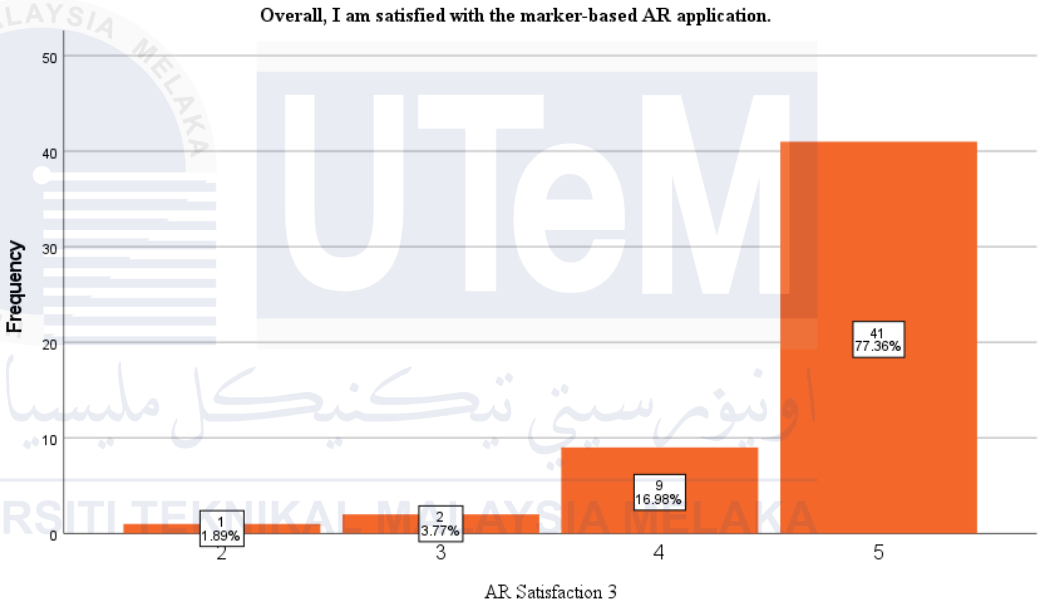


Based on the Table 6.19 chart above, 34 out of 53 tourists (64.15%) strongly agree that the AR application has satisfying functions indicating a substantial level of satisfaction with the application's features and functionalities. This suggests that many users find the functions of the application to meet or exceed their expectations. The single tourist (1.89%) who disagreed might have had a specific issue or dissatisfaction with the application's functions.

Table 6.20 Graph of Satisfaction 2 of AR application

Based on Table 6.20 chart above, the question asked about tourists' satisfaction with the content of the AR application. The fact that 75.47% of respondents strongly agree that they are satisfied with the contents of the AR application indicates a strong level of approval and satisfaction. This reflects that a substantial majority of users find the content provided by the application to be valuable and satisfying. The 5.66% of respondents who chose neutral indicate that there are a few users who did not have a strong opinion on content satisfaction.

Table 6.21 Graph of Satisfaction 3 of AR application



Based on Table 6.21, above, 41 out of 53 tourists (77.36%) strongly agree with the statement "Overall, I am satisfied with the marker-based AR application" which indicates a high level of satisfaction among the majority of users. This demonstrates that the application is well-received and meets the expectations of a significant portion of the user base. A tourist who disagreed represents a small fraction of the respondents. This indicates that while the overall feedback is very positive, there is some variation in user experience and satisfaction.

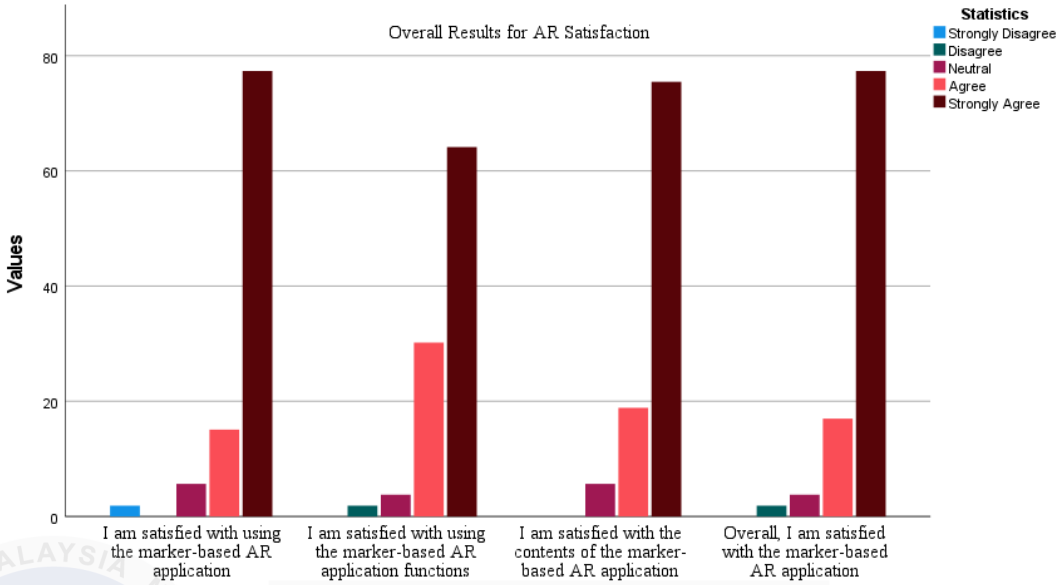


Figure 6.5 Overall Results for AR Satisfaction

The test results in Figure 6.5 demonstrate a high level of user satisfaction with the marker-based AR application. A substantial majority strongly agree that they are satisfied with the application overall (77.4%), its functions (64.2%), and its content (75.5%) as shown in Table 6.22 below. The minimal neutral and disagreeing responses further emphasize the positive reception.

