

**AUGMENTED REALITY-GUIDED ONLINE SHOPPING MOBILE
APPLICATION**

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**A project report submitted in partial fulfilment of the
requirements for the award of Bachelor of Science
(Honours) Software Engineering**

**Lee Kong Chian Faculty of Engineering and Science
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September 2022

DECLARATION

I hereby declare that this project report is based on my original work except for citations and quotations which have been duly acknowledged. I also declare that it has not been previously and concurrently submitted for any other degree or award at UTAR or other institutions.

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APPROVAL FOR SUBMISSION

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ABSTRACT

People's behaviour improved with these intelligent technologies and covid-19 pandemic to get rid of old traditions that limit society and even human beings by restricted under the lockdown policy. Meanwhile, the biggest drawback facing is the ability to touch, feel and try products, and the fact that the products consumers receive often do not match the description as it generally adopting text and pictures approach. Thus, a more detailed and realistic visualization of the product is lacking in existing mobile commerce applications. Those description might be a great test of human comprehension as varying individual comprehension and intelligibility on different product. Therefore, this project is implementing Augmented Reality function to help consumers, and it was proven to increase sales conversions. There is a web application for administrators to manage and a mobile application for consumers. The requirements of the application be analysed through literature review and existing applications with user needs and usage intent. The adopted methodology in this project is Prototyping-based Methodology. The augmented reality function implemented by ViroReact visualize GL Transmission Format Binary file(GLB) models about a physical object in the real world and there is 10 specific product models were proposed, all of which were built by blender. This project uses a three-tier architecture, application, server, and database. Firebase is the database and node.js is used for server-side scripting. The results show that the augmented reality features are helpful for the product description, but more features are recommended to enrich the mobile application.

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CHAPTER 1

INTRODUCTION

1.1 General Introduction

The internet has brought us great convenience in this age of information technology advancements. With the help of the penetrations of smartphones and computers. Many companies have gradually started to step into the world of electronic business in the past few years. In the simulation of new development technique and Covid-19 pandemic, worldwide retail e-commerce sales are increasing year after year by 1.3\$ trillion to 4.2 trillion from 2014 to 2020 and will continue growth to 6.5 \$trillion in 2023 (Chevalier, 2021). In the meantime, consumer-facing the benefit and drawbacks brought by smart technologies. Some consumer will encounter product is not what they are expecting, or unable to estimate the real size especially for the large product since they are out of sight and mind.

To help the consumer to address this problem, the Augmented Reality(AR) technique is proposed. This project will develop a mobile application by embedded AR. AR allows partial stacking of virtual objects over the real world captured by a camera. It can detect the location of physical objects and then find out where to allocate the virtual object (Storozhkova,2020). According to Perfectial, it estimates the usage of AR on retail will soar from 0.5\$ billion to 1.6\$ billion from 2020 to 2025. The main concern of this project is to give advantageous to the consumer who attempts to purchase large product such as furniture. It allows users to observe the real size and condition via their camera.

1.2 Problem Background

People's mind was able to get away from the old tradition that limits the social or even the human being improved with the help of these smart technology and covid-19 pandemic. In fact, the entire world has the vigorous growth of e-commerce in each country.

Simultaneously, most of the country's online retail sales leaped at least 35% from 2018 to 2020 (United Nations, 2021). Global development of e-commerce shares increased 10% at the peak of the pandemic. Besides that, Malaysian consumers have been highly adaptable to online shopping, with 80 percent of mobile users presently shopping online with their smartphone device (Aprameya, 2020). Remarkable figures imply that online purchasing became a mainstream shopping channel in this pandemic and will become a common method in the future. 56%, 62%, and 38% of mobile commerce were completed on mobile devices, mobile applications, and browsers, respectively.

Moreover, since online shopping not only brings advantage but also a drawback, there is 51% of respondents agree with the biggest disadvantage of online shopping is they are not able to touch, feel, and try a product (BrizFeel, 2021). And 64.2% of respondents agree with one of the reasons for returning is the product does not match the description (SaleCycle, 2020). This is a difficulty that merchants and consumers to be addressed.

1.3 Problem Statement

1.3.1 A more detailed and realistic visualization of the product is lacking in existing mobile commerce applications.

Although the current development of online shopping has taken a leap forward, the techniques of online product description are generally adopting the traditional text and pictures approach. Nowadays, there are many existing business applications that are well known. These include Lazada and Shopee for example. Most of these shopping apps specialize in mobile shopping and provide only 2D images of products to consumers. Consumers are also unable to view the true size and condition of the item with a physical appearance by their eyes and hands. Moreover, the photography technology and machinery used by merchants and each consumer have their own preference towards the

resolution of color on a different brand of the mobile phone might reduce the similarity between pictures to the real thing.

As a result, consumers are only able to view a 2D image of the product provided by the seller and the consumers may be unable to have a detailed understanding of the product. The reason for this is that consumers are not able to visualize the products they are intending on purchasing in a more detailed manner or in a realistic environment.

1.3.2 Varying individual comprehension and intelligibility on different product

The text and pictures are a great test of human comprehension because people have different interpretations for different vocabulary. Merchants are not natural communicators; They were restricted by their limited personal understanding and descriptive ability. Some of them are unable to embed and express the maximum amount of information and message about their products into words and pictures. In the same way, some consumers are unable and have limited imagination to restructure the product in their mind from the little information. This leads to merchants and consumers being confined to limited or even narrow information space.

1.4 Project Goal

This project is to implement a Augmented Reality function mobile application that user makes use of the AR feature in their smartphone.

This mobile application will allow user to experience virtually placing the product in their own place without visiting the physical store via their phone camera. The products are in 3D and scaled in the real size. It helps user to maximize their imagination and comprehensibility on their interested product. The mobile application will consist of ten furniture products to be experience.

The web application will be act as the backend management system for mobile application.

1.5 Project Objective

1. To analyze project requirements on user requirement and usage intention through literature review and currently available augmented reality-enabled furniture application function and other applications that would be beneficial to the project.
2. To design and develop a mobile shopping application on the Android platform which incorporates the Augmented Reality function.
3. To visualize ten GLB models of information about a physical object in the real world using virtual components through the mobile application.
4. To design and develop a web-based management application for the admin to manage the record and information where that needs to be published in the mobile application.

1.6 Proposed Solution

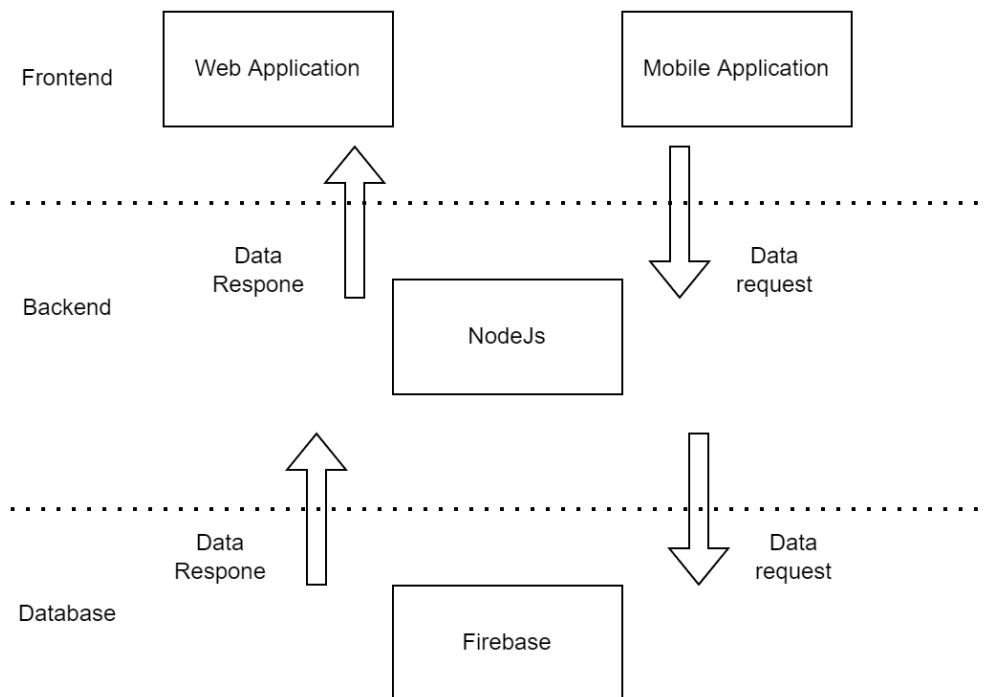


Figure 1.1: System Architecture

In this project, a mobile and web application will be developed. Both application will communicate to the identical database. Firebase is been chosen to be our project database. Firebase will be used to store the main component of each product's AR GLB model which is necessary to display at the client-side. Thus, followed by the product image and description. The information stored in

the firebase will be retrieved from to both application once the data is requested. The built-in camera will have to capture the topography for the placement of the object.

1.7 Proposed Approach

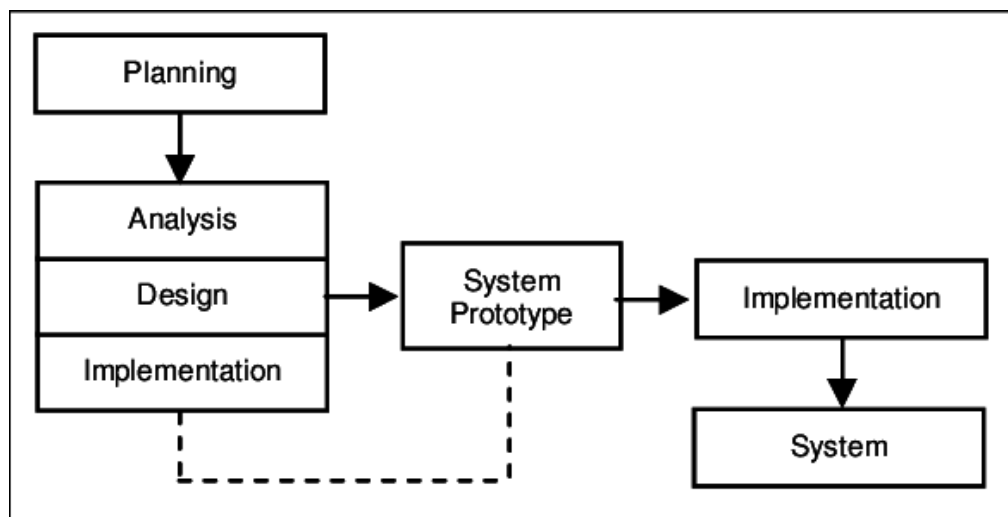


Figure 1.2: Prototype (Helmy and Wahab, 2007)

In this project, prototype approach will be adopted as a methodology to develop the augmented reality mobile application. Prototyping is emphasizing the analysis, design, and implementation will be performed concurrently. The first system prototype will be formed, this implies the basic and first part of the system. Therefore, it enables the developer to interact with the prototype after the first round of analysis, design, and implementation, and then to evaluate the prototype and further refine the requirements for the software to be developed. The process will continue to perform until the developer agrees that the prototype consists of adequate functionality to enter the final implementation (Dennis et al, 2015). By gradually adopting the prototype to meet the user requirements and allow to greatly satisfy the end user needs. Since this project is not involving UAT, the person evaluating the prototype is the developer.

Clearly, the prototyping approach can overcome the shortcomings of the waterfall model and significantly reduce the development risks associated with ambiguous software requirements. That is why prototyping such a refined version of waterfall model. The essential point of rapid prototyping is to build the system prototype as soon as possible and improve the built prototype once the additional user requirement is raised.

In nutshell, the flexibility of refining prototypes provides space for developers to modify the application. Even though developers found out mistakes or errors later, they still can recycle the whole steps from the analysis. Unlike waterfall which would waste a great deal of money and effort if necessary to go back to the previous stage.

1.8 Project Scope

1.8.1 Target User

This mobile application is not limited to specific users, it allows people who like to experiment with AR features, who want to tweak and redecorate their room and who are looking to purchase new furniture. However, this is catered for Android platform smartphones.

1.8.2 Features/modules

This is an application that addresses only the lack of information in existing product description pages and gives the user a quick and better image of overview for the actual furniture by utilizing the AR function. In addition to this, it also provides the actual physical dimensions so that the user can visualise the placement of the furniture.

1.8.2.1 Mobile Application

Augmented Reality(AR) appearance

The mobile application should provide augmented reality function for the product. The camera will be requested and detect the live captured real-world space, if it has enough space, the web application will allow the user experience placing virtual object on real world.

Search by keyword or categories

The mobile application should allow the user to search the furniture by the provided categories.

Product page

The mobile application should provide product page for each product. It should contain the product details with name, size, and description. Every product page

come with an AR appearance button, user can simply click on it to launch the AR function and the appeared virtual object will follow accordingly to the particular product.

Favourite list

The mobile application should provide favourite function to user to mark down their interested product and listed in favourite list. This function will provide convenience to user when they want to browser a particular favourite product.

1.8.2.2 Web Application

Login

The web application should provide user – admin to login into the application to perform manage action.

Manage item

Although this application only displays products. But these products are grouped by categories and collections, the application is required to display in category and collection, thus admins need to be responsible for these things. Admin able to create new product, modify product attributes, delete product, create new category, modify category attributes, delete category, create new collection, modify collection attributes, and delete collection, Besides that, since this is an internal application, there will not be any register page, so all operations will be done through the administrator, except for modifying/resetting the password. These action including create new admin, modify admin name, and delete admin.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Science and technology are advancing at a breakneck speed, human's vision never stops in the space in front of the line of sight. Instead, we use advanced technologies to break the constraints of space and break people's cognition of visual display. In recent years, with the development of Augmented Reality (AR), brand-new display and experience methods have also emerged into our lives. Such an epoch-making technology naturally cannot escape the sharp eyes of businessmen. Let this space-breaking technology play its unique role, bring many fresh stimuli to the business operation model, and stimulate more possibilities.

Now, this kind of technology has matured year by year, and in recent years it has become more and more complete. In addition to enriching the game's playability, this technology is now being promoted to the digital home makeup and furniture industry for commercial purposes, making the house viewing experience more imaginative. In overseas, such as China, AR has already been incorporated into the business operation model. The most familiar ones include the AR system implanted by Tmall Group in shopping malls (CNET, 2012) and mobile apps. This successful operation example confirms the applicability of AR in the e-commerce industry. This technology undoubtedly improves customer satisfaction and provides a lot of convenience. However, AR technology has not yet been widely promoted in my country, and it can even be said to be quite general. There are very few examples that can be thought of at the moment. Although this is a shortcoming of the business circle in our country, it also proposes a direction for progress, that is, popularizing the application of AR technology in e-commerce.

Within augmented reality systems, visual markers are often used. Their objective is usually to identify real objects and calculate the position of the camera pose relative to the real object. For instance, ARToolKit uses square targets, the pattern inside the square is used to decide which model should be augmented, and the square is used to calculate the camera pose. ARTag,

MXRToolKit, and stbTracker are other examples of augmented reality libraries that use similar two-step techniques (Adithya et al., 2010).

Continuing from the above background, in this chapter, more about AR along with VR as a comparison was introduced to the choice for AR as main focus.

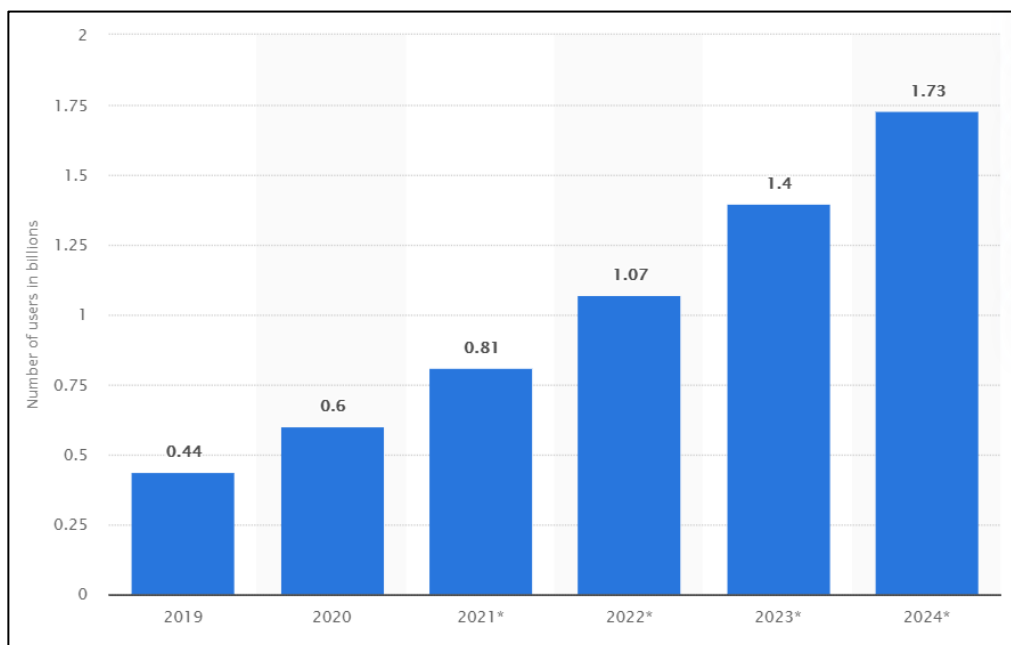


Figure 2.1: Number of mobile augmented reality (AR) active users worldwide from 2019 to 2024 (Global mobile augmented reality (AR) user devices 2024 | Statista, 2022)

2.2 Introduce and Compare between AR and VR

When talking about AR, then another concept is often mentioned along with it, and that is VR. These two technologies are often used for comparison, and laymen who are not familiar with these technologies often confuse the concepts of these two technologies. In this section will be introduce what these two technologies are and what are the differences between them.

2.2.1 Augmented Reality(AR)

The use of computer graphics and visualisation technology to develop virtual objects that do not “live” in the our world is referred to as augmented reality

(AR). Through the image of the camera, and "place" the virtual objects into the real world to increase the reality on the screen.

AR technology creates virtual objects and having them interact with the reality surrounding, presenting a new environment with richer perception effects to users. People will see the real world and virtual content coexisting on the screen at the same time. Through technological means, AR can be used to realise the "illusion" in reality. AR can share more details to the real object, strengthen three-dimensional sense, along with the visual effect and interactive experience. The use of augmented reality (AR) is becoming more widespread as the computing power of portable electronic devices improves. The use of AR is getting closer to our lives locally, and more developers use this technology to bring us convenience.

In terms of technical means and forms of presentation, AR can be explicitly classified into two groups (Edwards-Stewart et al., 2016).

1. Vision based AR, computer vision based AR;
2. LBS based AR, geographic location information based AR.

The technology used in this project is classified as the first type of AR, so I will only focus on explaining and analyzing this type of AR. Vision based AR is computer vision based. It employs computer vision methods create a correspondence between the actual world and the screen, allowing us to draw graphics or 3D models that appear on the screen, it is as if they were connected to real objects. Essentially, it is designed to find a subordinate plane in a real scene, Then mapping the surface under this 3D scene onto our 2D screen and subsequently display the drawn graphics on this plane that you wish to display.