Table 6.22 Overall Results for AR Satisfaction

	I am satisfied with using the marker-based AR application	am satisfied with using the marker-based AR application functions	I am satisfied with the contents of the marker-based AR application	Overall, I am satisfied with the marker-based AR application
Strongly Disagree	1.9%	0.0%	0.0%	0.0%
Disagree	0.0%	1.9%	0.0%	1.9%
Neutral	5.7%	3.8%	5.7%	3.8%
Agree	15.1%	30.2%	18.9%	17.0%
Strongly Agree	77.4%	64.2%	75.5%	77.4%

As indicated in Table 6.23 below, the independent samples t-test was used to compare the AR system quality scores between the two groups, ARS and gender. While the mean satisfaction score for females (N = 21) is marginally higher at 4.7381 with a smaller standard deviation of 0.33049, the mean satisfaction score for males (N = 32) is 4.6016 with

a standard deviation of 0.67160. The test results, which are greater than the conventional significance level of 0.05, indicate that the assumption of equal variances is not broken (F = 3.538, p =.066). There is no statistically significant difference in AR Satisfaction between genders, according to the t-test results (t(51) = -0.863, p =.392 for assumed equal variances, t(47.974) = -0.983, p =.331 for not assumed equal variances). Assuming equal variances, the 95% confidence interval for the mean difference between the groups is roughly between -0.454 and 0.181. The difference between the groups is -0.13653.

The AR Satisfaction scores of males and females do not differ statistically significantly. Despite the fact that women's mean satisfaction scores are marginally higher than men's, this difference is not statistically significant. Therefore, it doesn't seem that gender has a significant impact on AR Satisfaction in this sample.

sample.

Table 6.23 Summary of Independent T-Test for ARS

Independent Samples Test

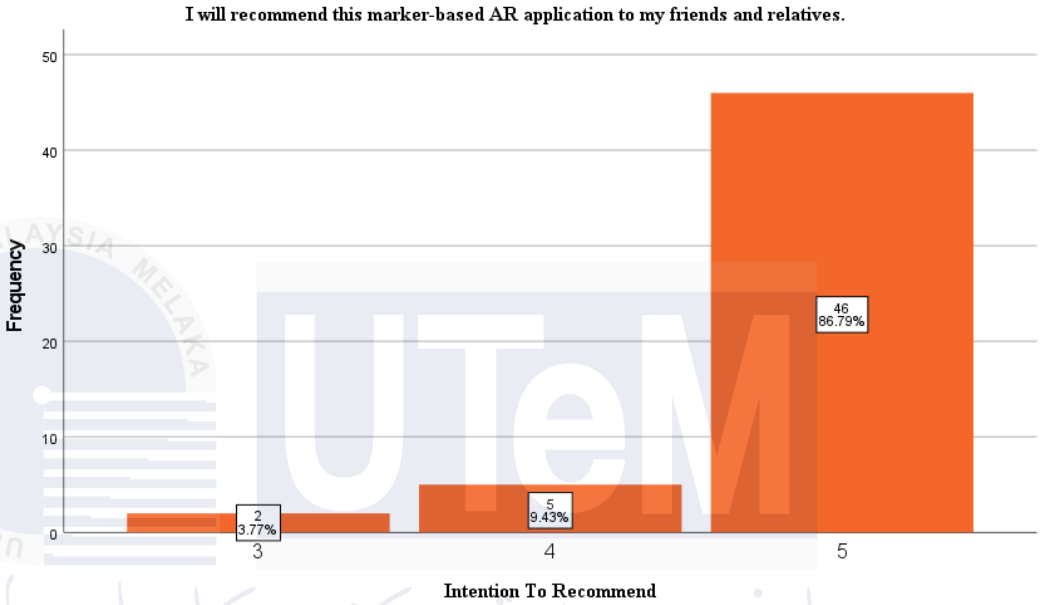
			MeanForARS	
			Equal variances assumed	Equal variances not assumed
Levene's Test for Equality of Variances	F		3.538	
	Sig.		.066	
t-test for Equality of Means	t		-.863	-.983
	df		51	47.974
	Sig. (2-tailed)		.392	.331
	Mean Difference		-.13653	-.13653
	Std. Error Difference		.15812	.13891
	95% Confidence Interval of the Difference	Lower	-.45397	-.41584
		Upper	.18090	.14277

6.5.1.4 Questionnaire Intention to Recommend Test

Based on the Table 6.24 chart below, 46 of 53 tourists (86.79%) strongly agree that they would recommend the marker-based AR application to friends and relatives, indicating a high level of satisfaction and endorsement. This suggests that the majority of users find the application valuable and worthy of sharing with others. The 3.77% of

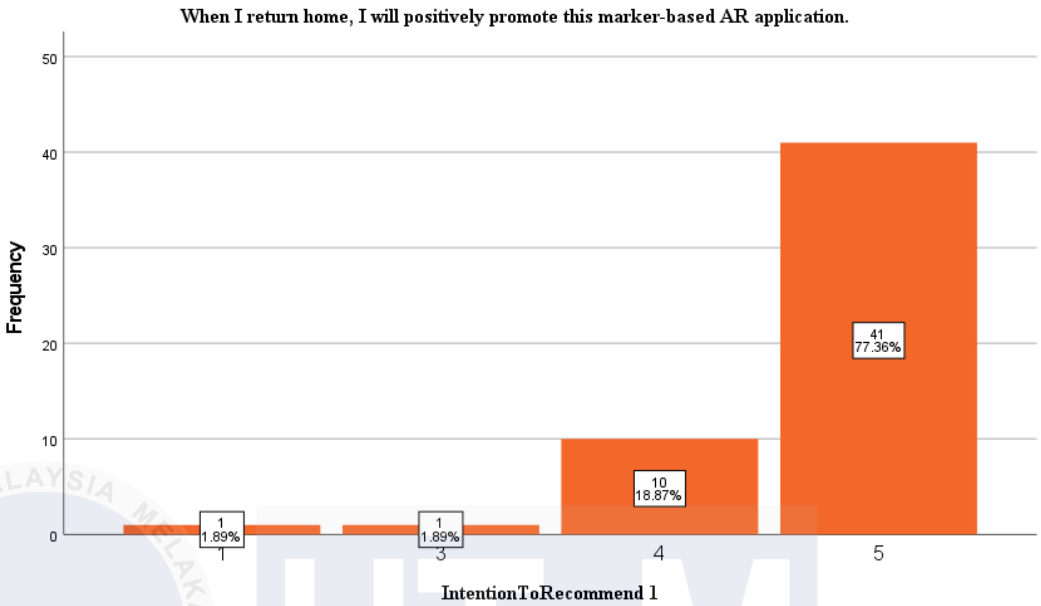
respondents who chose neutral may indicate that while they had a satisfactory experience, they were not as enthusiastic about recommending the application. This can be due to a variety of reasons, including individual preferences or specific expectations.

Table 6.24 Graph of Intention to Recommend AR Application



Based on the Table 6.25 chart below, 41 of the respondents (77.36%) strongly agree that they will positively promote the marker-based AR application when they return home indicating a very high level of satisfaction and willingness to advocate for the application. This suggests that many users had a highly positive experience and are eager to share it with others. The single response of strong disagreement (1.89%) highlights that while the overall feedback is very positive, there can be significant variations in user experiences. This individual may have had specific issues or concerns that impacted their willingness to promote the application.

Table 6.25 Graph of Intention to Recommend 1 AR Application



79.25% of respondents strongly agree that they will strongly recommend the marker-based AR application to others indicating a very high level of satisfaction and endorsement as shown in Table 6.26 below. This suggests that the majority of users find the application valuable and are enthusiastic about sharing it with others. The single response of disagreement (1.89%) indicates that while the overall feedback is overwhelmingly positive, there is a small segment of users who may have had different experiences or expectations. This disagreement highlights the presence of varying perspectives among users.

Table 6.26 Graph of Intention to Recommend 2 AR Application

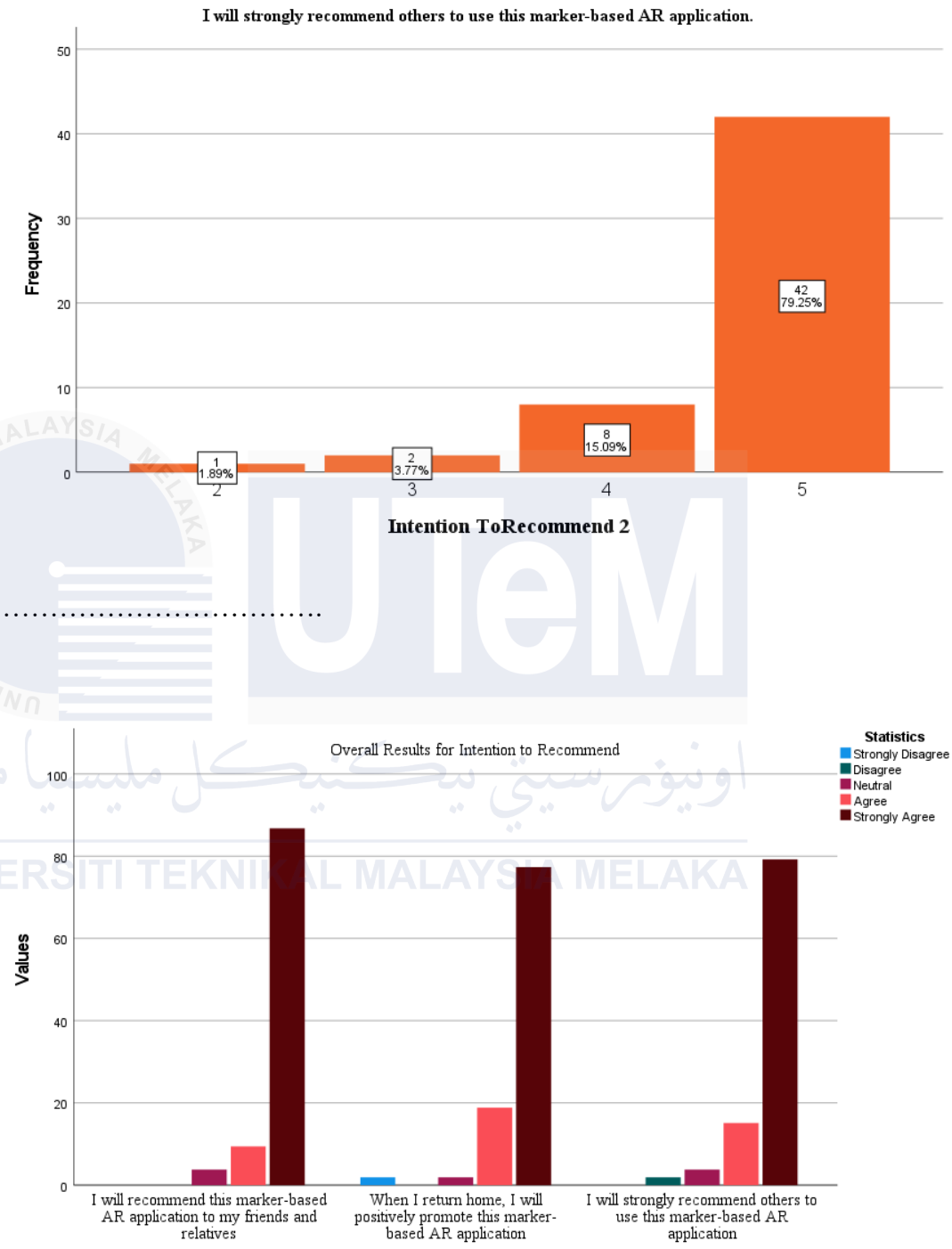


Figure 6.6 Overall Results for Intentions to Recommend

The survey overall results shown in Figure 6.6 indicate strong user advocacy for the marker-based AR application. A significant majority of respondents strongly agree that they will recommend the

application to friends and relatives (86.8%), promote it positively upon returning home (77.4%), and strongly recommend its use to others (79.2%) as shown in Table 6.27 below. The minimal neutral and disagreeing responses further reinforce this positive sentiment. These findings suggest that users are highly satisfied and willing to endorse the application to others, highlighting its effectiveness and appeal.

Table 6.27 Overall Results for Intention to Recommend

	I will recommend this marker-based AR application to my friends and relatives	When I return home, I will positively promote this marker-based AR application	I will strongly recommend others to use this marker-based AR application
Strongly Disagree	0.0%	1.9%	0.0%
Disagree	0.0%	0.0%	1.9%
Neutral	3.8%	1.9%	3.8%
Agree	9.4%	18.9%	15.1%
Strongly Agree	86.8%	77.4%	79.2%

An independent samples t-test was used to compare the AR content quality scores between the two groups, as indicated in Table 6.28 below. Males (N = 32) have an average ITR score of 4.6667 and a standard deviation of 0.61638. Females (N = 21) have a slightly higher mean ITR score of 4.8730 and a smaller standard deviation of 0.30689. Just above the traditional cutoff of.05, the test results for equality of variances show a marginal result (F = 3.991, p =.051), indicating that variances are nearly equal but not quite so. According to the t-test results, there is no discernible difference between males and females' ITR scores (t(51) = -1.420, p =.162 for assumed equal variances, t(48.186) = -1.613, p =.113 for not assumed equal variances).