In terms of technical implementation methods, it falls into two groups:

2.2.1.1 Marker-Based AR

The first type of AR is Marker-Based AR. This method of implementation necessitates the creation of a pre-define Marker, such as drawing a QR code or a template card with a specific specification and diagram, and then locate the marker in front of us, where corresponding to defining a plane in a real scene. The camera is then used to recognise and evaluate the Marker (Pose Estimation), as well as to determine its position. The coordinate system with the Marker's centre as the origin is then known as Marker

Coordinates, and it is the template coordinate system. We have to discover a transformation that maintains the mapping relationship between both the template coordinate system and the screen coordinate system, so that graphics drawn on the screen utilising this transformation can achieve the effect of graphics attached to the Marker. Understanding the principle necessitates a basic understanding of 3D projective geometry. To transform the template coordinate system to the real screen coordinate system, first rotate and translation is required to the camera coordinate system, and then map from the camera coordinate system to the screen coordinate system (Katiyar, Kalra and Garg, 2015).



Figure 2.2: Image of Marker-Based AR (Filali, s2019).

2.2.1.2 Marker-Less AR

The second type of AR is Marker-Less AR. The basic concept is about the same in Marker based AR, however, it can use any object with sufficient feature points, including the table, as a flat reference, eliminating the necessities of creating a special template in advance and attempting to remove the template constraints on AR applications. Its basic idea is to extract feature points from a template object using a series of algorithms and then record or learn these feature points. When the camera scan and detects the nearby scene, it extracts feature points from the scene and compares them to the template object's recorded feature points. If the number of scanned feature points and template feature points exceeds the threshold, the template is considered scanned.

In the augmented reality industry, there are three main profit models for software companies: B2B, B2B2C, and B2C. B2B is currently the primary profit model for AR software companies. With the advancement of smart mobile

terminal performance, the rapid development of mobile Internet, and the growing number of mobile Internet users, B2B2C and B2C based on mobile applications (APP) have emerged as important areas of exploration for AR software companies. AR mobile applications rely on location, social networking, life services, and product databases to connect data, scenes, and people, as well as to introduce new location navigation, advertising forms, game modes, and social methods (Katiyar, Kalra and Garg, 2015). The AR browser APP integrates multiple application contents to achieve a platform effect.

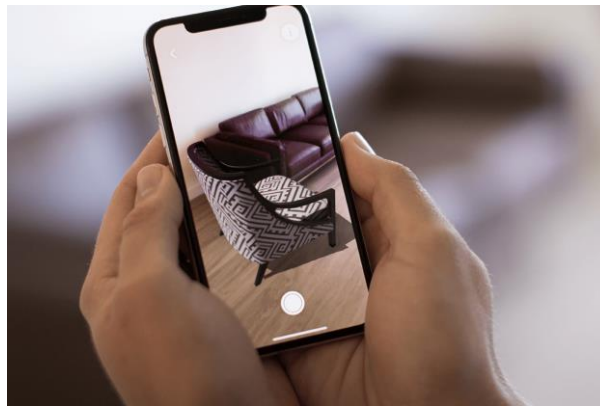


Figure 2.3: Image of Marker-Less AR (Schechter, 2014)

In short, Marker-Less AR is more convenient than Marker-Based AR because it does not require any pre-defined markers. Users can simply use their phones to perform functions without markers.

2.2.2 Virtual Reality (VR)

VR, also known as spiritual technology, has the characteristics of immersion, interaction and conception. It is a category of imaging technology that uses 3D interactive logic. The application time of virtual reality technology is relatively short, so the core structure is mainly composed of an environment simulation system, environment perception system and environment sensing system.

Virtual reality technology, as its name suggests, is to bring users into a preset virtual space, and realize visual image stimulation through virtual space experience, so as to achieve the purpose of 3D imaging technology application. In other words, it is to use computer simulation to generate a three-dimensional virtual world, which provides users with the simulation of vision, hearing, touch and other senses, so that users can observe the three-dimensional space in a timely and unlimited manner as if they were on the scene. Things, in this virtual

space, what users interact with are things in the virtual world. Although the application of modern virtual reality technology is generally relatively mature, it does not have an independent environment preset function. It is necessary to realize the control of the imaging content through the connection with the computer, and the computer becomes the virtual space design, so the virtual realization technology application mainly plays the actual role of visual transmission and visual information dissemination, so that the image information is changed from two-dimensional spatial structure to three-dimensional. The spatial structure transitions to form a complete image processing system to enable users to achieve the best image perception experience. In addition, users can communicate in real time through language, gestures, etc., to enhance the sense of entry and immersion. Through VR technology, people can feel the reality of the real world while breaking through the constraints of time and space, and feel the wonderful experience of entering the virtual world (Zheng, Chan and Gibson, 1998).

2.2.3 Comparison between AR and VR

AR and VR are technologies that are often confused. In this section, this section will talk about the difference between the two and why AR will be used in this project.

VR is essentially a more advanced media form, while AR is a powerful computing platform. VR enables users to get an immersive closure in a virtual world; AR helps bring virtual objects to the physical world of the user and empowers their awareness of the actual world by viewing, listening and touching virtual information. Looking solely at the proportion of virtual to real components, it is possible to briefly argue that VR presents a 100% virtual world that is closed; whereas AR is based on virtual objects or electronic information superimposed with a real environment, and bringing virtual objects to the user. In the physical world, the perception of the physical world can be enhanced by listening, seeing, and touching virtual information, so as to achieve an "enhanced" effect on reality. Through the comparison of the two, it is not difficult to find that in real life, AR will be more widely used. As a superposition of the real environment, the virtual environment that people need is implanted into the real scene, which is closer to people's life and work. .

VR has a relatively small user base, with sense of isolation, immersion and a poor mobility, hence it is mostly intended for entertainment. Entertainment revenue may account for two-thirds of the entire industry's revenue, and hardware accounts for about a quarter. Although VR will also have corporate uses, it is much less than AR and smart glasses. VR e-commerce and advertising revenue will grow, but the current size and dispersion of the user base limits its development. AR stands to be more accessible to more people than VR as it is a seemingly seamless addition to people's daily lives. AR is a computer-generated virtual world superimposed over the actual world. The use of AR as a tool has been proven to have a more profound impact on humans by various practical applications in medicine, education and industry. Unlike VR, which creates a completely virtual world outside the real world. At the meantime, the widespread and cost-effective adoption of mobile AR is contributing to the adoption of AR technology by enterprises, and enterprise AR can grow steadily (Caboni and Hagberg, 2019).

2.2.4 Comparison of Shopping Modes

2.2.4.1 Traditional Retail

The development of the traditional retail industry has gone through nearly a hundred years. Traditional shopping is the most primitive, the most direct, and our daily contact with the most. We need to go to the store to select and purchase the items we need. In this process, we can intuitively obtain product information, so that customers can develop a greater understanding of the product's texture, fabric, and details In order to determine whether the product meets its own needs and prices.

2.2.4.2 Online Retail

Online shopping is to "move" the store home directly, and use the convenience of get the products or services you need directly on the Internet. The overall transaction is through one-click shopping on the Internet or online trading platform. You can buy the products you like without leaving your home. There is no time limit, some of the things are good and cheap, there are more choices, and there are no geographical restrictions on the products. Especially in this epidemic of not being able to go out, the convenience of online shopping is more

prominent. But no matter how perfect things are, there are loopholes in them. Online shoppers can only see and imagine products through texts and images, and the senses are not strong. As if the purchased product deviates from or fails to meet the consumer's anticipations and expectations.

2.2.5 Risks That Influence Purchase Intentions

People's subjective judgments based on the characteristics and severity of a specific risk are important indicators for measuring public psychological panic. It is made up of a series of processes for comprehending external risk events that are triggered by human psychology, and it can eventually guide people's decision-making behaviour. Consumers may not be able to know for sure whether their expected results are correct for any purchase behavior. Therefore, the uncertainty of the results implicit in the consumer's purchase decision and the consumer's perception of risk are essential for determining their evaluation ability and purchasing behavior.

2.2.5.1 Perceived Risk

According to Lee and Tan (2003), consumers who perceive higher risks are less likely to purchase online products or services. It can be concluded that perceived risks have a negative impact on consumer intentions to make online purchases (Liu and Wei, 2003). As a result, it was confirmed that perceived risk has a negative impact on online purchase intentions (Shaizatun Aqma, 2018).

2.2.5.2 Product Risk

The customer's perception of the product will entirely depend on the information provided by the merchant. If businesses only provide text descriptions, it will be a huge challenge for customers. Because of product risks, online shoppers' intention and confidence in buying products online can easily be weakened. Consumers may perceive product risk if the price of the product is higher with limited information displayed on the website (SK Ariffin, 2018).

2.2.5.3 Time Risk

Time risk also includes circumstances where the product does not meet the consumer's expectations level and where the consumer has no choice to return

the product but to exchange it for a new one. In addition, there is a time-consuming process for the consumer to re-search, browse, purchase and wait for the product to arrive.

2.2.5.4 Psychological Risk

Psychological risk is related to the consumer's perception of the social risk caused by his/her misjudgment of online purchase intention, and refers to his/her perception of the reaction of others to his purchase behavior. Possible regrets and frustrations may cause consumers to experience psychological pressure in the future because their purchase decision did not achieve their goals. Uncertainty or pressure may be the cause of psychological risk and affect their purchasing decision. Risk of damage to customer's ego due to poor decision making, acknowledged as the possible loss of self-respect due to the frustration of not attaining a purchasing goal (Stone and Grønhaug, 1993).

2.2.6 Added Value of AR to Mitigate Risks

2.2.6.1 Value to Customer

AR helps consumers reshape the appearance, size, and size of products. AR increases the interaction between consumers and objects, giving an opportunity to touch products in an augmented way. This not only increases the authenticity of the product but also increases the consumer's purchase confidence. Indirectly lead to an increase in their desire to buy. At the same time, this application provides a deeper level of customer satisfaction for participating and thus changes their decision making. The shopping experience becomes more intuitive and sensitive when customer satisfaction is enhanced (Dacko, 2017).

2.2.6.2 Value to Retail

AR has the possibility for retailers to achieve several goals in their advertising and marketing strategies. Stimulate customers to come to their shopping space while increasing brand awareness and customer loyalty. AR has become an excellent channel to help promote the store and increase the number of customers. At the same time, it can increase speed for gaining information on consumer behavior, thereby improving service at the point of sale. Merchants no longer need to spend extra time and energy to do customer surveys and so

on. The application of AR satisfies the retailer's demand for efficiency improvement in order to compete with rival retailers and online industries. At the same time, as purchase intention increases, sales will naturally increase. As underlined by Scholz and Smith (2016), AR is important for retailers as a means of generating a memorable customer experience and creating consumer engagement (Bonetti et al., 2018).

2.2.6.3 Functionality

This factor refers to the functionality provided by the AR application (Egaji et al., 2019.). Users are no longer limited to a single function in a single application. They pursue a variety of different functions that can be gathered in the same application to improve convenience. Users can experience a fun-filled shopping experience with AR application programs and interactive experiences.

2.2.6.4 Usability

This factor refers to system availability from the user's point of view. The usability of an AR application is measured by the following variables: the ease of use of the application, the normal working of the application, the recommendation index to others etc (Egaji et al., 2019.). The higher consumers' perception of augmented reality technology in helping them obtain higher-quality information than traditional networks, the greater their chances of buying products. Ease of use and normal workability are also an important factor. Too difficult operation methods will result in users not being able to make good use of the program. A program that does not work properly can also cause users to lose interest and confidence in the program.

The results of data processing show that virtual presence will affect perceived enjoyment and usability. High-quality equipment can produce a higher perception of Enjoyment. In the study of Leonard (2019), Enjoyment cannot be a factor influencing purchases. Enjoyment cannot be a direct influence factor, but the feeling impulse generated in the enjoyment process is an indirect influence factor. In addition, it also depends on the type of consumers, whether they have hedonistic or utilitarian values. The former is easily affected by feeling the impulse to purchase goods, while the latter is not so easily affected. This is consistent with previous research that consumers feel a higher level of

enjoyment in virtual shops than in physical shops(Lee & Chung, 2008). The desire of consumers to pay for products is no longer because of the quality and characteristics of these products, but because of their experience using virtual reality applications (Li & Meshkova, 2013).

2.2.6.5 Hedonistic Values

The decisions of consumers with hedonistic values will be more influenced by their fun and play experience. And just the function provided by AR, the novelty will be this booster. Intuitively feel the impulse to connect with such consumers. When they are strongly impacted, they will increase the user's desire to buy and lead to impulsive consumption. Therefore, consumers who are more concerned about hedonic satisfaction will not pay for the functionality of the product.

2.2.6.6 Utilitarian Values

Consumers with utilitarian values are different from those with hedonistic values. Their biggest motivation for using augmented reality technology on e-commerce websites is to improve the quality of information they need when evaluating products.

2.2.7 AR and VR in E-commerce

Having the above-mentioned knowledge, considering the differences between AR and VR, the positive effects generated by AR are more appropriate for brick-and-mortar stores as through AR, consumers have the opportunity, for example, to test several products/clothes without physically trying them (Verhagen et al., 2014; Yim et al., 2017).

2.2.7.1 Market Valuation

From a technical perspective, AR and VR are inclusive and included, and belong to the category of computer graphics and image research. The application of AR is relatively simple to the public at this stage. With the improvement of the software level and the application of artificial intelligence, AR will be brought from the current "perception" to the next stage of "cognition". The essence of AR is to adapt to and retain reality. Because it adapts to reality, AR can truly face the ever-changing real world and is closely connected with various industry

scenarios. It is precisely because of the preservation of reality that it can achieve selective information enhancement, reduce the time cost and production cost of technology application, and achieve efficient recognition.

According to the analysis report "Global Mobile Augmented Reality Market 2016-2020" on the global mobile augmented reality market recently released by market analysis agency RnR Market Research, analysts predict that from 2016 to 2020, the global mobile augmented reality market will be a compound year. The growth rate is 89% (Eastern Standard Time, 2016). The report also pointed out that demand for augmented reality applications in the automotive, fashion, logistics, medical and retail industries will increase, and augmented reality technology will also help increase brand awareness and promote product sales.

2.2.7.2 User Experience

First of all, in terms of wearing comfort and convenience for users, taking Microsoft Hololens AR device as an example, it can be used completely independently, without cable connection, and no need to synchronize a computer or smartphone. In contrast, VR devices, such as HTC vive and Oculus Rift, have attracted the attention of most users, but when users experience it, it means that most VR headsets on the market are too heavy and require cables to be connected. The user's use space is limited, and the current VR devices on the market tend to be homogeneous in appearance.

In addition, it is reflected in the interactivity and fun. AR can satisfy the user's sense of experience, allowing users to truly feel the simulated affairs in the virtual world in the real world, which not only enhances the user's interest in use, but also guarantees the interaction between users and technology.

2.2.8 A Previous Method

A Paper Map Visualization solution is proposed. However, only its AR working principle is taken in here (Adithya, 2010).

The previous method

Initially, augmented reality was widely used in education and games, such as Storyboard. Nick. R. Hedley and Hirokazu Kato present a GIS visualization technique using augmented reality. They describe a combination of different interface techniques, such as camera-based and gesture-based, to create two hybrid interfaces for visualizing geospatial data. In our work, we use similar approaches such as marker-based tracking and interaction. At any time, the pop-up 3D stereoscopic visualization of the selected area of interest and the remaining paper map are simultaneously visible. This enhances the realism of the scene and is an effective representation of real world and virtual world information, which is critical for any AR application. This is very critical for any AR application. Captures live video of a paper map with physical markers. The live video image is converted into a binary image according to a preset illumination threshold. The obtained images are used to search for square areas. For each discovered square, the pattern inside it is matched with a pre-stored marker pattern template. If a match occurs, a marker is detected. In the next step, the position and the orientation of the physical marker with respect to the camera are calculated. The position of the physical marker and its orientation with respect to the camera are calculated.

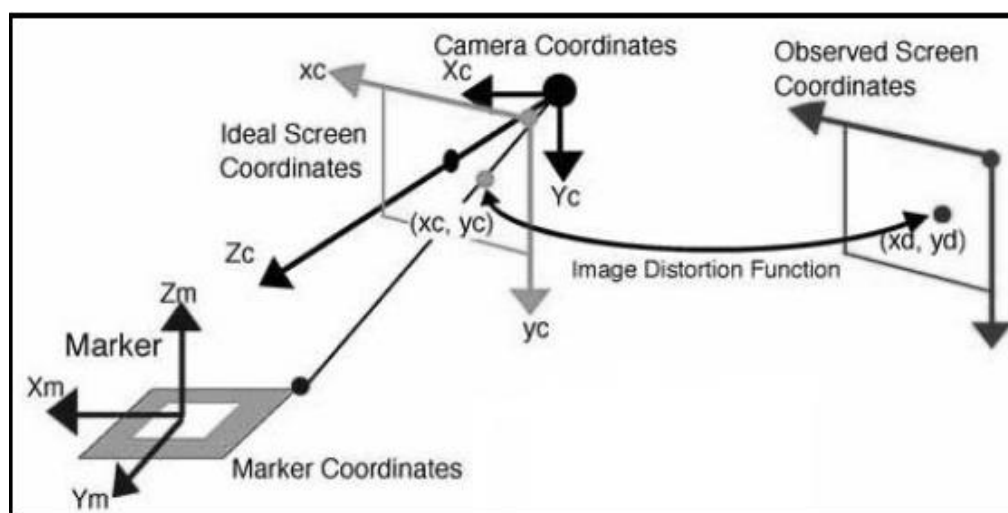


Figure 2.4: A previous method (Adithya, 2010)

The camera has a camera coordinate system, and there is a perspective relationship between the camera coordinates and the screen coordinates. A straight line in a 3D environment ideally, converted to screen coordinates should remain straight. In practice, however, this does not occur due to lens distortion. To compensate for these two screen coordinates, the ideal screen coordinates that maintain perspective transformation with the camera coordinates are introduced; and these ideal camera coordinates are passed to the observed coordinate system, the image coordinate system(Adithya, 2010)..

There are two transformation processes in the ARToolKit.

1. Marker coordinates to Camera coordinate system. (3D to 3D)
2. Camera coordinates to Image coordinate system. (3D to 2D)

2.2.9 Review on Similar Applications

2.2.9.1 IKEA Place

IKEA Place was launched in 2017. It is an ARKit technology-based AR app just launched by IKEA that allows you to experience IKEA products from anywhere. The augmented reality app lets you see 3,200 items from IKEA's inventory and can do so by putting a 3D version of them on your phone's live view. Users can simply swipe their phone's camera at a room and "place" the selected home in any corner of the room. On IKEA Place, users can quickly browse all of its products and see how these homes actually look in your home, or change the placement of the home at will, either closer or further away, to see the final effect from different angles.

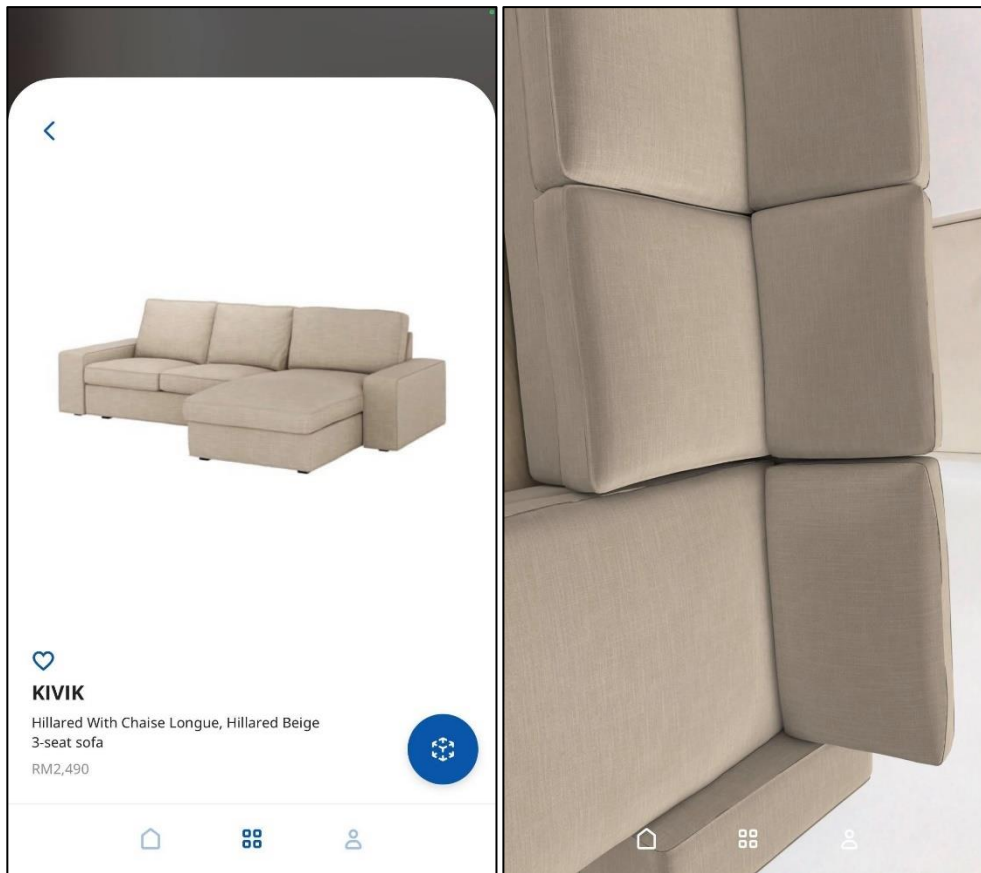


Figure 2.5: Application of IKEA Place

Strength

- Clear and nice interface
- Easy and user-friendly
- AR function enable to view the product from different perspective with 360°

Weakness

- Often crashes
- Very minimal items to browse
- No search function makes it hard to find particular furniture
- Not a ecommerce application
- Only enable on

2.2.9.2 Target

target is a retail department store group that is the second largest in the United States. It offers thousands of unique styles of merchandise for a fun, easy and convenient shopping experience. Clothing, mother and baby products, electronics, toys, stationery, sporting goods, pet supplies, kitchen appliances, furniture and home appliances, there are snacks and drinks, frozen foods, and a small amount of fresh vegetables and meat, and a beauty department and pharmacy are enough to meet everyone's daily needs. This is his shopping program with embedded AR function. Before this, it used the photo method to achieve the same concept as ar. Users must photograph their environment and then Using directional arrows and other controls, or by pinching and dragging the object across the phone's touchscreen, you can move, scale, and rotate the product in question(techcrunch, 2017). Nowadays, users no longer need to take photos but directly use the ar function on their phone. Although its ar function is limited to in the furniture section. Users can only use it in the furniture section.

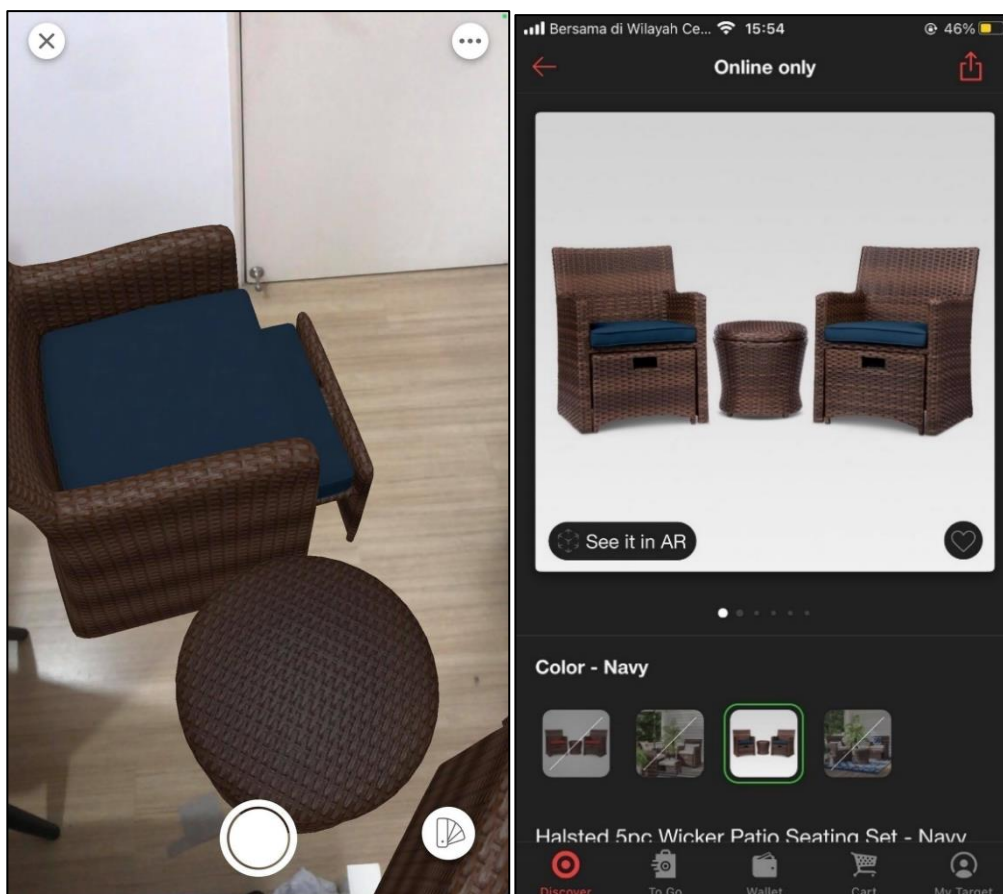


Figure 2.6: Application of Target

Strength

- Clear and nice interface
- Easy and user-friendly guidance on ar function
- Come with ecommerce function

Weakness

- Unable to accurately scan the surface and obstacles
- Often unable to present ar items
- Limited in furniture section

2.2.9.3 SayDuck

Sayduck is in the business of helping e-commerce companies integrate their products into 3D versions and visualize the corresponding virtual models through AR. Sayduck enables businesses to incorporate their digital product portfolios into 3D e-commerce and enables end users to deploy virtual 3D models in the real world by using augmented reality technology.

This is a application where allow their customer to try on the AR without any ecommerce function. Therefore, I will not consider weakness of this application

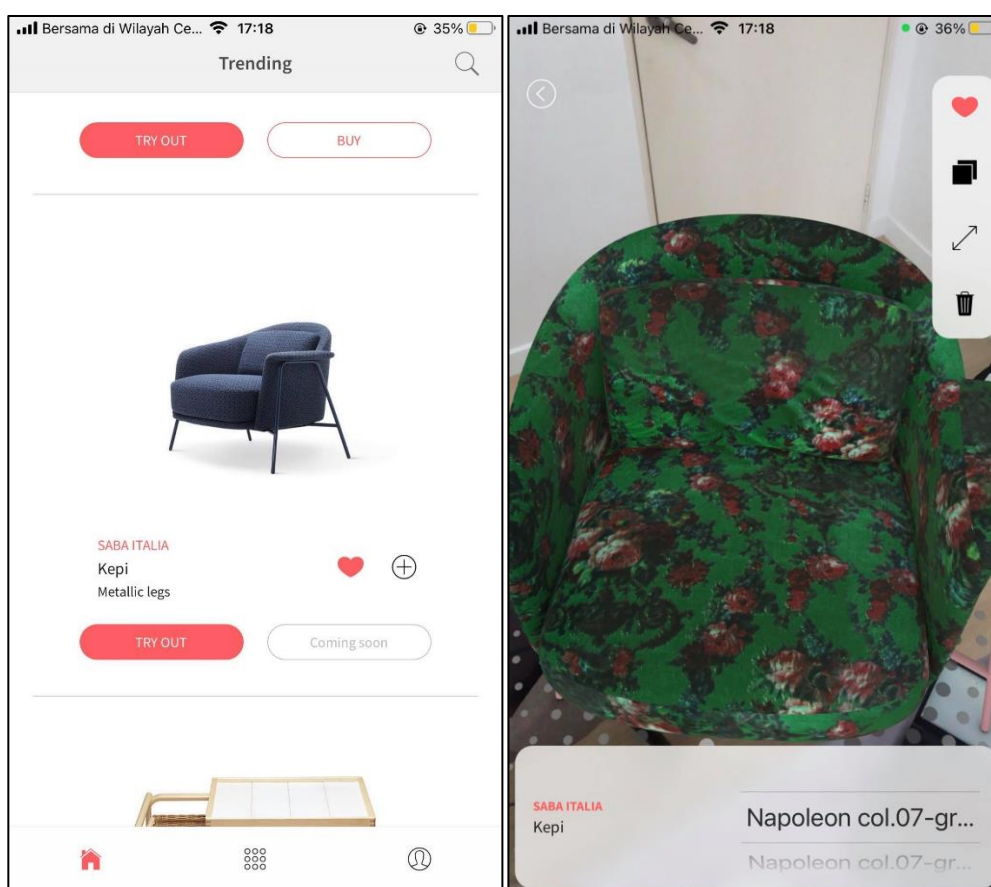


Figure 2.7: Application of SayDuck

Strength

- Clear and nice interface
- Easy and user-friendly guidance on ar function
- Clear 3D model with multiple colour
- AR function enable to view the product from different perspective with 360°

2.2.9.4 Comparison Among the Reviewed Simliar Application

	IKEA Place	Target	SayDuck
Register Account	✗	✓	✗
Login Account			
E-commerce Function	✗	✓	✗
Search Bar	✗	✓	✓
Search by Category	✓	✓	✓
Search by Collection	✓	✗	✗
Search by Brand	✗	✗	✓
View Product Details	✓	✓	✓
View Product in AR mode	✓	✓	✓
Wishlist/Favourite	✓	✓	✓
Customize collection	✗	✗	✓

Table 2.1: Comparison Among the Reviewed Simliar Application

*

Search by Collection : Search all product of the particular collection. Such as
Cristmas Collection.

Customize collection : User create own specific section in favourite list.

CHAPTER 3

METHODOLOGY AND WORK PLAN

3.1 Introduction

This chapter will go over the project's development methodology and work plan. The methodology used in this project is Prototyping-based Methodology. Moreover, this chapter describes each stage of the development methodology in detail. Development tools for developing this web and mobile application are determined and described. The work breakdown structure is defined in detail and the Gantt chart is also composed of a schedule.

3.2 Software Development Methodology

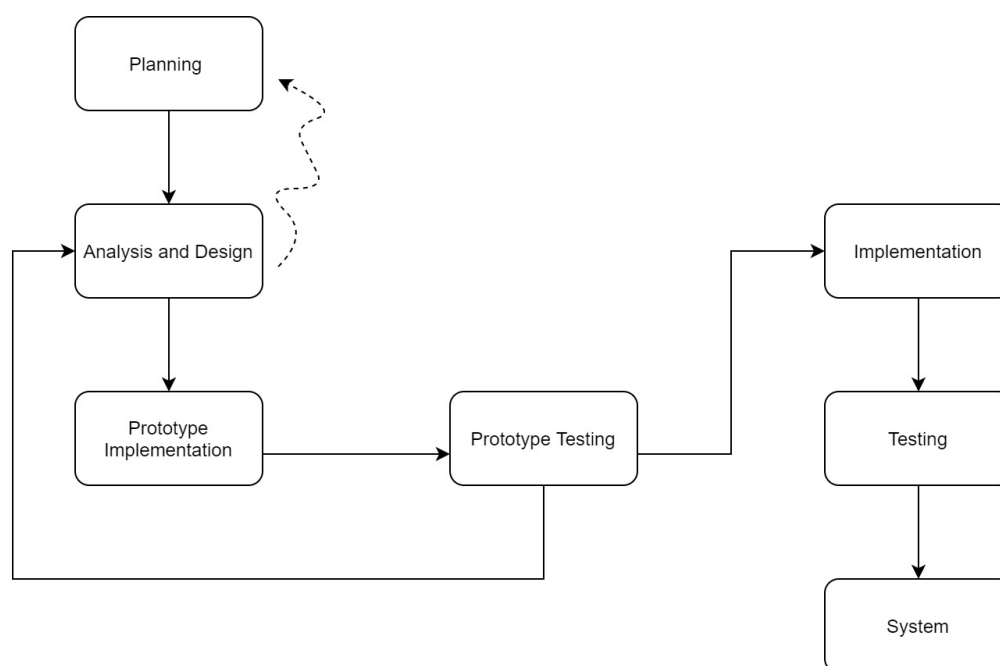


Figure 3.1: Prototyping-based Methodology

Figure above shows the prototyping-based methodology is adopted to develop the proposed project. This methodology consists of four major stages: planning, analysis and design, development, and testing. Each stage will begin immediately after the previous stage has been completed.

Those stage performed in this methodology is not exactly the same as the reference book. To avoid overwhelming testing at the end, I decide to have testing while developing.

In this methodology, a basics of analysis and design will be performed, and work immediately begins on a system prototype that provides a minimal amount of features (Dennis,2015). This approach allows user, project sponsor and relevant stakeholder to comment on the prototype. Therefore, the prototype will be reanalyse and redesigned, reimplement and retesting to implement a second prototype where posses more features and higher satisfaction. These stage will be repeated in a cycle until the system prototype is achieved sufficient satisfaction. The most significant features will be implemented in earlier prototype because they are the core of the system. Moreover, main features can be ensured to perform in the final system as it consists longer development duration.

3.2.1.1 Planning

Planning is the starting point of every methodology to ensure that the subsequent stage can proceed more smoothly. In this phase, the initial proposal such as project goal, project statement and objective will be determined. Planning helps to clarify and create plans for time, cost, resource, quality, risk, issues managing. This project's planning phase identified the issues that consumers run across when shopping online. To support the issues, numerous articles and journal were consulted to learn more about the impact of augmented reality technology on users, such as purchase intentions.

After the problem statement is determined, the objectives of this project were determined. The project's development was guided by the identified objectives, which also ensured that it proceeded as planned. This ultimately contributed to the success of the project.

For reference more the user requirement, review similar application and relevant application is the way to gather the requirement is prior to the development. In total, 3 mobile application were reviewed and compared. All the application were developed by foreign companies. A list of common properties was generated by contrasting these comparable systems. Which is

Search by Category, View Product Details, View Product in AR mode and Whishlist/Favourite. During the reference process, strengths and weakness of the particular project will be further analyzed and recorded. By analysis, what should the system provide will be determine. The emphasis in this project is on AR mode; therefore, even if the project's title refers to an online shopping platform, the shopping function will be neglected.

Lastly, a detailed work breakdown was conducted. All of the tasks and subtasks that must be completed were listed in the work breakdown. With this, a WBS will be offered, to ensure that all subtasks are clearly stated. A Gantt Chart for the full development cycle was then created using the project schedule by WBS. The timeframe and all required tasks are shown in the Gantt chart. Each task has an expected delivery date in the Gantt chart as well as beginning and ending times. It offers a development roadmap together with the WBS and Gantt chart. It offers development advice to guarantee that the project can be completed within the limitations of cost, time, and scope.

3.2.1.2 Analysis and Design

Therefore, the second stage is analysis and design. Develop analysis strategy, design architecture and prototype interface and so on were processed in this stage. At the beginning, web and mobile functional requirement and non-functional requirement will be finalize. An analysis was done in accordance with the project's scope and functional requirement, and corresponding diagrams were created to support the system's implementation. Use case diagrams, and flow diagrams are created. Flow diagram including interface flow and functional flow. Use case descriptions were also created to provide specific information for each use case.

Meanwhile, after analysis is complete, designing will go on in succession. Prototypes were developed to decide the system's design in addition to that. Improvements can therefore be made while the system is being implemented. Prototypes are wireframed during this stage for both mobile and online applications. The wireframe depicts how users interact with a page's information and features as well as how those features are displayed. These prototypes include intricate interface and user experience designs.

3.2.1.3 Implementation

The system's implementation began at this period and was split into two parts. At the Phase 1, the UI will be set to look like and some basic functions that are not very changed. Only then in Phase 2, the rest of the functions continue to be implemented. Throughout each phase, different applications have different features, so it all focuses on different features, each of which contains some tests. Testing is performed to make sure the current implementation won't be broken by future implementation improvements.

Phase 1

Prior to actually starting coding, the all of the appropriate tools for development will be determine and installed. Following this, the connection between the database and server will be configured and monitored to confirm that the connection is successfully created. The only database used in this project is Firebase. The web and mobile application will share the same db. In this phase, mobile and web application will be develop. It was necessary to set up the application first because it was a new project, which included connecting the database.

Approximately 70% of the mobile application functionality will be completed during this phase. Since the mobile application does not need to have a create, update, delete action. Not only that both application ui will be finalized. Because ui is the beginning of everything. It becomes difficult to modify when many component are added later, it is very important to get it right at the beginning. But it's also convenient for phase 2 to add functional buttons, especially since the ui will become crowded if no space is reserved.

In short, at the beginning of phase 1 in the task concentrates on the configuration of the system setup, connections and read action. By setting up the server and database connections before the development of the application the reason for this is to be sure that the developers can successfully operate it. Furthermore, most functions of the system require a database to execute CRUD functions. Having to configure the server and database in the middle of production may lead to complications and cause delays to the project.

Phase 2

In the same way as Phase 1, Phase 2 is structured into several sub-development based on the uncompleted functionality. In the mobile application case is the view product in AR mode. Because it is necessary to have GLB model before implementing AR function, the GLB model requires to be built before. In the web application, the rest are unbuilt create, update, delete components. All CRUD functions in each page are the same.