The analysis reveals no statistically significant difference in Intention to Recommend (ITR) scores between males and females. While females have a slightly higher mean score, this difference is not statistically significant.

Table 6.28 Summary of Independent T-Test for ITR

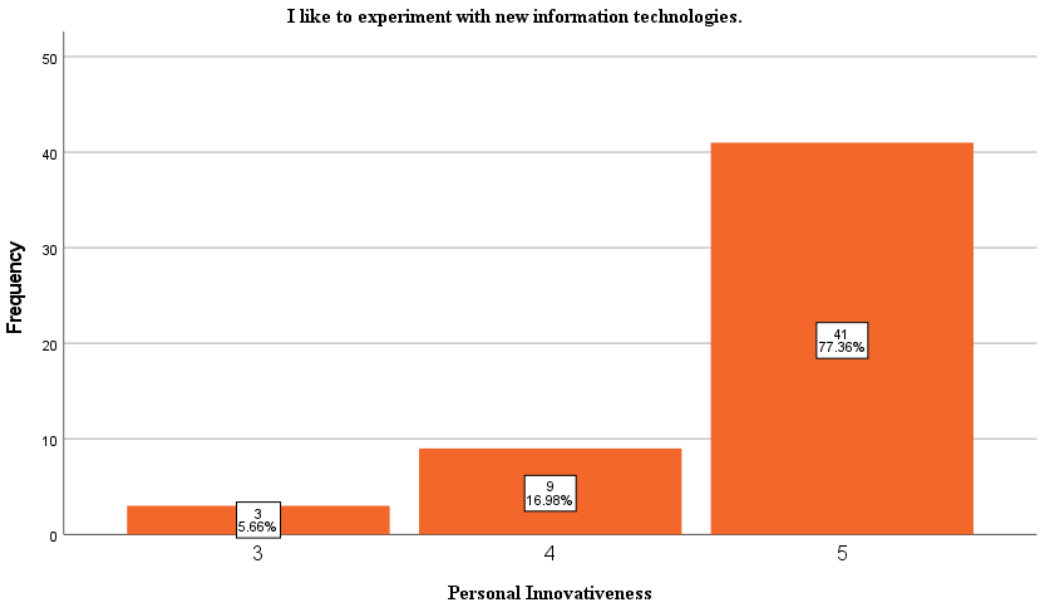
Independent Samples Test

			MeanForITR	
			Equal variances assumed	Equal variances not assumed
Levene's Test for Equality of Variances	F		3.991	
	Sig.		.051	
t-test for Equality of Means	t		-1.420	-1.613
	df		51	48.186
	Sig. (2-tailed)		.162	.113
	Mean Difference		-.20635	-.20635
	Std. Error Difference		.14535	.12790
	95% Confidence Interval of the Difference	Lower	-.49815	-.46348
		Upper	.08545	.05078

6.5.1.5 Questionnaire Personal Innovativeness Test

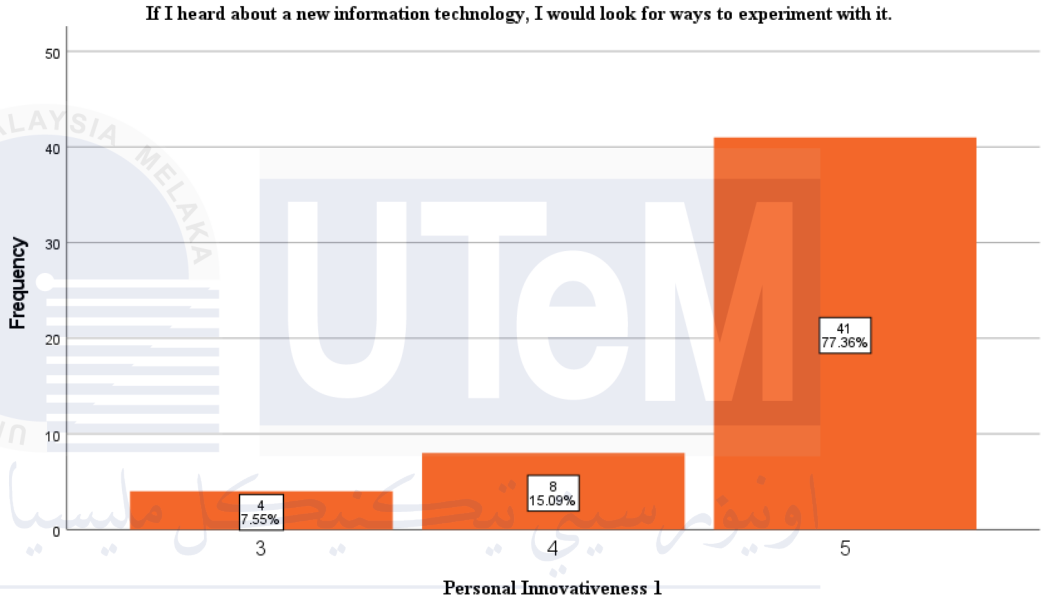
Table 6.29 displays the AR application personal innovativeness graph. The majority of users seem to be very interested in and enthusiastic about trying out new information technologies, as evidenced by the fact that 77.36% of respondents strongly agree with this statement. This implies that most users are enthusiastic and receptive to interacting with cutting-edge technologies.