3.2.1.4 Closing/System

The system's documentation was then finished, including the project proposal, the design for the system's implementation, and the actual system. To clarify the functionality of the system, a thorough explanation was supplied. Additionally, slides for a presentation explaining the project's full development process were created. This slide presentation covered the entire project, from project planning to project completion. Additionally, a poster was made to give a quick overview of the entire project.

3.3 Tool used for development

React Native

React Native is used as the mobile application development framework in this project. React Native is a JavaScript based, therefore developers can use JavaScript to create Android and iOS applications that operate and look similar to native applications. Code written in React Native can also be shared across platforms, which allows for efficient development on both iOS and Android.

React Js

Reactjs is used as the web application development framework in this project. Reactjs is also a JavaScript library that can be used to develop complex user interfaces at a much faster pace than any other framework. React's popularity has grown over time. As we look at the benefits of React JS, we will explore performance and user interfaces in more detail. ReactJS is an open source platform that is easy to choose and use, offering a large number of documentation options, tutorials, and training materials

FireBase

Firestore will be the only database used in this project. Both applications will be sharing the same database. Firebase is a real-time back-end database startup that enables developers to quickly create web-based and mobile applications. And also a Google service that provides a NoSQL database provide flexibility in storing data. The primary goal is to assist developers in building applications more efficiently. Designed for developers, it separates the back-end and deploys it in the cloud, providing numerous cross-platform excuses to significantly reduce development costs and shorten product development cycles.

Visual Studio Code

Visual Studio Code is a free, cross-platform source code editor. It includes syntax highlighting, code auto-completion, code refactoring, and the ability to view definitions, as well as command line tools and a Git version control system. Users can personalise the software by changing themes and keyboard shortcuts, or by installing extensions from the built-in extensions shop. It is used for coding without using heavy code editor.

Axure RP

Axure RP is a professional rapid prototyping tool that allows designers to quickly create wireframes, flowcharts, prototypes and specification documents for applications using requirements, design features and interfaces. The most basic work of Prototype Design is to combine annotations, a lot of instructions and flowcharts to draw WireFrame, to present product prototype completely and accurately to UI, UE, program engineers, marketers, and through communication meetings, repeatedly revise the Prototype until it is finally confirmed and put into execution. Moreover, Axure RP was used to create the application prototype interface for this project.

Blender

As this project needs to have a 3D object in the augmented reality projection process, and the software that can create 3D objects was Blender. Blender is a permanent open source and free 3D creation suite. It supports the entire 3D creation process: modeling, sculpting, skeleton assembly, animation, simulation,

real-time rendering, compositing and motion tracking, and can even be used as a full-featured tool for video editing and game creation. Not only that blender offers a wide range of file formats. In this case it can export GLB, which is the type of object file this project need.

ViroReact

The open-source ViroReact platform was created by Viro Media to create AR/VR applications using React Native. Behind the scenes, ARCore and ARKit are used by ViroReact. The augmented reality (AR) development platform for Android is called ARCore, while ARKit is used for iOS. The platform is made up of tailored React extensions for the creation of AR and VR applications.

To display the 3D object, Scenes is needed. In ViroReact, applications are made up of Scenes that are either represented by ViroScene or ViroARScene components. Scenes are the 3D equivalent of the Views found in most 2D application frameworks. They include all the UI controls, 3D objects, lighting, and other stuff that ViroReact renders in AR/VR. Besides, placing things on a plane is one way to place objects in the real world. To do this, ViroARPlane or ViroARPlaneSelector componenta are be utilise. When the system detects a plane, the Viro platform attempts to attach it to any declared ViroARPlane components and continually keeps the virtual plane anchored to the detected real-world plane. However, using the ViroARPlaneSelector component, developers may let their consumers choose the plane they want the developer to utilise. Planes appear as mobile move around the empty space. In our real world, both the table and floor plane were detected.

Positioning Objects in a Scene

Viro uses a right-handed coordinate system, where the direction of view is along the negative z-axis. The point of view can be modified by changing the Camera. By default, the camera is positioned at [0, 0, 0] and looks in the direction [0, 0, -1]. In frameworks with only 3DOF (3 degrees of freedom) support (like mobile VR), the camera stays at [0,0,0] until moved by the developer with the end user only able to control the rotation of the camera. On the other hand, 6DOF (6 degrees of freedom) supported frameworks allow the end-user to move about their world and move the camera in the Viro Scene in response (like in AR).

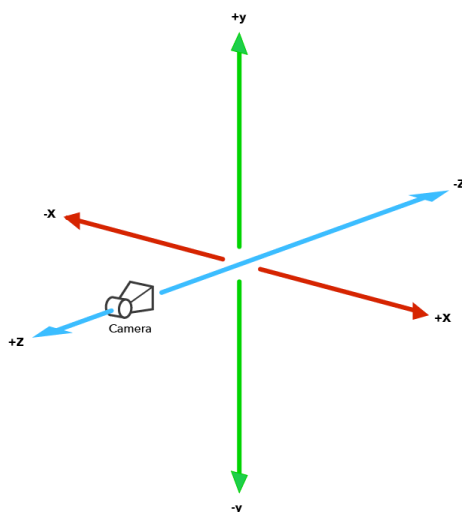


Figure 3.2: Position of Object

3D model file type

Originally it was intended to use .GLTF, but at the end .GLB was used. GLB file (. glb), is a standardized file format for “GL Transmission Format Binary file” in order to share 3D data. The difference is that the GLB format is a binary file format while the GLTF is based on JSON (JavaScript Object Notation). The GLB locates all of the elements of a 3D scene, including materials, node hierarchy and cameras in one single compressed file.

3.4 Work Plan

3.4.1.1 Work Breadown Structure

0.0 Final Year Project

1.0 Preliminary Planning

1.1 Investigate Project Title

1.2 Project title Background Analysis

1.3 Determine Problem Background

1.4 Determine Project Statement

1.5 Determine Project Goal

1.6 Determine Project Objective

1.7 Determine Propose Solution

1.7.1 System Architecture

1.7.2 Prototype-based Methodology

1.8 Determine Project Scope

- 1.8.1 Determine Target Users
- 1.8.2 Determine Features
- 1.9 Literature Review
 - 1.9.1 Introduce and Compare between AR and VR
 - 1.9.1.1 Study Augmented Reality(AR)
 - 1.9.1.1.1 Marker-Based AR
 - 1.9.1.1.2 Marker-Less AR
 - 1.9.1.2 Study Virtual Reality(VR)
 - 1.9.1.3 Compare AR and VR
 - 1.9.2 Review on shopping Modes
 - 1.9.2.1 Traditional Retail
 - 1.9.2.2 Online Retail
 - 1.9.3 Study on risk to influence purchase intention
 - 1.9.3.1 Perceived Risk
 - 1.9.3.2 Product Risk
 - 1.9.3.3 Time Risk
 - 1.9.3.4 Psychological Risk
 - 1.9.4 Value of AR to Mitigate Risks
 - 1.9.4.1 Value to Customer
 - 1.9.4.2 Value to Retail
 - 1.9.4.3 Various Value
 - 1.9.4.4 Market Value
- 1.10 Review Similar Systems
 - 1.10.1 Review on IKEA Place
 - 1.10.2 Review on Target Application
 - 1.10.3 Review on SayDuck
- 1.11 Finalize Literature Review
- 1.12 Requirement Gathering and elicitation by Literature and Similar System
 - 1.12.1 Select Functional Requirement/Features
 - 1.12.2 Draft Selected Functional Requirement
 - 1.12.3 Draft Non-functional Requirement
- 1.13 Project Scheduling
 - 1.13.1 Work Breakdown Structure(WBS)

1.13.1.1 Determine Activities

1.13.1.2 Break Heavy Weight Activities into Smaller
Task

1.13.2 Gantt Chart

1.13.2.1 Determine each Task Dependency

1.13.2.2 Estimate each of the Task Duration

1.13.2.3 Draft Gantt Chart

1.13.2.4 Examine Gantt Chart

1.13.2.5 Finalize Gantt Chart

2.0 Analysis and design

2.1 Finalize Web Functional Requirement

2.2 Finalize Mobile Functional Requirement

2.3 Finalize System Non-functional Requirement

2.4 Create Use Case Diagram

2.5 Determine Use Case Description

2.6 Create Flow Diagram

2.6.1 Create Interface Flow Diagram

2.6.1.1 Web Application

2.6.1.2 Mobile Application

2.6.2 Create Functional Flow Diagram

2.6.2.1 Web Application

2.6.2.2 Mobile Application

2.7 Create Prototype UI

2.7.1 Create Web Application WireFrame

2.7.2 Create Mobile Application WireFrame

3.0 Prototype Development

3.1 Phase before Prototyping

3.1.1 Initialting development tools

3.1.2 Determine library to be use

3.2 Phase 1

3.2.1 Analysis and Design

3.2.2 Create a repository for mobile application

3.2.3 Create a repository for web application

3.2.4 Setup FireStore database

- 3.2.5 Configure the connection between mobile application and Firebase
- 3.2.6 Configure the connection between web application and Firebase
- 3.2.7 Configure Firebase Authentication between web application and FireStore
- 3.2.8 Mobile Application Prototype Implement
 - 3.2.8.1 Create Main - Trending Screen UI
 - 3.2.8.1.1 Implement algorithm to display trending product
 - 3.2.8.2 Create Search Bar
 - 3.2.8.2.1 Create Search modal
 - 3.2.8.2.2 Implement algorithm to allow user to make search function
 - 3.2.8.3 Create Category Screen UI
 - 3.2.8.3.1 Implement algorithm to display product in group
 - 3.2.8.4 Create Product Screen UI
 - 3.2.8.4.1 Implement algorithm to display product information
 - 3.2.8.5 Create Favourite Screen UI
 - 3.2.8.5.1 Implement algorithm to display all favourited item
 - 3.2.8.5.2 Implement algorithm to allow user to unfavourite item from Favourite Screen
 - 3.2.8.5.3 Implement algorithm to allow user to favourite item from Product Screen
 - 3.2.8.5.4 Implement algorithm to allow user to unfavourite item from Product Screen
- 3.2.9 Web application prototype Implement
 - 3.2.9.1 Create Dashboard

- 3.2.9.2 Create Admin management page UI
 - 3.2.9.2.1 Create UI to display admin list
- 3.2.9.3 Create Product management page UI
 - 3.2.9.3.1 Create UI to display product list
 - 3.2.9.3.2 Create description modal
- 3.2.9.4 Create Category management page UI
 - 3.2.9.4.1 Create UI to display category list
 - 3.2.9.4.2 Create description modal
- 3.2.9.5 Create Collection management page UI
 - 3.2.9.5.1 Create UI to display collection list
 - 3.2.9.5.2 Create description modal
- 3.2.9.6 Create Login Page UI
- 3.2.9.7 Create Reset Password Page UI
- 3.2.10 Prototype Testing
 - 3.2.10.1 Test the connection between mobile application and Firebase
 - 3.2.10.2 Test the interaction in all screen in mobile application
 - 3.2.10.3 Test the display element in web application
- 3.3 Phase 2
 - 3.3.1 Fine-tuning improvement point on mobile application
 - 3.3.2 Design and implement GLB model
 - 3.3.3 Mobile Application Prototype Implement
 - 3.3.3.1 Product Screen
 - 3.3.3.1.1 Implement algorithm to display in AR mode
 - 3.3.4 Integrate GLB model into mobile application AR mode
 - 3.3.5 Web application prototype Implement
 - 3.3.5.1 Admin management page
 - 3.3.5.1.1 Create add admin modal
 - 3.3.5.1.2 Create modify admin modal
 - 3.3.5.1.3 Create delete admin modal

- 3.3.5.1.4 Implement an algorithm for add, modify and delete admin
- 3.3.5.2 Product management page
 - 3.3.5.2.1 Create add product modal
 - 3.3.5.2.2 Create modify product modal
 - 3.3.5.2.3 Create delete product modal
 - 3.3.5.2.4 Implement an algorithm for add, modify and delete product
- 3.3.5.3 Category management page
 - 3.3.5.3.1 Create add category modal
 - 3.3.5.3.2 Create modify category modal
 - 3.3.5.3.3 Create delete category modal
 - 3.3.5.3.4 Implement an algorithm for add, modify and delete category
- 3.3.5.4 Collection management page
 - 3.3.5.4.1 Create add collection modal
 - 3.3.5.4.2 Create modify collection modal
 - 3.3.5.4.3 Create delete collection modal
 - 3.3.5.4.4 Implement an algorithm for add, modify and delete collection
- 3.3.5.5 Login Page
 - 3.3.5.5.1 Implement an algorithm for admin login with Firebase Authentication
- 3.3.5.6 Reset Password Page
 - 3.3.5.6.1 Implement an algorithm for reset password with Firebase
- 3.3.5.7 Create export item list into excel in Admin, Product, Category, Collection page
- 3.3.6 Configure Firebase Function with web application and Firebase
- 3.3.7 Deploy connection
- 3.3.8 Prototype Testing
 - 3.3.8.1 Test the AR function

3.3.8.2 Test the Firebase Function between web application and Firebase

3.3.8.3 Test the admin login access with Firebase Authentication

3.3.8.4 Test all the add, modify, delete function of access in the Firebase

3.3.8.5 Test the export function in all page

4.0 System/Closing

4.1 Finalize the documentation of the project

4.2 Prepare Final Year Project Poster

4.3 Prepare Presentation Slides

3.5 Gantt Chart

Augmented Reality-Guided Online Shopping Mobile Application

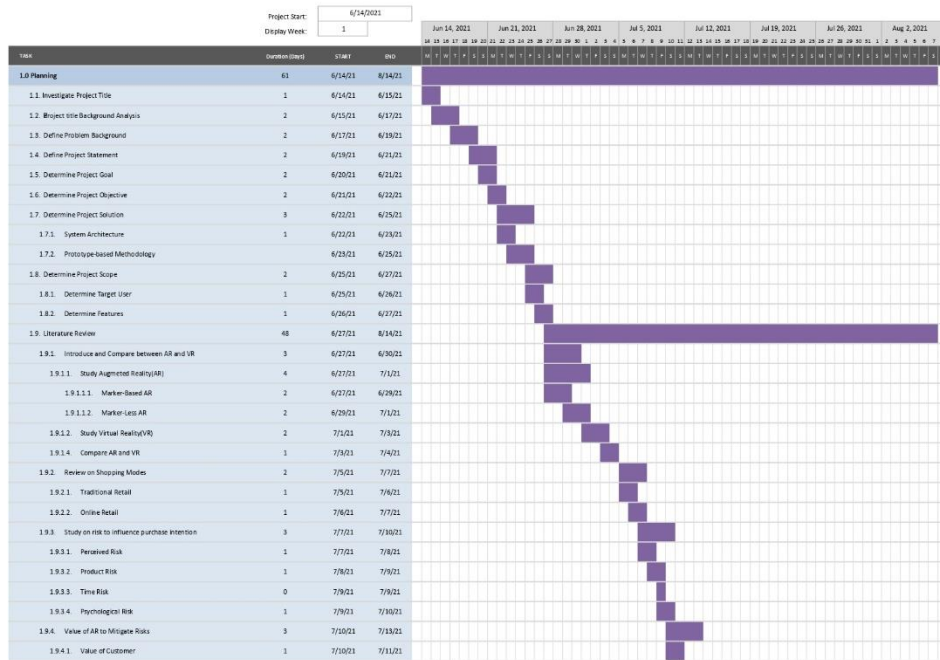


Figure 3.3: Gantt Chart Phase1-1

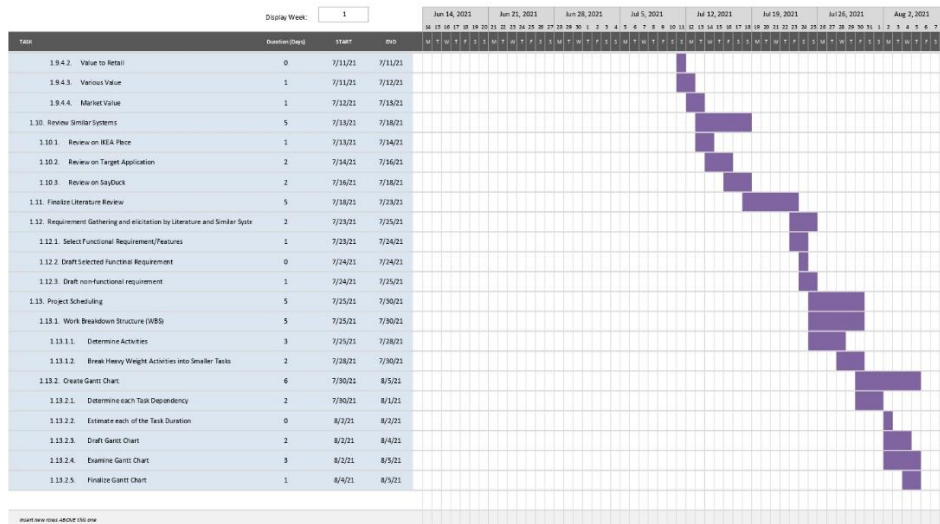


Figure 3.4: Gantt Chart Phase1-2

Augmented Reality-Guided Online Shopping Mobile Application

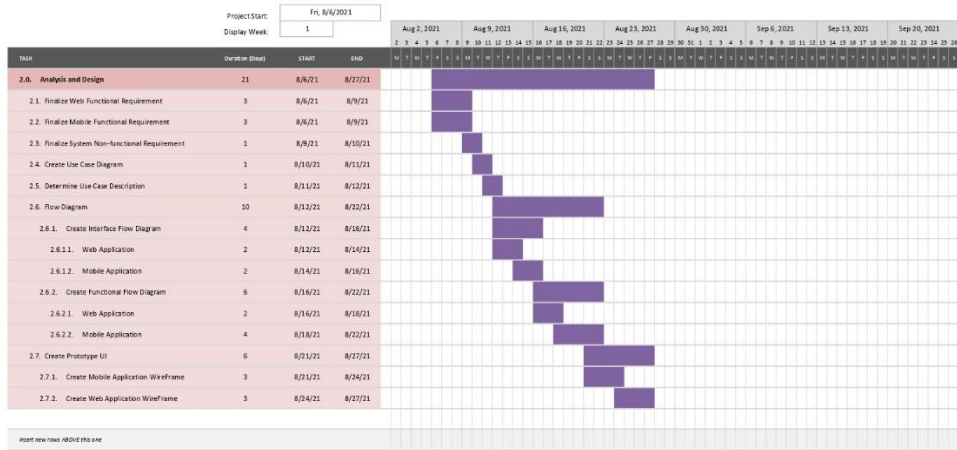


Figure 3.5: Gantt Chart Phase2

Augmented Reality-Guided Online Shopping Mobile Application

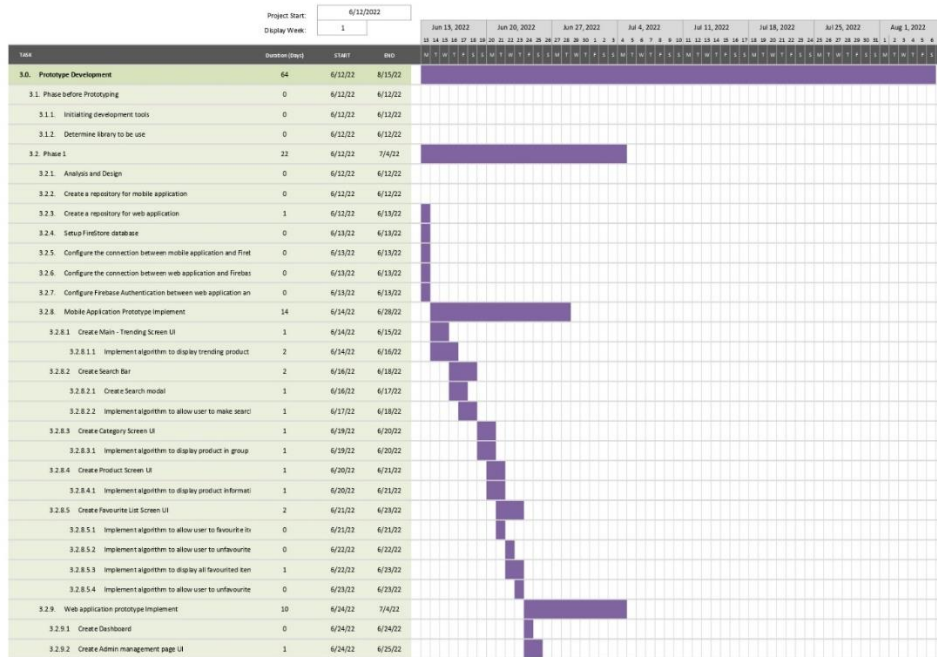


Figure 3.6: Gantt Chart Phase3-1

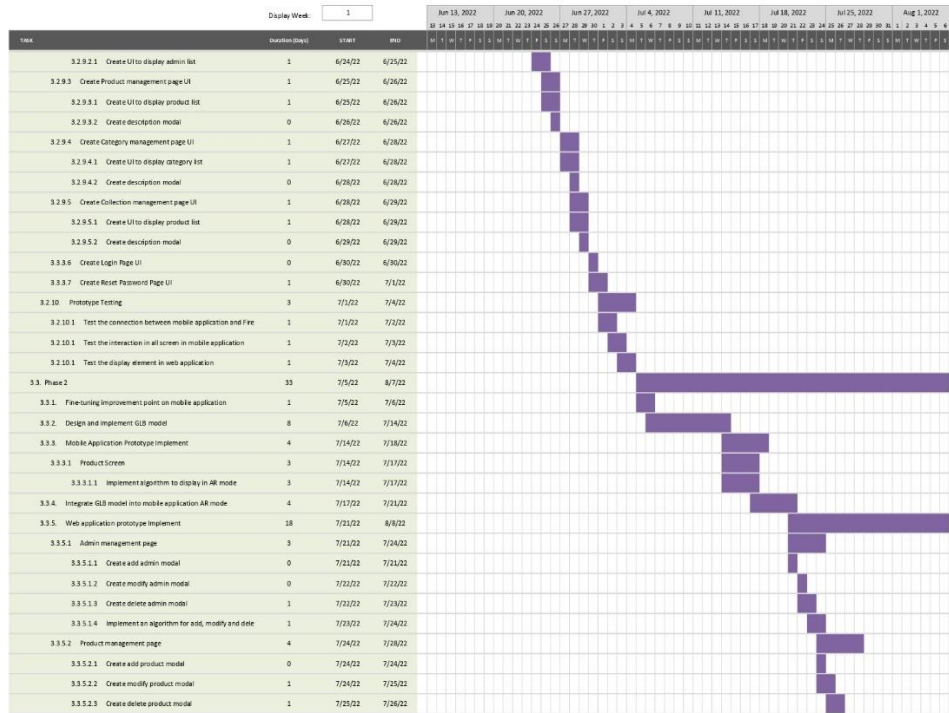


Figure 3.7: Gantt Chart Phase3-2

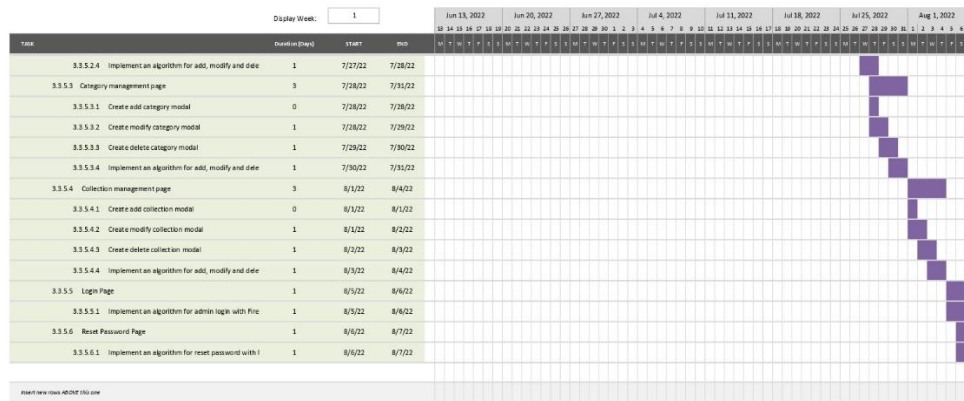


Figure 3.8: Gantt Chart Phase3-3

Augmented Reality-Guided Online Shopping Mobile Application

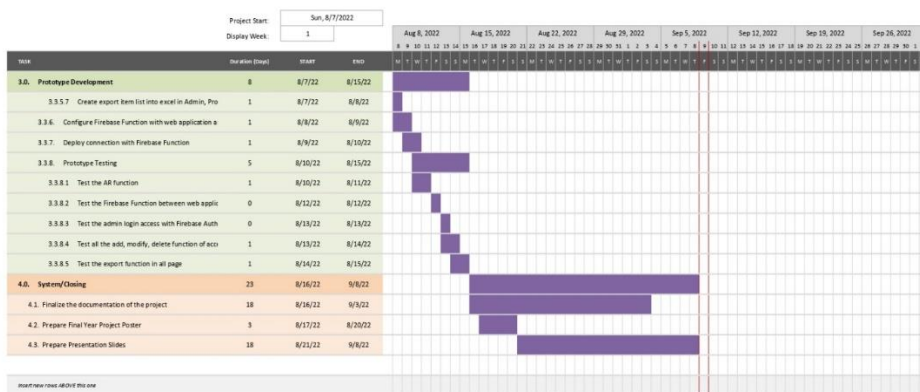


Figure 3.9: Gantt Chart Phase3-4 and Phase

3.6 Summary

This project will be developing a Augmented Reality Product System by using prototyping-based development methodology included planning stage, analysis and design stage, prototype development stage, implementation stage and testing stage as well as closing stafe. The entire project includes 108 subtasks, which is aimed to complete within 163 days. The estimated completion date is Tuesday, 8 September 2022.

CHAPTER 4

PROJECT SPECIFICATION

4.1 Introduction

In order to provide a better understanding of the overall system's functionality, this chapter discusses the requirements gathered, which were functional and non-functional requirements, and determines the project specification in detail with a use case diagram and use case description. Also, interface design and flowcharts are created to visualize the design of the system and function.

4.2 Project Requirement Specification

The project requirement specification was divided into two parts which are functional requirements and non-functional requirements. In functional requirements, this system will be divided into two groups, which represent the web application and mobile application respectively. Non-functional requirements are features that must be present in order for the system to function but are not components of the functional requirements. Availability, reliability, performance, and adaptability are all specified in the non-functional requirements of this system.

In addition, the end user of the mobile application is the customer, while the end user of the web application is the system admin. Mobile applications can be used without an account login, but web applications are not. Web applications are restricted to being used by admins only. To prevent data leakage or logins from unrelated people, all login accounts must be created by the highest priority admins. Therefore, there is no registration page available. Since the scope of different levels of admins is not specified in this project, all activities of the following admins will be done in the name of the highest priority admin.

4.2.1 Functional Requirement

4.2.1.1 Web application

1. The web application shall allow admin login.

Admins can only perform functions after they have been authenticated. Therefore, admins need to log in with a valid email and password.
2. The web application shall allow the admin to reset the account password.

If an admin has forgotten their account password, they can reset their account password by using the forgot password option at the bottom of login page.
3. The web application shall allow the admin to manage other admin accounts.
 - 3.1. Admin able to add new admin account with email, password, and name.
 - 3.2. Admin able to modify other admin's account name.
 - 3.3. Admin able to delete other accounts.
4. The web application shall allow the admin to manage the category list.
 - 4.1. Admin able to add new category with name and image.
 - 4.2. Admin able to view category's description after they added the new category.
 - 4.3. Admin able to modify category's name and image.
 - 4.4. Admin able to delete category.
5. The web application shall allow the admin to manage the collection list.
 - 5.1. Admin able to add new collection with name and image.
 - 5.2. Admin able to view collection's description after they added the new collection.
 - 5.3. Admin able to modify collection's name and image.
 - 5.4. Admin able to delete collection.
6. The web application shall allow the admin to manage the product list.
 - 6.1. Admin able to add new product.

In add new product modal, the admin needs to insert product attributes which include the product name, height, length, width, price, colour, category, collection, description, trending or new section, image, and GLB model needed in AR view.

- 6.2. Admin able to view product's description after they added the new product.
- 6.3. Admin able to modify product detail.
They can update any of the attributes of the product.
- 6.4. Admin able to delete product.
7. The web application shall allow the admin to export documents via excel. Admins are able to export admin list, category list, collection list and product list to an Excel document based on different pages.

4.2.1.2 Mobile application

1. The mobile application shall allow the customer to browse products in different variations.
As there are four pages, including three tabs and a search page that includes search results. Customers can browse their preferences through the options provided. Each part offers interrelated products. In addition, customers can view product descriptions on the product detail page by selecting a product from the product list in that section.
2. The mobile application shall allow the customer to search for product. Customers can search for their interested product by particular keyword, and category. Then, the system will display the search results.
3. The mobile application shall allow the customer to view the product in AR mode.
There will be an AR mode button on each product detail page. Customers can view the products they are interested in AR mode by clicking on the AR icon button provided.
4. The mobile application shall allow the customer to manage their favourite list.
 - 4.1. Customer able to add product to favourite list.
 - 4.2. Customer able to remove product from favourite list.

4.2.2 Non-Functional Requirement

1. Development Requirements
 - 1.1. The system should be built in with two platforms which is the Web and Android platform.
 - 1.2. Prototyping-based Methodology will be the methodology used in this system.
 - 1.3. The Firebase database is the only database of this system where web and mobile applications will share the same database and the same records.
2. Usability
 - 2.1. The interface of web and mobile applications should be user-friendly for all age groups in a way that is easy to intuit, operate and learn.
 - 2.2. The interface design of web and mobile applications should reduce the short-term memory load of users.
 - 2.3. When the user's input is invalid or incorrect, the system should apply an error message to alert the user's action.
3. Reliability
 - 3.1. When the delete operation is performed by an admin, the web application should prompt a confirmation message to ensure the user's action.
4. Performance
 - 4.1. Exception of downtime for system maintenance, the system must be operational 24 hours a day.
 - 4.2. Without an Internet connection, mobile applications should be available.
 - 4.3. Both web and mobile applications should display appropriate error messages by managing 99% of exceptions thrown during application runtime.
 - 4.4. The mobile application's response time to user input should be less than one second.

5. Adaptability

5.1. Mobile applications should be able to adapt to various resolutions.

6. Security Requirements

6.1. The web application should only allow authorized administrators to access the web application.

6.2. The system only allows requesting data from the backend if a Firebase configuration is provided.

6.3. Reset password link only provides a one-time password change, and if that change is successful, the link will expire immediately.

4.3 System User Case

System User Case will be demonstrating the important activities that can be performed by the system end users. There are 11 use cases in total. Each use case description of each use case includes the primary actor in the use case, the relationship to other use cases, the event flow, and the exceptional flow of the event.

4.3.1 Use Case Diagram



Figure 4.1: Use Case Diagram of Augmented Reality System

4.3.2 Use Case Description

4.3.2.1 Web application Use Case Description

Use Case Name: Login account	ID: 1	Importance Level: high
Primary Actor: Admin	Use Case Type: Detail, essential	
Stakeholders and Interests: Admin – Person who wants to login into the web application.		
Brief Description: This uses case describes steps to login into the web application.		
Trigger: An admin wants login into a web application to execute activities.		
Relationships: <ul style="list-style-type: none"> • Association: Admin • Include: - • Extend: Reset Account Password 		
Normal Flow of Events: <ol style="list-style-type: none"> 1. The admin enters the email and password. 2. The system validates the login information. 3. After successful login, the web application navigates to the dashboard. 		
Sub Flows of Events: <p><u>1.1 Admin forgets account password</u></p> <p>1.1.1. The admin clicks the “forgot password” option and the system navigates them to forgot password page.</p>		
Alternate/Exceptional Flows: <p><u>2.1 Empty text field</u></p> <p>2.1.1. The system displays an error alert to remind the admin to fill in the empty text field if the login is submitted with the empty text field.</p> <p><u>2.2 Invalid credential</u></p> <p>2.2.1. The system displays an error alert if the login credentials do not match. The admin is required to re-enter the login information.</p>		

Table 4.1: Use Case of Login Account

Use Case Name: Reset account password	ID: 2	Importance Level: high
Primary Actor: Admin	Use Case Type: Detail, essential	
Stakeholders and Interests: Admin – Person who wants to reset their account password.		
Brief Description: This use case describes steps to reset the account password.		
Trigger: An admin wants login into web application but forgets their login password.		
Relationships: <ul style="list-style-type: none"> • Association: Admin • Include: - • Extend: - 		
Normal Flow of Events: <ol style="list-style-type: none"> 1. The admin enters the email. 2. The system sends a password reset email to the admin's mailbox. 3. The admin selects on the provided reset link to the reset page. 4. The admin enters a new password. 5. The system prompt with a successful message once the reset process is complete. 		
Sub Flows of Events: -		
Alternate/Exceptional Flows: -		

Table 4.2: Use Case of Reset Account Password

Use Case Name: Manage other admin accounts	ID: 3	Importance Level: high
Primary Actor: Admin	Use Case Type: Detail, essential	
Stakeholders and Interests: Admin – Person who wants to add, modify, or delete other admin accounts.		
Brief Description: This use case describes steps required for the admin to view, add, modify, and delete other admin accounts		
Trigger: An admin wants to add a new admin account, modify the name of admin account, and delete an admin account		
Relationships: <ul style="list-style-type: none"> • Association: Admin • Include: - • Extend: Export Document 		
Normal Flow of Events: <ol style="list-style-type: none"> 1. The admin selects admin option from the sidebar. 2. The system displays all the existing admin accounts through the list of admin. 		
Sub Flows of Events: <p><u>2.1 Admin add a new admin</u></p> <ol style="list-style-type: none"> 2.1.1. The admin selects the “add new admin” button at the far right of the page title. 2.1.2. The admin inserts all the text fields and selects the “create” button. 2.1.3. The system prompts the creation success message to alert the admin when the creation process is complete. <p><u>2.2 Admin to modify an admin name</u></p> <ol style="list-style-type: none"> 2.2.1. The admin selects “edit” button on the action column of each admin row. 2.2.2. The admin checks the checkbox for the attribute to display the text field they need to modify. 		

<p>2.2.3. The admin inserts the modified data into the text field and selects “update” button.</p> <p>2.2.4. The system prompts the update success message to alert the admin when the update process is complete.</p> <p><u>2.3 Admin to delete an admin</u></p> <p>2.3.1. The admin selects dustbin icon button on the action column of each admin row.</p> <p>2.3.2. The admin selects “delete” button to confirm their action.</p> <p>2.3.3. The system will prompt the admin deletion success message to alert the admin when the delete process is complete.</p>
<p>Alternate/Exceptional Flows:</p> <p><u>2.1.2 Empty field while adding a new admin</u></p> <p>2.1.2.1. The system displays an alert message to remind the admin to fill in the empty text field if the attributes are submitted with the empty text field.</p> <p><u>2.2.3 Empty field while modifying a new admin</u></p> <p>2.2.3.1. The system displays an alert message to remind the admin to fill in the empty text field if the attributes are submitted with the empty text field.</p>

Table 4.3:Use Case of Manage other Admin Account

Use Case Name: Manage Category	ID: 4	Importance Level: high
Primary Actor: Admin	Use Case Type: Detail, essential	
Stakeholders and Interests: Admin – Person who wants to view, add, modify, or delete category.		
Brief Description: This use case describes steps required for the admin to view, add, modify and delete category.		
Trigger: An admin wants to add a new category, modify the name or image of the category or delete category.		
Relationships: <ul style="list-style-type: none"> • Association: Admin • Include: - • Extend: Export Document 		
Normal Flow of Events: <ol style="list-style-type: none"> 1. The admin selects category option from the sidebar. 2. The system displays all the categories by a category list. 3. The admin triggers category description modal by selecting the “description” button. 4. The system displays all the category attribute on the description modal. 		
Sub Flows of Events: <p><u>2.1 Admin to add a new category</u></p> <ol style="list-style-type: none"> 2.1.1. The admin selects the “add new category” button at the far right of the page title. 2.1.2. The admin inserts all the text fields and selects the “create” button. 2.1.3. The system prompts the category creation success message to alert the admin when the creation process is complete. <p><u>2.2 Admin to modify a category attribute</u></p> <ol style="list-style-type: none"> 2.2.1. The admin selects “edit” button on the action column of each category row. 		