Table 6.29 Graph of Personal Innovativeness AR Application



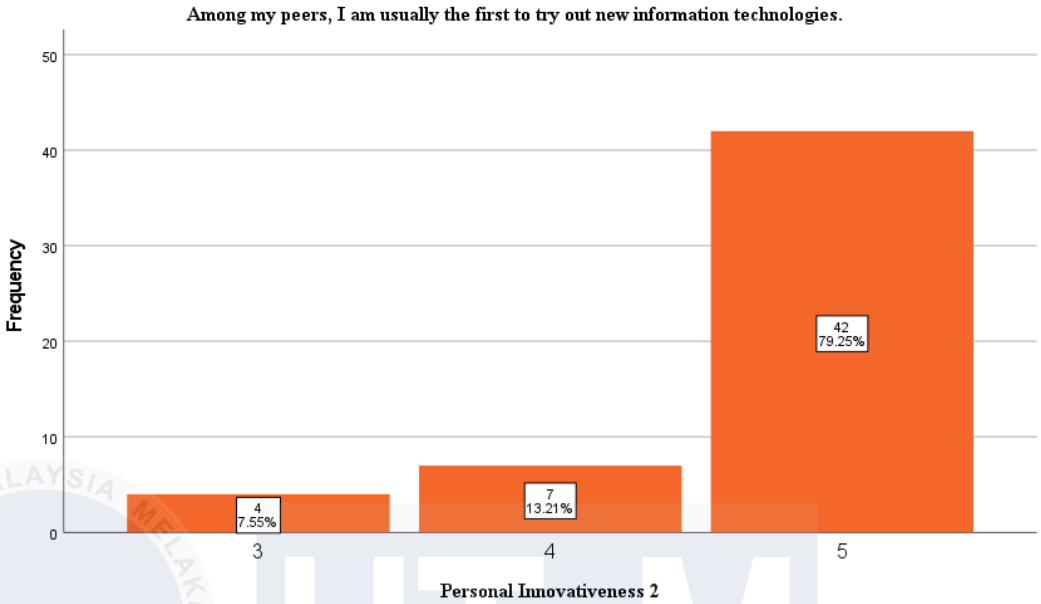
As Table 6.30 demonstrates, there is a strong interest and proactive attitude towards interacting with new technological innovations, as evidenced by the fact that 77.36% of respondents strongly agree that they would look for ways to experiment with new information technology. According to the chart below, this indicates that most users are keen to investigate and try out new technologies.

Table 6.30 Graph of Personal Innovativeness 1 AR Application



42 out of 53 tourists (79.25%) strongly agree that they are typically the first in their peer group to try out new information technologies, as shown in Table 6.31 below, demonstrating a high degree of personal inventiveness. This implies that most users are early adopters who are willing to try out and accept new technologies. The 7.55% of respondents who selected "neutral" could mean that, although they are receptive to new technologies, they don't always take the initiative to introduce them to their peers.

Table 6.31 Graph of Personal Innovativeness 2 AR Application



The survey results reveal a strong inclination among users toward experimenting with new information technologies as shown in Figure 6.6.

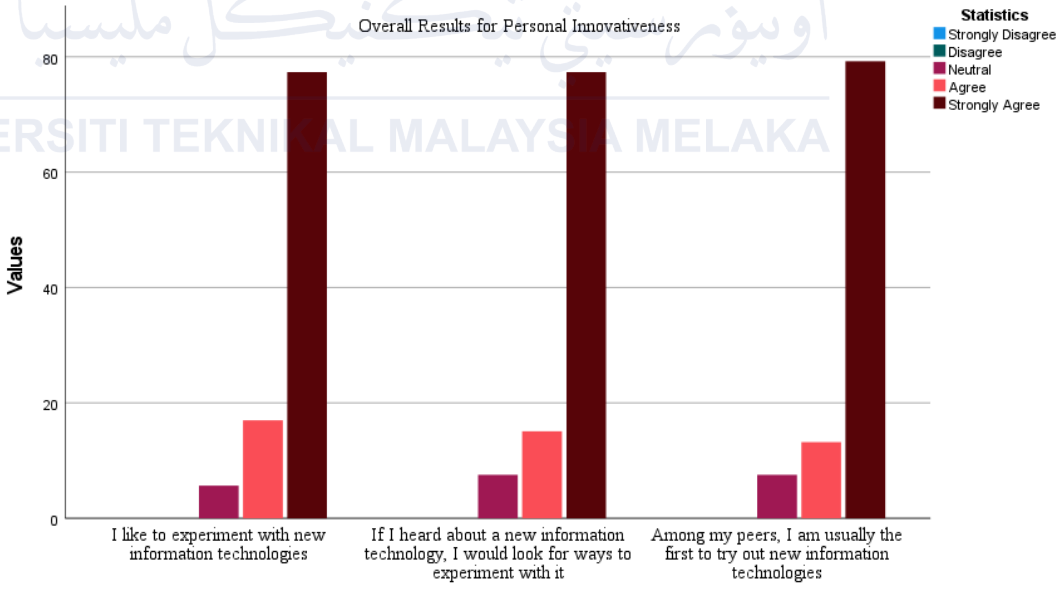


Figure 6.7 Overall Results for Personal Innovativeness

Table 6.32 shows that a sizable percentage of respondents strongly agree that they would look for opportunities to experiment with

new technologies after learning about them (77.4%), that they enjoy doing so (77.4%), and that they are frequently the first among their peers to try out new technologies (79.2%). The few indifferent responses serve as more evidence of this excitement. These findings indicate that users are highly creative and open to adopting new technological advancements, as well as that they have a positive attitude towards learning about and using new information technologies.

Table 6.32 Overall Results for Personal Innovativeness

	I like to experiment with new information technologies	If I heard about a new information technology, I would look for ways to experiment with it	Among my peers, I am usually the first to try out new information technologies
Strongly Disagree	0.0%	0.0%	0.0%
Disagree	0.0%	0.0%	0.0%
Neutral	5.7%	7.5%	7.5%
Agree	17.0%	15.1%	13.2%
Strongly Agree	77.4%	77.4%	79.2%

The mean Personal Innovativeness (PI) score for males (N = 32) is 4.7187, with a standard deviation of 0.54285. As indicated in Table 6.33 below, the mean PI score for females (N = 21) is 4.6984, with a standard deviation of 0.45832. Given that the p-value is significantly higher than the conventional cutoff of 0.05, the test finds that the variances between the two groups are equal (F = 0.030, p =.864). The t-test results (t(51) = 0.142, p =.888 for equal variances assumed; t(47.696) = 0.147, p =.884 for equal variances not assumed) indicate that there is no significant difference in PI scores between males and females. As indicated in Table 6.33 below, the groups' mean difference is 0.02034, with a 95% confidence interval that, assuming equal variances, ranges from roughly -0.268 to 0.309.