<p>2.2.2. The admin checks the checkbox for the attribute to display the text field they need to modify.</p> <p>2.2.3. The admin inserts the modified data into the text field and selects “update” button.</p> <p>2.2.4. The system will prompt the category update success message to alert the admin when the update process is complete.</p> <p><u>2.3 Admin to delete a category</u></p> <p>2.3.1. The admin selects dustbin icon button on the action column of each category row.</p> <p>2.3.2. The admin selects “delete” button to confirm their action.</p> <p>2.3.3. The system will prompt the category deletion success message to alert the admin when the delete process is complete.</p>
<p>Alternate/Exceptional Flows:</p> <p><u>2.1.3 Empty field while adding a new category</u></p> <p>2.1.3.1. The system displays an error alert to remind the admin to fill in the empty text field if the add category attributes are submitted with the empty text field.</p> <p><u>2.2.3 Empty field while modifying a category</u></p> <p>2.2.3.1. The system displays a reminder message to remind the admin to fill out the empty field if the admin checks a certain checkbox with an empty field and submits it</p>

Table 4.4:Use Case of Manage Category

Use Case Name: Manage Collection	ID: 5	Importance Level: high
Primary Actor: Admin	Use Case Type: Detail, essential	
Stakeholders and Interests: Admin – Person who wants to view, add, modify, or delete collection.		
Brief Description: This use case describes steps required for the admin to view, add, modify and delete collection.		
Trigger: An admin wants to add a new collection, modify the name or image of the collection or delete collection.		
Relationships: <ul style="list-style-type: none"> • Association: Admin • Include: - • Extend: Export Document 		
Normal Flow of Events: <ol style="list-style-type: none"> 1. The admin selects collection option from the sidebar. 2. The system displays all the collections by a collection list. 3. The admin triggers collection description modal by selecting the description button. 4. The system displays all the collection attribute on the description modal. 		
Sub Flows of Events: <p><u>2.1 Admin to add a new collection</u></p> <ol style="list-style-type: none"> 2.1.1. The admin selects the “add new collection” button at the far right of the page title. 2.1.2. The admin inserts all the text fields and selects the “create” button. 2.1.3. The system prompts the collection creation success message to alert the admin when the creation process is complete. <p><u>2.2 Admin to modify a collection attribute</u></p>		

<p>2.2.1. The admin selects “edit” button on the action column of each collection row.</p> <p>2.2.2. The admin checks the checkbox for the attribute to display the text field they need to modify.</p> <p>2.2.3. The admin inserts the modified data into the text field and selects “update” button.</p> <p>2.2.4. The system will prompt the collection update success message to alert the admin when the update process is complete.</p> <p><u>2.3 Admin to delete a collection</u></p> <p>2.3.1. The admin selects dustbin icon button on the action column of each collection row.</p> <p>2.3.2. The admin selects “delete” button to confirm their action.</p> <p>2.3.3. The system will prompt the collection deletion success message to alert the admin when the delete process is complete.</p>
<p>Alternate/Exceptional Flows:</p> <p><u>2.1.3 Empty field while adding a new collection</u></p> <p>2.1.3.1. The system displays an error alert to remind the admin to fill in the empty text field if the add collection attributes are submitted with the empty text field.</p> <p><u>2.2.3 Empty field while adding a new collection</u></p> <p>2.2.3.1. The system displays a reminder message to remind the admin to fill out the empty field if the admin checks a certain checkbox with an empty field and submits it.</p>

Table 4.5:Use Case of Manage Collection

Use Case Name: Manage Product	ID: 6	Importance Level: high
Primary Actor: Admin	Use Case Type: Detail, essential	
Stakeholders and Interests: Admin – Person who wants to view, add, modify, or delete product.		
Brief Description: This use case describes steps required for the admin to view, add, modify and delete product.		
Trigger: An admin wants to add a new product, modify the attributes of the product or delete product.		
Relationships: <ul style="list-style-type: none"> • Association: Admin • Include: - • Extend: Export Document 		
Normal Flow of Events: <ol style="list-style-type: none"> 1. The admin selects product option from the sidebar. 2. The system displays all the products by a product list. 3. The admin triggers product description modal by selecting the “description” button. 4. The system displays all the product attribute on the description modal. 		
Sub Flows of Events: <p><u>2.1 Admin to add a new product</u></p> <ol style="list-style-type: none"> 2.1.1. The admin selects the “add new product” button on the far right of the page title. 2.1.2. The admin inserts all the text fields and selects “create” button. 2.1.3. The system prompts the product creation success message to alert the admin when the creation process is complete. <p><u>2.2 Admin to modify a product attribute</u></p> <ol style="list-style-type: none"> 2.2.1. The admin selects “edit” button on the action column of each product row. 		

<p>2.2.2. The admin checks the checkbox for the attribute to display the text field they need to modify.</p> <p>2.2.3. The admin inserts the modified data into the text field and selects “update” button.</p> <p>2.2.4. The system will prompt the product update success message to alert the admin when the update process is complete.</p> <p><u>2.3 Admin to delete a product</u></p> <p>2.3.1. The admin selects dustbin icon button on the action column of each product row.</p> <p>2.3.2. The admin selects “delete” button to confirm their action.</p> <p>2.3.3. The system will prompt the product deletion success message to alert the admin when the delete process is complete.</p>
<p>Alternate/Exceptional Flows:</p> <p><u>2.1.3 Empty field while adding a new product</u></p> <p>2.1.3.1. The system displays an error alert to remind the admin to fill in the empty text field if the add product attributes are submitted with the empty text field.</p> <p><u>2.2.3 Empty field while modifying a product</u></p> <p>2.2.3.1. The system displays a reminder message to remind the admin to fill out the empty field if the admin checks a certain checkbox with an empty field and submits it</p>

Table 4.6:Use Case of Manage Product

Use Case Name: Export document	ID: 7	Importance Level: high
Primary Actor: Admin	Use Case Type: Detail, essential	
Stakeholders and Interests: Admin – Person who want to export admin, category, collection, or product list.		
Brief Description: This uses cases describes steps to export excel document on different pages.		
Trigger: An admin wants to export an excel document with a different list.		
Relationships: <ul style="list-style-type: none"> • Association: Admin • Include: - • Extend: - 		
Normal Flow of Events: <ol style="list-style-type: none"> 1. The admin navigates to the page they want, either admin, category, collection, or product page by selecting an option on the sidebar. 2. The admin selects the “export” button to trigger the export excel file action beside of creation button. 		
Sub Flows of Events: -		
Alternate/Exceptional Flows: -		

Table 4.7: Use Case of Export Document

4.3.2.2 Mobile application Use Case Description

Name: Browse product	ID: 8	Importance Level: high
Primary Actor: Customer	Type: Detail, essential	
Stakeholders and Interests: Customers – Person who operates the mobile application and want to browse some products.		
Brief Description: This uses cases describes steps to browse on different pages.		
Trigger Situation: A customer wants to browse products.		
Relationships: <ul style="list-style-type: none"> • Association: Customers • Include: - • Extend: Search Product, View in AR mode 		
Normal Flow of Events: <ol style="list-style-type: none"> 1. The customer is directed to the first tab, the trending page. 2. The customer selects their preferred tab. 3. The customer selects a product. 4. The system navigates to the product details page and displays the product description. 		
Sub Flows of Events: -		
Alternate/Exceptional Flows: -		

Table 4.8: Use Case of Browse Product

Use Case Name: Search Product	ID: 9	Importance Level: high
Primary Actor: Customer	Use Case Type: Detail, essential	
Stakeholders and Interests: Customers – Person who want to search for a particular product.		
Brief Description: This uses case describes steps to search for product.		
Trigger: A customer wants to search for a particular product or series of products by a specific keyword.		
Relationships: <ul style="list-style-type: none"> • Association: Customers • Include: - • Extend: - 		
Normal Flow of Events: <ol style="list-style-type: none"> 1. The customer selects the search bar to expand the search modal on the top of trending page. 2. The customer clicks on the text field to focus. 3. The customer enters the product's name or any keyword. 4. The customer selects keyboard enter to search. 5. The system displays the search result. 		
Sub Flows of Events: -		
Alternate/Exceptional Flows: <u>5.1 No relevant product</u> <ol style="list-style-type: none"> 6.1.1. No matching items are searched, and the system displays “No result”. 		

Table 4.9: Use Case of Search Product

Use Case Name: View in AR mode	ID: 10	Importance Level: high
Primary Actor: Customer	Use Case Type: Detail, essential	
Stakeholders and Interests: Customers – Person who want to view the product in AR mode.		
Brief Description: This uses case describes steps to view the product in AR mode on product details page.		
Trigger: A customer wants to view the product in AR mode.		
Relationships: <ul style="list-style-type: none"> • Association: Customers • Include: - • Extend: - 		
Normal Flow of Events: <ol style="list-style-type: none"> 1. The customer selects the AR icon button. 2. The system activates the customer’s camera. 3. The customer move camera to detect plane. 4. The customer selects a plane. 5. The system displays the product model. 		
Sub Flows of Events: -		
Alternate/Exceptional Flows: <p><u>2.1 Camera permission is unable</u></p> <p>2.1.1. The device prompts for permission for this application to access the camera.</p> <p><u>2.2 AR Core permission is unable</u></p> <p>2.2.1. The device prompts for permission for this application to access the AR Core.</p>		

Table 4.10: Use Case of View in AR mode

Use Case Name: Manage favourite list	ID: 11	Importance Level: high
Primary Actor: Customer	Use Case Type: Detail, essential	
Stakeholders and Interests: Customers – Person who want to view, add product, or remove a product in favourite list.		
Brief Description: This uses case describes steps required for the user to view favourited list, favourite a new product, or unfavourite a product.		
Trigger: A customer wants to view, favourite a new product, or unfavourite a product.		
Relationships: <ul style="list-style-type: none"> • Association: Customers • Include: - • Extend: - 		
Normal Flow of Events: <ol style="list-style-type: none"> 1. The customer selected a product. 2. The customer triggers the favourite feature by clicking on the star icon located to the far right of the product name. 3. The system fills the star icon with red while the favourite function succeeds. 4. The customer clicks on the favourite tab, and the favourited products appear in the favourite list. 		
Sub Flows of Events: <p><u>2.1 Customer unfavourite product from product page</u></p> <ol style="list-style-type: none"> 2.1.1. The customer triggers unfavourite function by clicking the red star icon again. 2.1.2. The system transforms the red star icon back to outlined star icon while the unfavourite function is performed successfully. <p><u>4.1 Customer unfavourite product from favourite list</u></p> <ol style="list-style-type: none"> 4.1.1. The customer swiped left on the product. 4.1.2. The system will show a red remove button. 		

4.1.3. The customer clicks on the red remove button to trigger the unfavourite function.
<u>4.2 Customer navigate to the product page from favourite list</u>
5.2.1. The customer clicks on the product image or product name.
Alternate/Exceptional Flows: -

Table 4.11: Use Case of Manage Favourite List

4.4 Flow Chart

Likewise, this section will be divided into two parts which are web application and mobile application. It will begin with a brief introduction to the interface flow chart before moving on to the functional flow chart in each part.

4.4.1 Web Application

4.4.1.1 Interface Flow Chart

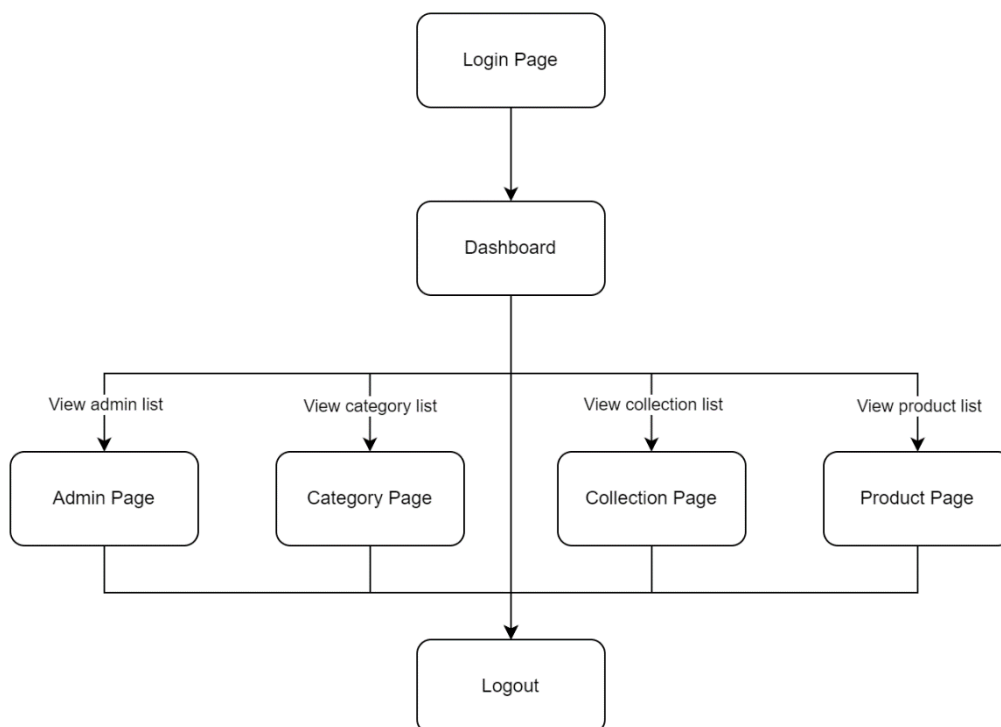


Figure 4.2: Interface flow chart of Web Application

After the user has successfully logged in, the system will redirect the user to the dashboard which is the first page. Then the user can go to Admin, Category, Collection, and Product Page with sidebar. On each page, there will be a logout button for the user to log out from the system anytime and anywhere.

4.4.1.2 Functional Flow Chart

Login and Reset Password

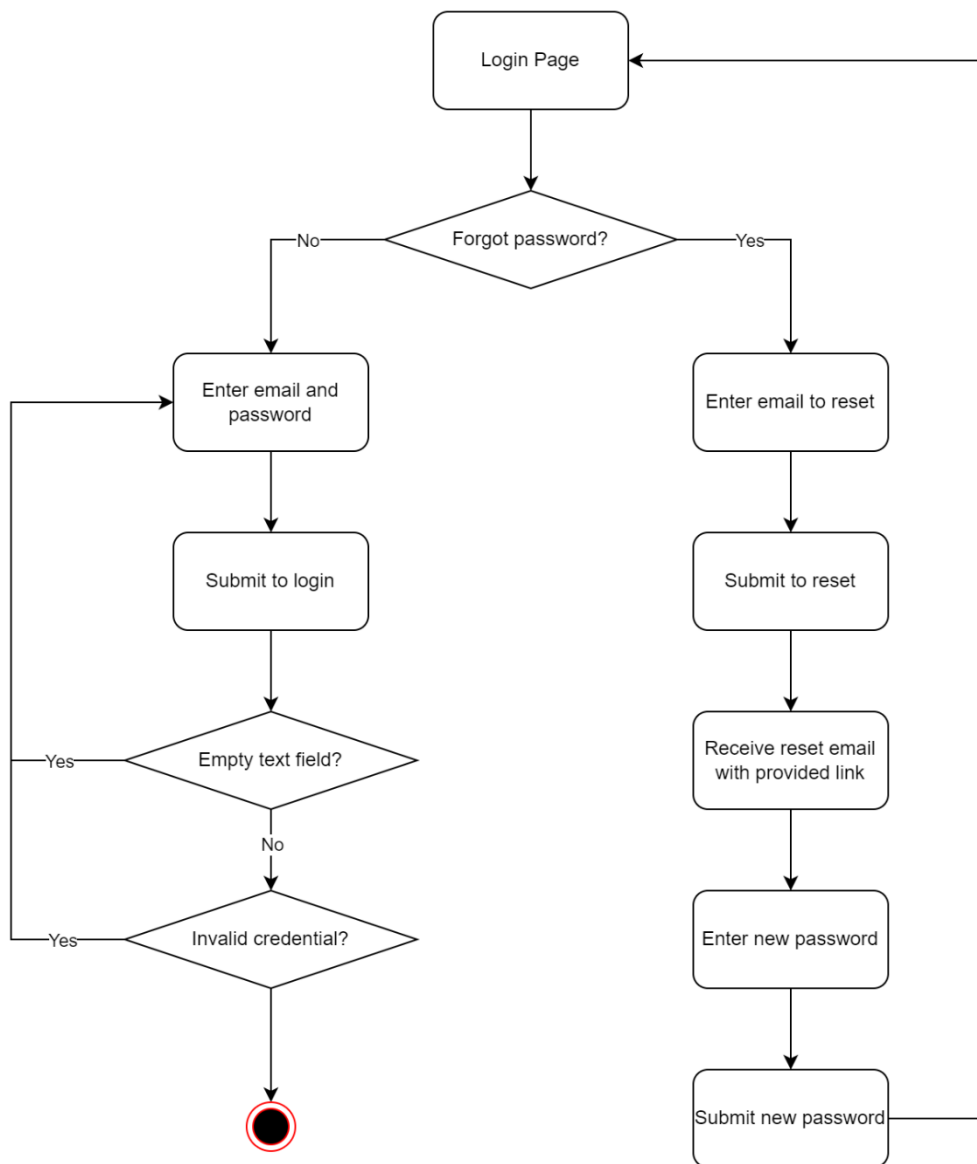


Figure 4.3: Log in and Reset Password flow chart

This is the process by which the customer attempts to log in to the web application. Admin has the option to reset their password by selecting the "forgot password" option. Once they have accessed the reset password page and

submitted their email. They will receive a reset email in their mailbox. The email includes a reset link through which the admin can reset their password. Once the action is successful, the admin will be redirected to log in again. Instead, the admin can simply log in with their account information where the system will be checking to see if they have entered empty fields or mismatched credentials.

Manage Admin

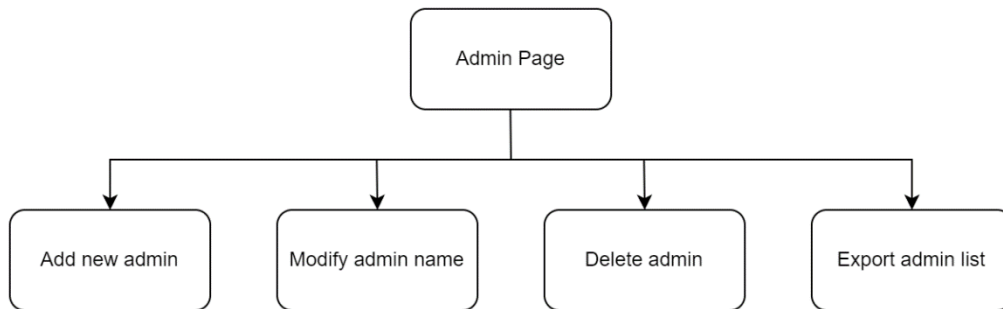


Figure 4.4: Function can be done in admin page

There are five functions can be executed on the admin page, which is add a new admin, modify admin name, delete an admin account, and export admin list.

Add New Admin

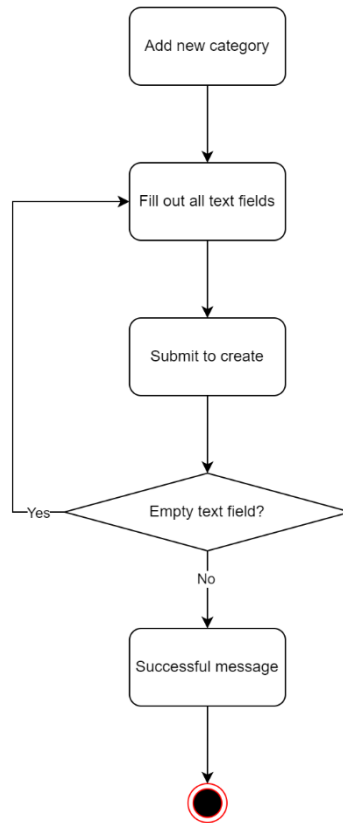


Figure 4.5: Add new admin function flow

The admin can add more administrator accounts. Admin needs to enter information. The system will check and require empty text fields to be filled in during submission.