Table 6.33 Summary of Independent T-Test for PI

			MeanForPI	
			Equal variances assumed	Equal variances not assumed
Levene's Test for Equality of Variances	F		.030	
	Sig.		.864	
t-test for Equality of Means	t		.142	.147
	df		51	47.696
	Sig. (2-tailed)		.888	.884
	Mean Difference		.02034	.02034
	Std. Error Difference		.14361	.13861
	95% Confidence Interval of the Difference	Lower	-.26797	-.25839
		Upper	.30865	.29907

6.5.2 Finding Analysis

Table 6.34 Descriptive Statistic of AR Content Quality

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
The Marker-based AR application provides relevant information of traditional tales.	53	3	5	4.70	.607
The Marker-based AR application provides easy to understand information of traditional tales.	53	3	5	4.77	.505
The information of traditional tales from the marker-based AR application is clear.	53	1	5	4.72	.744
Valid N (listwise)	53				

The descriptive statistics for the AR Content Quality section of the questionnaire, which includes three questions, provide insight into how respondents perceived the application's ability to deliver traditional tales as shown in Tabe 6.34 above. The first question, regarding the relevance of the information provided by the AR application, has a mean score of 4.70 with a standard deviation of 0.607, indicating that respondents generally found the information relevant and were consistent in their responses. The second question, which addresses the ease of understanding the information, received a slightly higher mean score of 4.77 and a lower standard deviation of 0.505,

suggesting that the information was not only relevant but also easy to comprehend, with even more consistency among responses. The third question, focusing on the clarity of the information, had a mean score of 4.72 with a standard deviation of 0.744, reflecting that while the information was generally clear, there was slightly more variability in how respondents perceived this aspect.

Overall, the results show a positive evaluation of the AR content's quality, with respondents finding the information relevant, easy to understand, and clear, though there was some variation in their perceptions of clarity.

Table 6.35 Descriptive Statistic of AR System Quality

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
The Marker-based AR application is easy to use.	53	2	5	4.66	.706
The Marker-based AR application is convenient to see.	53	3	5	4.70	.575
The Marker-based AR application has visually appealing materials.	53	3	5	4.42	.602
The Marker-based AR application allows access to relevant information.	53	3	5	4.72	.533
Valid N (listwise)	53				

Based on Table 6.35 above, showing the descriptive statistics, the marker-based AR application is generally perceived as user-friendly, with an overall high satisfaction rate. The mean scores across all four questions about AR System Quality are above 4.4, indicating a positive user experience. Users found the application easy to use (Mean = 4.66) and visually appealing (Mean = 4.42), with convenient access to relevant information (Mean = 4.72). This suggests that the AR system has been successful in delivering an engaging and accessible user experience, which aligns with existing literature on the importance of usability and visual appeal in AR applications (Azuma, 1997). However, the slight variation in standard deviations reflects differences in user perceptions, particularly in the application's visual appeal.

Overall, the results indicate that respondents viewed the AR system favorably, particularly in terms of visual appeal and ease of access to relevant information, though there was slightly more variability in their perceptions of the application's convenience.

Table 6.36 Descriptive Statistic of AR Satisfaction

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
I am satisfied with using the marker-based AR application.	53	1	5	4.66	.758
I am satisfied with using the marker-based AR application functions.	53	2	5	4.57	.665
I am satisfied with the contents of the marker-based AR application.	53	3	5	4.70	.575
Overall, I am satisfied with the marker-based AR application.	53	2	5	4.70	.638
Valid N (listwise)	53				

The descriptive statistics for the AR Satisfaction section of the questionnaire shed light on respondents' general level of satisfaction with different elements of the marker-based AR application, as shown in Table 6.36 above. High levels of satisfaction are found in all items, according to the analysis, with mean scores for each question ranging from 4.57 to 4.70 on a 5-point scale. The mean score for the first question, which assesses users' overall satisfaction with the AR application, is 4.66, with a standard deviation of 0.758. This implies that, despite some variation in their answers, respondents were generally satisfied with the application. The application's functions were the subject of the second question, which produced a slightly lower mean score of 4.57 with a standard deviation of 0.665. This suggests that there was a moderate range of opinions among users, despite the fact that they were generally satisfied with the functionality of the application. High mean scores of 4.70, with standard deviations of 0.575 and 0.638, were obtained for the third and fourth questions, which deal with content satisfaction and overall satisfaction with the AR application, respectively. The findings demonstrate a high degree of agreement among participants, suggesting that they were satisfied with both the overall experience and the content of the application.

Overall, the table demonstrates that respondents were generally very satisfied with the marker-based AR application, particularly with its content and overall functionality. The consistently high mean scores across all items indicate a positive user experience with the AR application.

Table 6.37 Descriptive Statistic of Intention to Recommend

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
I will recommend this marker-based AR application to my friends and relatives.	53	3	5	4.83	.470
When I return home, I will positively promote this marker-based AR application.	53	1	5	4.70	.696
I will strongly recommend others to use this marker-based AR application.	53	2	5	4.72	.632
Valid N (listwise)	53				

As indicated in Table 6.37 above, the descriptive statistics for the questionnaire's "Intention to Recommend" section reveal that respondents strongly intend to suggest the marker-based AR application to others. Below is a summary of the results. The highest mean score of 4.83, with a standard deviation of 0.470, is obtained from the first question, which asks respondents if they would recommend the AR application to friends and relatives. This shows that respondents agreed on a very high level, indicating that most users are very likely to tell others about the application. With a mean score of 4.70 and a standard deviation of 0.696, the second question assesses respondents' willingness to positively promote the AR application after they get home. The slightly larger standard deviation, though still high, indicates a little bit more variation in answers when compared to the first question. The third question has a mean score of 4.72 and a standard deviation of 0.632, evaluating the degree to which respondents would strongly advise others to use the AR application. Similar to the first question, this one also shows a high degree of agreement among respondents, albeit with a little bit more variability.

Overall, the data shows that respondents are generally very willing to recommend the marker-based AR application, reflecting a positive reception and satisfaction with the app. The high mean scores across all items suggest that users have a strong intention to endorse the application to others.