Modify Admin Name

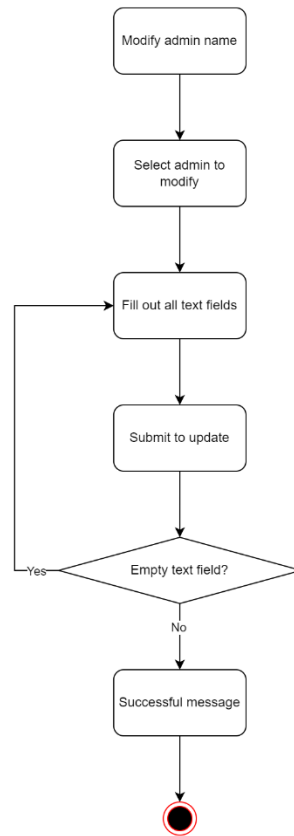


Figure 4.6: Modify admin name function flow

Only the administrator's name can be changed. The email for the administrator account is fixed and if they have forgotten their account password they can reset their password on the Login - Forgot Password page. The system will check the text field on submission.

Delete Admin

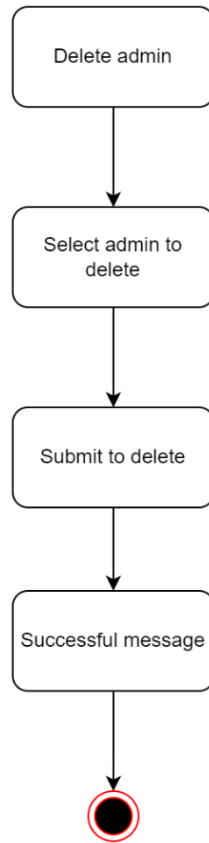


Figure 4.7: Delete

Manage Category

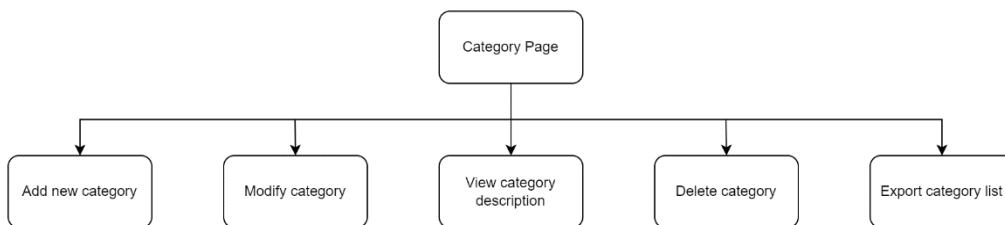


Figure 4.8: Function can be done in category page

There are five functions can be executed on the category page, which is view category description, add a new category, modify category, delete category, and export category list.

Add New Category

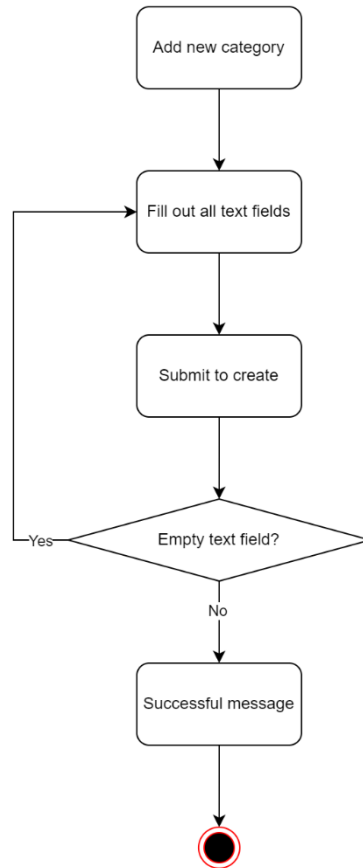


Figure 4.9: Add new category function flow

Admin needs to enter all the category attribute's information. The system will check and require empty text fields to be filled in during submission.

Modify Category

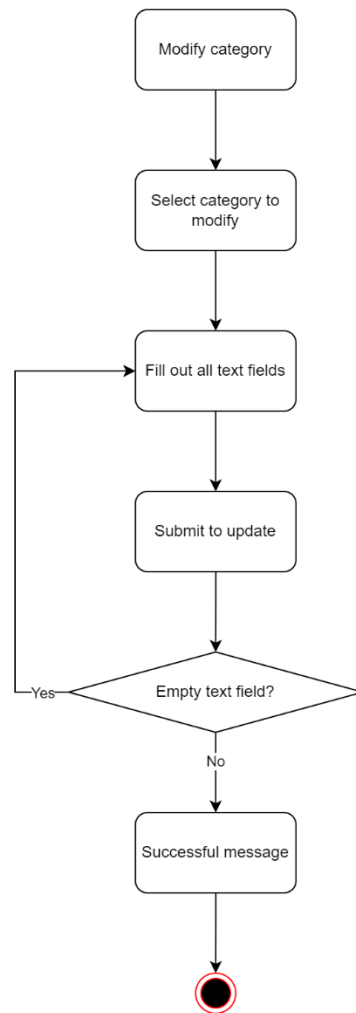


Figure 4.10: Modify category function flow

Since the category has name and image attribute, the admin can selectively pick the attributes that need to be modified. The admin needs to check the attribute's checkbox to reveal the text field. Empty text fields will be checked and required to be filled in.

Delete Category

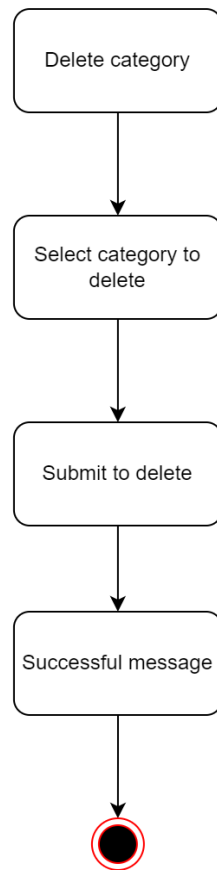


Figure 4.11: Delete category function flow

Manage Collection

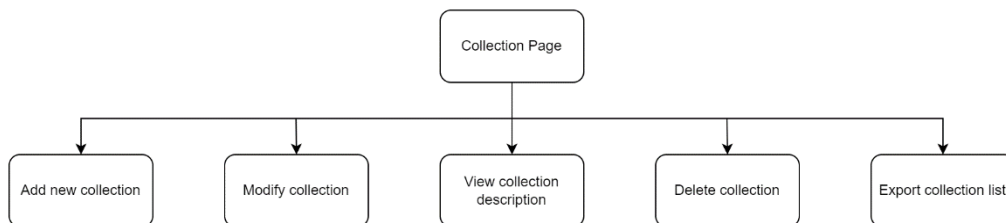


Figure 4.12: Function can be done in collection page

There are five functions can be executed on the collection page, which is view collection description, add a new collection, modify collection, delete collection, and export collection list.

Add New Collection

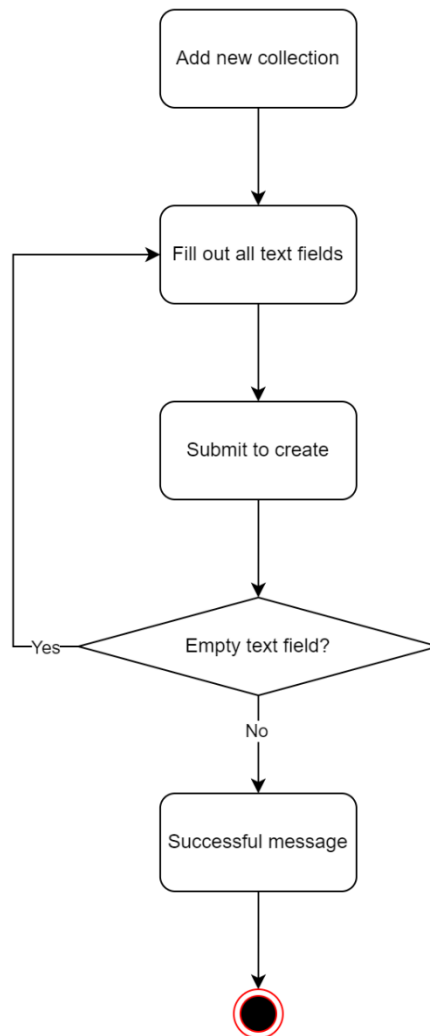


Figure 4.13: Add new collection function flow

Admin needs to enter all the category attribute's information. The system will check and require empty text fields to be filled in during submission.

Modify Collection

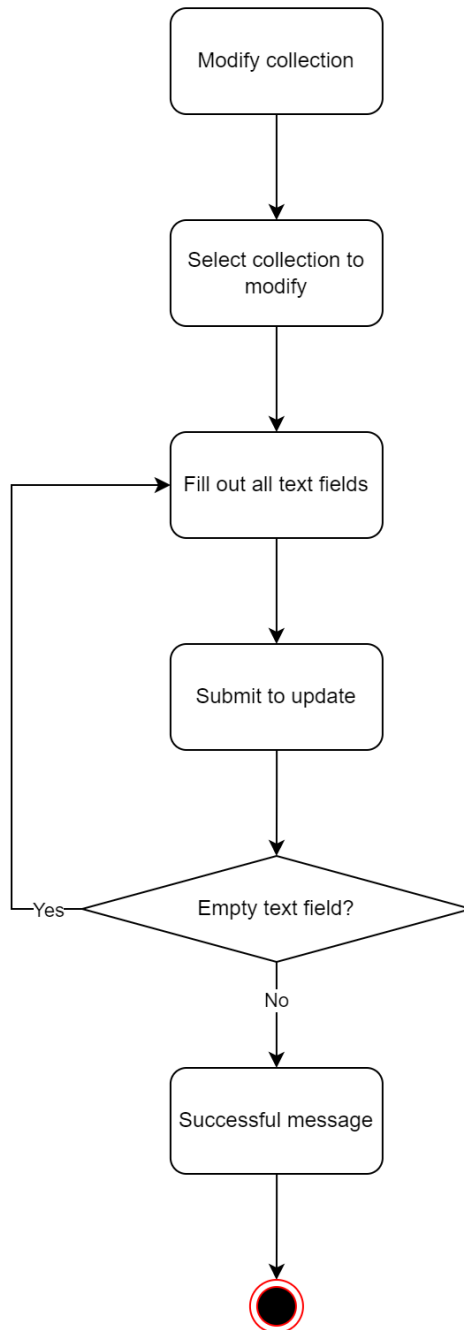


Figure 4.14: Modify collection function flow

Since the collection has name and image attribute, the admin can selectively pick the attributes that need to be modified. The admin needs to check the attribute's checkbox to reveal the text field. Empty text fields will be checked and required to be filled in.

Delete Collection

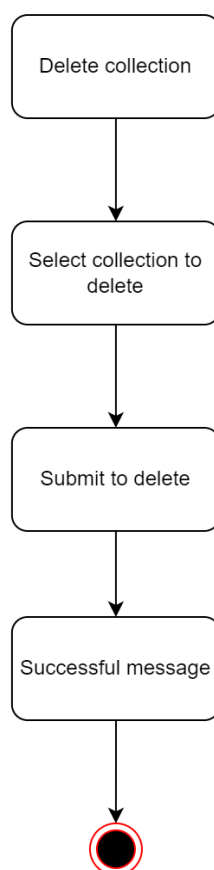


Figure 4.15: Delete collection function flow

Manage Product

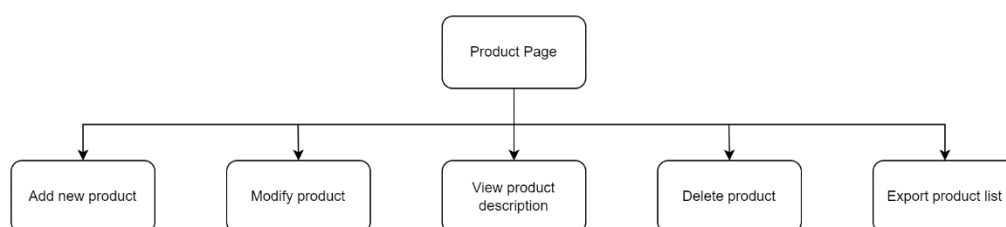


Figure 4.16: Function can be done in product page

There are five functions can be executed on the product page, which is view product description, add a new product, modify product, delete product, and export product list.

Add New Product

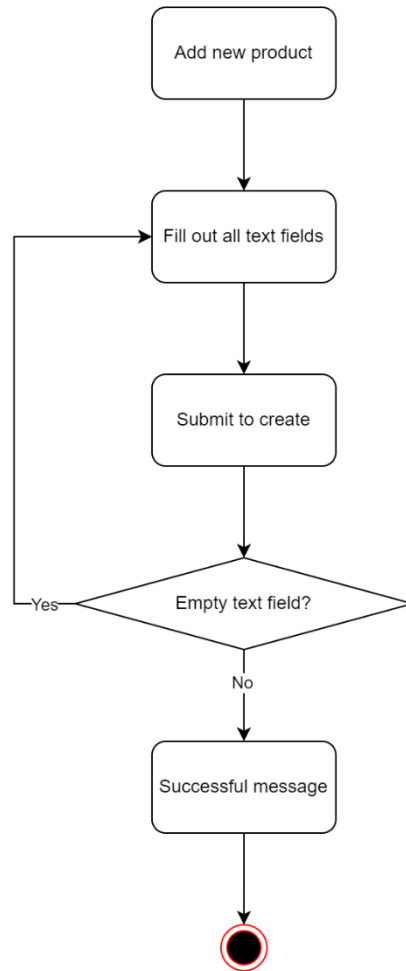


Figure 4.17: Add new product function flow

Admin needs to enter all the product attribute's information. The system will check and require empty text fields to be filled in during submission.

Modify Product

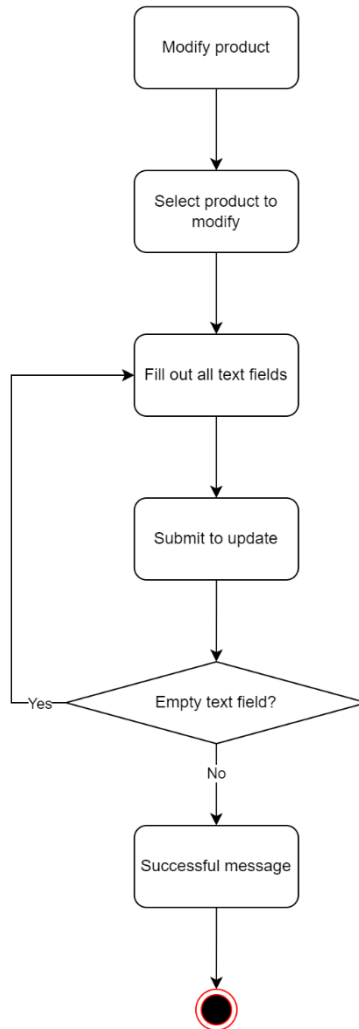


Figure 4.18: Modify product function flow

Since the product has more than one attribute including image and GLB model, the administrator can selectively pick the attributes that need to be modified. The administrator needs to check the attribute's checkbox to reveal the text field. Empty text fields will be checked and required to be filled in while submitting.

Delete Product

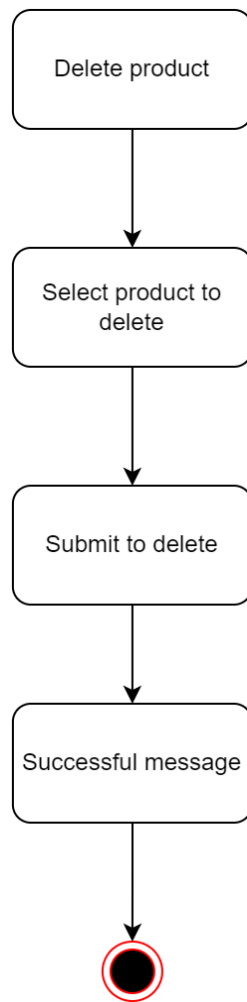


Figure 4.19: Delete product function flow

View Description and Export

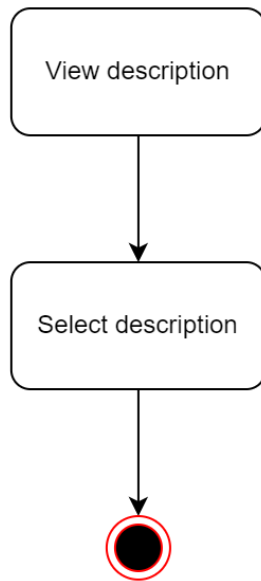


Figure 4.20: View description function flow

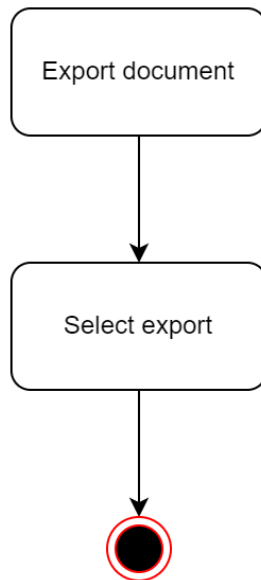


Figure 4.21: Export document function flow

Since the process of both view description and export document can be completed by pressing only one button, therefore I put it synthesized at the end. Since these two actions are the same on each page with only one button required, therefore I combined it into one.

4.4.2 Mobile Application

4.4.2.1 Interface Flow Chart

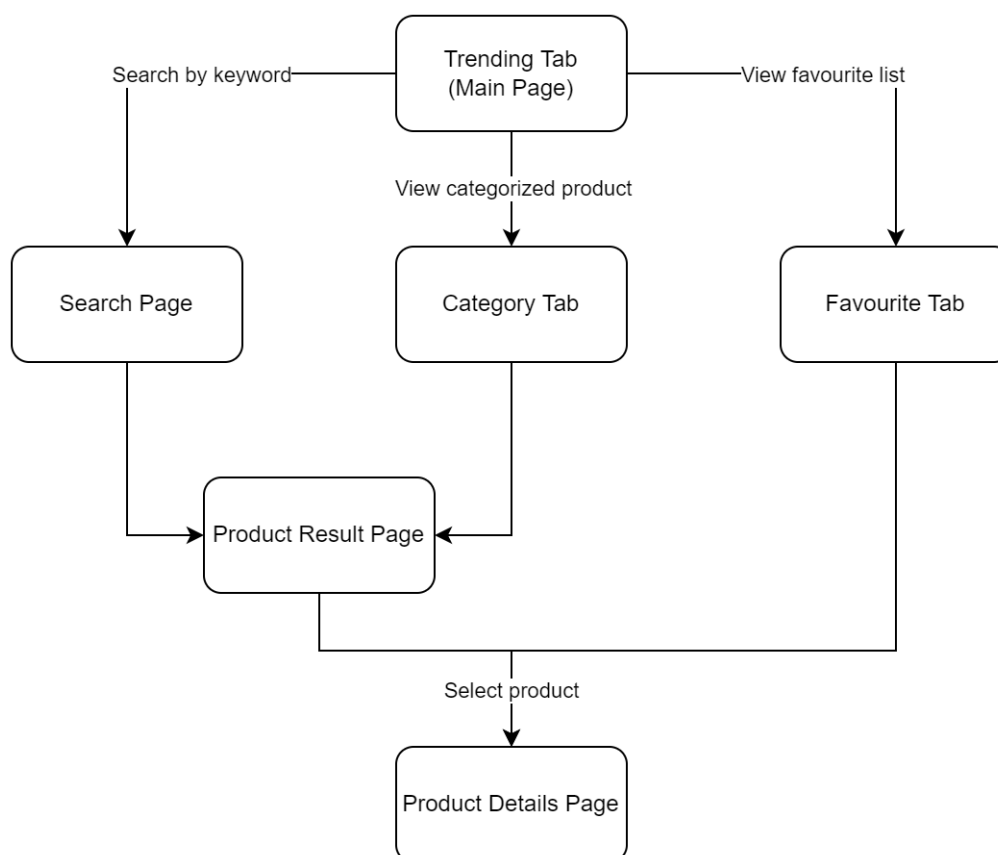


Figure 4.22: Interface flow chart of Mobile Application

When the application is launched, the system will direct the customer to the main page, which is the trending page. In the mobile application, there will consist of four pages, which are trending tab, category tab, favourite tab, and search page. The trending tab will be the first screen of the application. It will be consisting of the ongoing event, and newly added and trending products. The category tab included categorized products by category and collection, it brings greater convenience to the user who targeting a certain series. The favourite tab is the user's favourite product list, and the search page will represent the modal to execute the action.