Table 6.38 Descriptive Statistic of Personal Innovativeness

CC

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
I like to experiment with new information technologies.	53	3	5	4.72	.568
If I heard about a new information technology, I would look for ways to experiment with it.	53	3	5	4.70	.607
Among my peers, I am usually the first to try out new information technologies.	53	3	5	4.72	.601
Valid N (listwise)	53				

According to Table 6.38 above, which displays the descriptive statistics for the questionnaire's "Personal Innovativeness" section, most respondents thought of themselves as open to trying out new information technologies and being proactive about it. This is an overview of the results. The mean score for the first question, which gauges respondents' openness to trying out new information technologies, is 4.72, with a standard deviation of 0.568. This indicates that the majority of respondents have a relatively low degree of response variability and are very open to trying new technologies. The second question has a mean score of 4.70 and a standard deviation of 0.607, evaluating the likelihood that respondents will look for new technologies to experiment with after learning about them. Though there is a little more variation in the replies, the mean score still shows a strong tendency among respondents to be proactive in exploring new technologies—even though it is slightly lower than the first question. The third question has a mean score of 4.72 and a standard deviation of 0.601, assessing whether respondents are usually the first in their peer group to try out new technologies. This indicates that there is a consistent

degree of agreement among respondents regarding their perception of themselves as early adopters of new technologies.

Overall, the data reflects a strong personal innovativeness among respondents, indicating that they are generally eager to experiment with and adopt new information technologies. The high mean scores across all items highlight a positive attitude toward technological innovation among the respondents.

6.7 Summary

In conclusion, the application has been successfully completed. Chapter 3 covered the elements of the AR and how to apply them after comparing them to already-existing AR. Tables and diagrams have been created to display the questions' outcomes. The testing method is explained in this section. using a survey or questionnaire to investigate if the goals and target audience of the product have been met. The questionnaire-based outlines have demonstrated that the elements incorporated into the AR have been successfully completed. It explains the recommendations and comments received from the survey at the conclusion of the testing. To ensure that this project achieves the objective stated in the first chapter, it is essential to receive feedback and opinions from the user. We can assume that augmented reality has value in the tourism industry. A few improvements can be made for a better application based on the testing's results and feedback. The flaws, finish, and overall quality of the project will all be discussed in the section that follows.

CHAPTER 7: CONCLUSION

7.1 Introduction

The advantages and disadvantages of this augmented reality project are covered in this last chapter. In this project, the testing phase determines the product's strengths and weaknesses. For this AR application, there are a few shortcomings in the product that will need to be strengthened and improved in the future. Furthermore, this project will explain the contribution that Augmented Reality Batik has made to the industry today.

7.2 Observation of weakness and strength

Every application that has been created has advantages and disadvantages because it is a novel use of a recently developed technology—augmented reality. On the other hand, the advantages and disadvantages of this product might help to improve clarity and produce a superior product. This application's limitation is that it's only compatible with Android phones and allows users to experience augmented reality.

7.2.1 Weakness

7.2.1.1 Graphics and 3D Models

3D models used in the application should have a interaction with lot of gestures and movement to make the models looks more real. The graphics and image background should be more appealing and related with the topic more.

7.2.1.2 Fewer Augmented Reality Interaction

There are fewer interactions with users in Augmented Reality such as buttons and interactive animation.

7.2.1.3 Audio

The model's audio might use some improvement in terms of clarity and volume so that viewers can hear the narration.

7.2.2 Strength

7.2.2.1 Combination of multimedia element

The enjoyment of new media innovation can be intuitively transmitted through Augmented Reality. With the use of text, graphics, audio, video, and some user-device cooperation, it can provide users with a positive experience. According to the test results, the tester found the AR application's directive to be clear and simple to follow.

7.2.2.2 Utilising the use of smartphone

With this application, users do not need additional devices such as joysticks to engage with innovation of technology; by using their mobile it is enough to user experience AR that they can perceive on their own.

7.2.2.3 Interactive design of application

This AR application uses an attractive design for people to improve a better knowledge of Malaysian Heritage Tourism. Augmented Reality is a substitute tool that can turn into an interesting and rewarding method of teaching rather that read the information of Heritage Tourism on the Internet.

7.3 Proposition for improvement

This section will provide an explanation of a reasonable recommendation to improve and enhance the application's capabilities and execution. The main focus will be on developing a recommendation for improvement in order to overcome the limitations and deficiencies of the application. The tester's comment, derived from using the application during the testing phase, provided the recommendation and proposal for this undertaking's development. A few noteworthy upgrade recommendations have been made to enhance the product in order to improve performance in the future.

7.3.1 Build in iOS user

Nowadays, many smartphone users have changed from an Android operating system to an iOS operating system, therefore developing an application that can fulfill the market request is necessary.

7.3.2 Expand Content to Include More Heritage Places

The limited number of heritage places available in the application may restrict user interest. Conduct research to identify and include additional heritage sites. Collaborate with local historians and cultural experts to ensure accurate and enriching content. Expanding the list of heritage places will make the application more attractive to a wider audience, providing them with diverse options to explore.

7.3.3 Enhance UI Design

The existing UI may be difficult to navigate or visually unappealing. Revamp the UI by focusing on user-centric design principles. This includes improving the layout, using consistent and pleasing color schemes, and ensuring that all interactive elements are easily accessible. Enhancements in UI design can significantly improve user engagement and satisfaction.

7.3.4 Implement Proper UI Buttons for Sound

Users may find it challenging to control sound settings due to inadequate UI buttons. Integrate clear and functional sound control buttons within the application. Ensure that these buttons are prominently placed and easy to use, allowing users to control audio playback and volume settings efficiently. Proper sound controls enhance the overall user experience by providing seamless interaction with the audio elements of the application.

7.4 Project Contribution

Numerous industries have employed augmented reality for a variety of objectives. Augmented reality technology has been used to interact more naturally with people, change a variety of objects, and engage them. The organisation in charge of the tourism industry benefits from this project. It can improve the efficacious promotion of an augmented reality application. The use of AR innovation has the potential to inspire people to become interested in Heritage Tourism. In order to get users interested in using the augmented reality application, this project made use of eye-catching graphics and 3D models in the interface design. Graphical elements and three-dimensional models work together to effectively deliver content to users.

7.5 Conclusion

In summary, augmented reality has been developed and implemented successfully for the user. The comparison of current systems and project requirements is in line with AR application in the literature review chapter. To guarantee the project is completed successfully, the storyboard and user interface design are meticulously sketched during the design stage. The fascinating scene that users can encounter in the real world is greatly enhanced by augmented reality. The application prepares to inspire everyone in spite of the obstacles that things encounter. It is possible to enhance this application to increase user compatibility.

In conclusion, The Heritage Tourism Augmented Reality application have provided an effective way of exploring AR applications and meets its requirements. The association ought to have the option to convey the substance successfully and the user ready to get the data given in the mission fascinatingly and intelligently. This AR application is necessary to help tourists explore and use it in learning Heritage Tourism AR application.

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APPENDIX A: QUESTIONNAIRE

PERSONALISATION OF POINT OF INTEREST (POI) IN AR APPLICATION FOR TOURISM

Dear Participant,

Thank you for taking the time to complete this questionnaire. My name is Krishnaraj A/L Balakrishnan, and I am currently working on my final year project at Universiti Teknikal Malaysia Melaka. My project focuses on the personalisation of Points of Interest (POI) in an Augmented Reality (AR) application for tourism in Melaka, a city recognized as a World Heritage Site.

The objective of this study is to design and develop an AR-based mobile application that enhances the tourist experience by providing personalized information about various POIs. This application aims to increase the satisfaction level of heritage tourism by offering tailored data based on user preferences, historical data, and real-time interactions.

Your responses to this questionnaire will provide valuable insights into user preferences and behaviors, which will be instrumental in the development of the application. The data collected will be used solely for academic purposes and will remain confidential.

* Indicates required question

Consent Section

I consent to participate in the project above, I have been provided a copy of the project information statement and this consent form, and any questions I have asked to have been answered to my satisfaction.

I agree to be interviewed by research. *

- Yes
- No

I agree to make myself available for further information if required *

- Yes
- No

I agree to let the observation be conducted in the ubiquitous places. *

- Yes
- No

I give my permission for the named research(s) to access the analysis organization as requested *

- Yes
- No

I give my permission to the organization to be named for any publication arising from the research. *

- ○ Yes
- ○ No

In permitting access to or use of organization records, the following / attached condition(s) apply.

I acknowledge that:

a) The data itself is for research with an aim of producing publishable/peer-reviewed outcomes and not for direct profit.

b) The participation is voluntary, and I am free to withdraw from the project at any time without explanation.

c) The anonymity is preserved, and I will not be identified in publication or otherwise without express written consent.

Section 2 of 4

General Information

Description (optional)

Name *

Short answer text

Gender *

- Male
- Female

Age *

- 18 - 24 years old
- 25 - 29 years old
- 30 - 34 years old
- 35 - 39 years old
- 40 years and above

Nationality *

- Malaysian
- Other...

Smartphone usage period *

- Less than 6 months
- 6 months - less than 1 year
- 1 year - less than 2 years
- Over 2 years

Section 3 of 4

User Testing

This section contains various questions about your experience with the AR application. Please rate and answer the questions based on your experience.

Your feedback is valuable and will help us assess the effectiveness and user satisfaction of the marker-based AR application for tourism. Please tick (/) for following statement based on your level of agreement.

The rating is from 1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree and 5 = Strongly Agree.

Image title

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

AR Content Quality

Description (optional)

The Marker-based AR application provides relevant information of traditional tales. *

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

The Marker-based AR application provides easy to understand information of traditional tales.

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

The information of traditional tales from the marker-based AR application is clear.

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

AR System Quality

Description (optional)

The Marker-based AR application is easy to use. *

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

The Marker-based AR application is convenient to see. *

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

The Marker-based AR application has visually appealing materials. *

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

The Marker-based AR application allows access to relevant information. *

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

AR Satisfaction

Description (optional)

I am satisfied with using the marker-based AR application. *

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

I am satisfied with using the marker-based AR application functions. *

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

I am satisfied with the contents of the marker-based AR application. *

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

Overall, I am satisfied with the marker-based AR application. *

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

Intention to Recommend

Description (optional)

I will recommend this marker-based AR application to my friends and relatives. *

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

When I return home, I will positively promote this marker-based AR application. *

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

I will strongly recommend others to use this marker-based AR application. *

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

Personal Innovativeness

Description (optional)

I like to experiment with new information technologies. *

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

If I heard about a new information technology, I would look for ways to experiment with it. *

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

Among my peers, I am usually the first to try out new information technologies. *

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

Recommendations

Description (optional)

What improvements would you suggest for this application?

Long answer text

Any drawbacks, additional comments or feedback on the application?

Long answer text

Suggestion from Students

Recommendations

What improvements would you suggest for this application?

35 responses

- Use clear visual cues and feedback to guide users through interactions.
- Use clear visual cues and feedback to guide users through interactions.
- Ok
- So far so good. Everything is satisfying.
- Need to improve in UI design
- Implement a feedback mechanism within the app to gather user insights and bug reports
- Nice app
- Do improvement in UI design
- Add more heritage places.

What improvements would you suggest for this application?

35 responses

- NEED TO INCREASE USAGE
- No
- THE AR APPLICATION IS SATISFY FOR ME
- MY OPINION IS NEED TO IMPROVISE THE APPLICATION LITTLE BIT MORE TO GET MORE USERS
- OK NO PROBLEM
- NEED TO IMPROVISE MORE
- I'M IMPRESS BY THIS APP.... VISCA BARCA VISCA CATALUNYA
- I LIKE IT AND VERY RECOMMENDED
- Organizational skill

Any drawbacks, additional comments or feedback on the application?

38 responses

Allow users to share their experiences and discoveries within the app

OK

ok

Limited compatibility with different devices and operating systems.

I encountered a bug in the application where the AR content sometimes fails to load properly

Best app for the tourism.

Users should be informed about what data is being collected and how it will be used.

The effectiveness of AR applications depends on the quality of the device's camera, GPS, and AR capabilities.

Implementing ways for users to provide feedback on the accuracy and relevance of personalized POIs can

Any drawbacks, additional comments or feedback on the application?

38 responses

capabilities.

Implementing ways for users to provide feedback on the accuracy and relevance of personalized POIs can help improve the app over time.

Allow users to adjust personalization settings according to their preferences to enhance their experience.

AR applications can be demanding on device batteries, which might be a concern for users on long days of sightseeing.

Cool application

Good.

Limited POI

very good ♡

APPENDIX B: TESTING PHASE

Testing in real-time and ubiquitous mode