From the Trends tab, the search page can be reached. As the search page is searched by keywords and the categories are classified by products, they will have product results to show the searched products or series of products.

By clicking on the displayed products, customers can be directed to the product detail page. The product detail page shows the description of the product.

4.4.2.2 Functional Flow Chart

Search Product

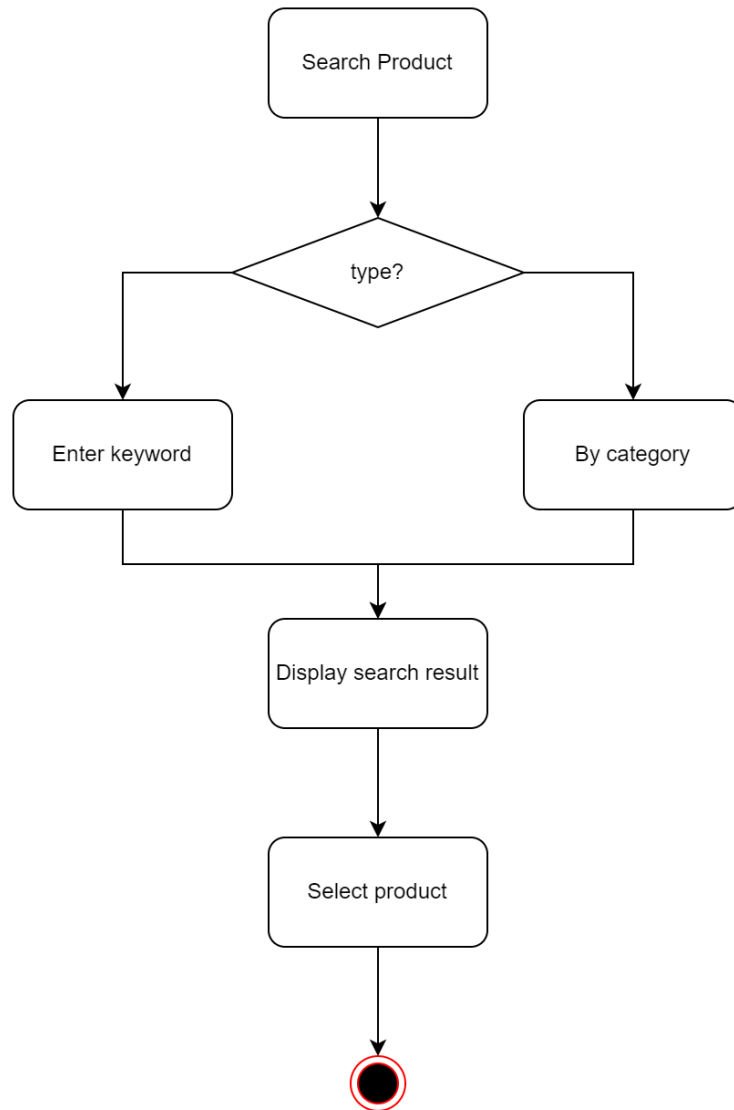


Figure 4.23: Search product flow

This is the process by which customers search for products on the search page. Customers can search for products by entering keywords in the search bar. In addition, some categories are displayed on the search page for customers' convenience. Therefore, customers can search by keywords or categories. The

product results will be displayed. Once they find the product they are interested in, clicking on it will lead them to the product detail page. The product description is included on the product detail page.

View Product Detail & View in AR mode

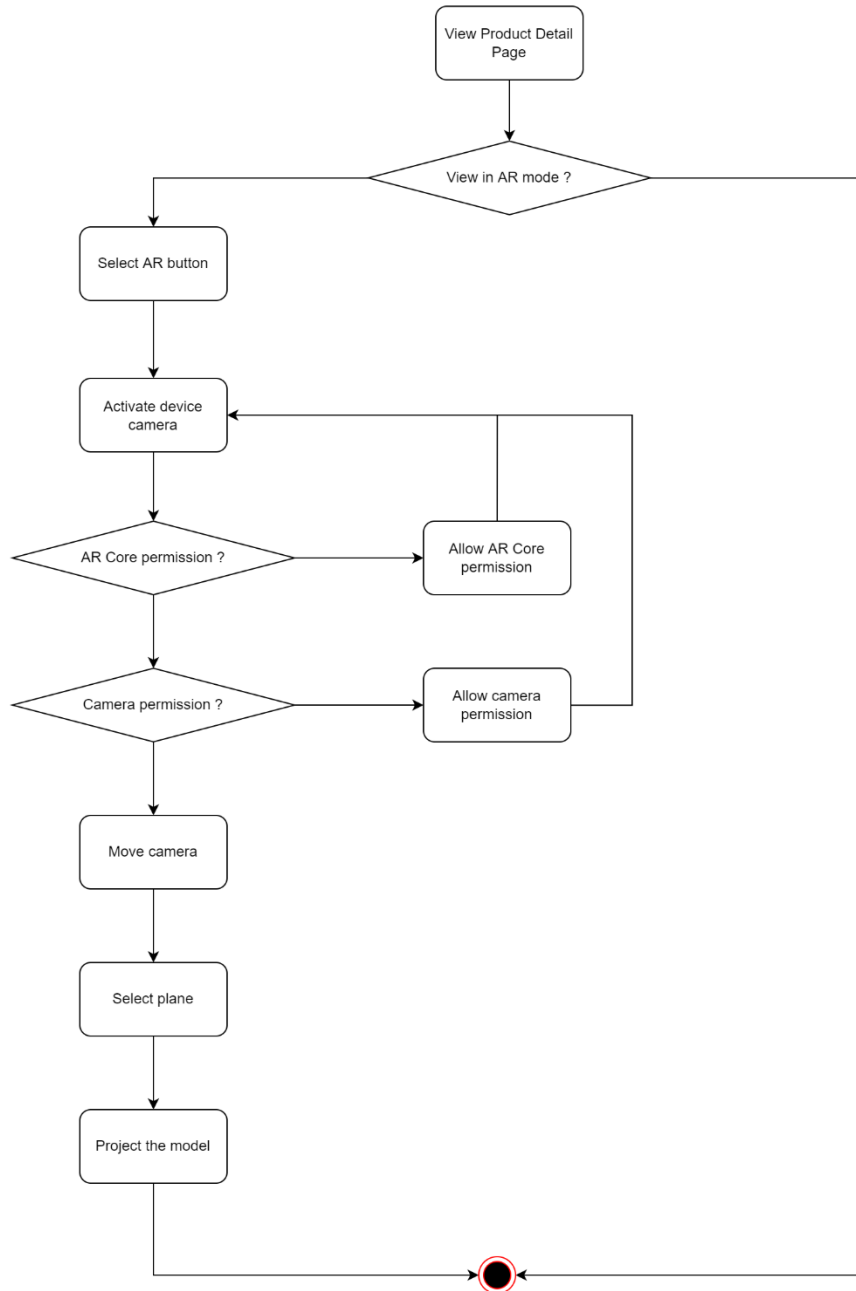


Figure 4.24: View product detail flow

This is the process by the customer to view the product details. The customer can view the product in AR mode or normal mode. If the customer wants to

view in AR mode, they need to select AR mode and then the application will activate the device camera.

Manage Favourite

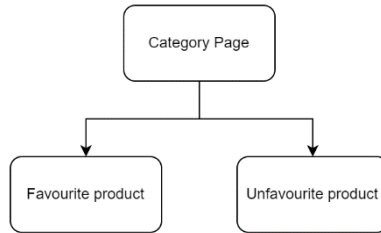


Figure 4.25: Function can be done to manage favourite list

The customer can favourite product and unfavourite product.

Favourite product

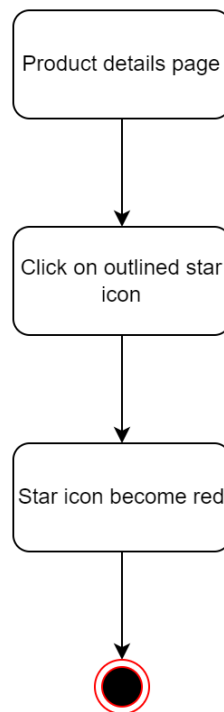


Figure 4.26: Favourite product flow

This is the process where customers favourite the product. After viewing the product, the customer can favourite the product by clicking on the star icon. The star icon will turn red after the favourite action is completed. Customers can only favourite products in the product details page.

Unfavourite product

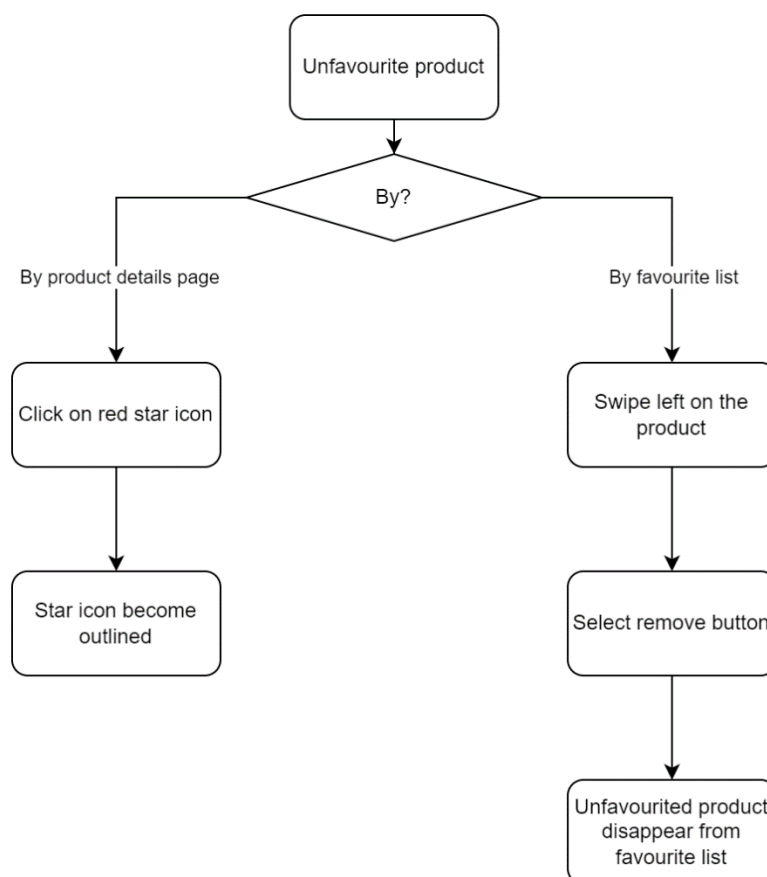


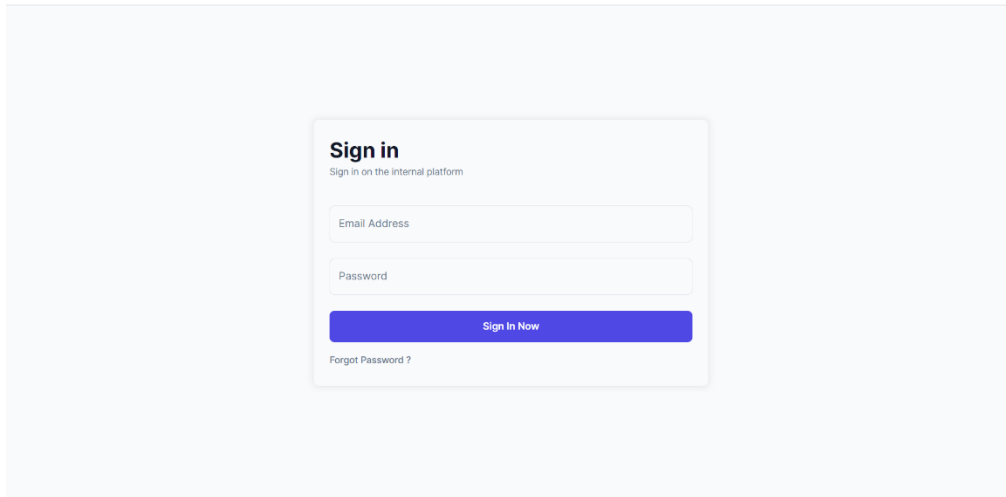
Figure 4.27: Unfavourite product flow

Customers can unfavourite a product on the product detail page or in the favourites list. In the product detail page, a red star icon will appear if the product is favourited. Otherwise, an outlined star icon will appear. Customers can unfavourite a product only when the red star icon appears. The customer can click on the red star icon to transform it back to the outlined star icon, then the unfavourite process is complete. In the favourite list, customers can swipe left to trigger the appearance of a delete button. The customer can then select the delete button to unfavourite the product. Once the unfavourite process is complete, the product will disappear from the favourite list.

4.5 Interface Design

4.5.1 Web Application

Login Page



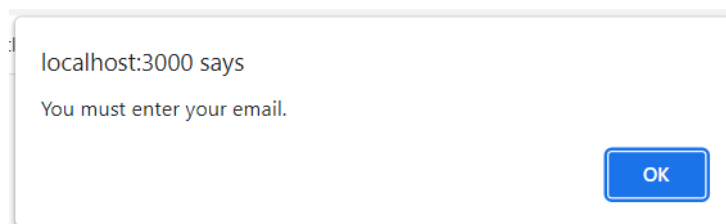
The screenshot shows a login form with the following elements:

- Sign in** (Section Header)
- Sign in on the internal platform (Sub-header)
- Email Address (Input field)
- Password (Input field)
- Sign In Now (Blue button)
- Forgot Password? (Link)

Figure 4.28: Login Page

A login screen will appear for all administrators who are not currently logged in when the app first launches. The dashboard screen will be immediately accessed by all logged-in administrators.

Warning in Login Screen

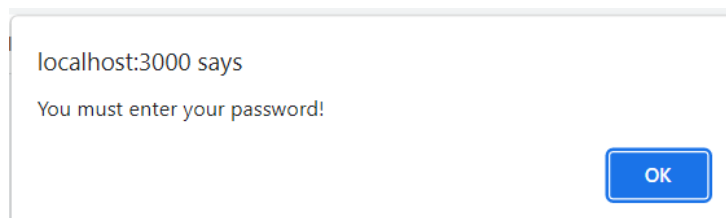


The alert dialog box contains the following text:

localhost:3000 says
You must enter your email.

OK (button)

Figure 4.29: Alert of empty email



The alert dialog box contains the following text:

localhost:3000 says
You must enter your password!

OK (button)

Figure 4.30: Alert of empty password

There are two text fields, email and password, on the login screen. Empty text fields are not permitted when logging into the web application. Admin must proceed without leaving any blank text fields.

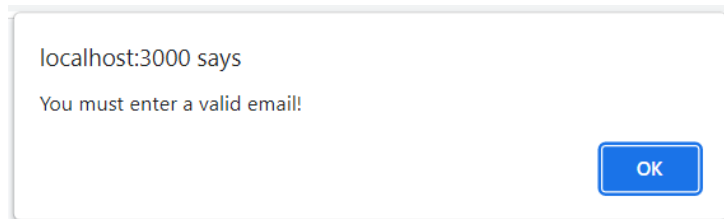


Figure 4.31: Alert of invalid email

It is also possible that the user entered the incorrect email format, such as by omitting the @ sign or the domain name.

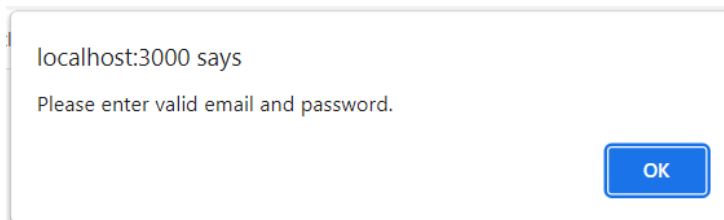
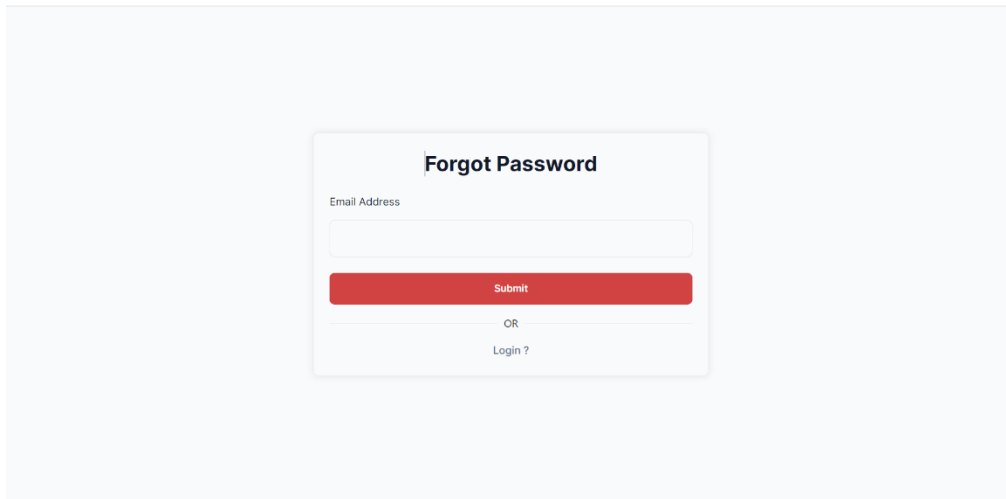


Figure 4.32: Alert of invalid password or account record

Lastly, if none of the database record can match the inserted email address and password with the data store. The admin could have been careless as well. Therefore, admin must again input the proper email address and password.

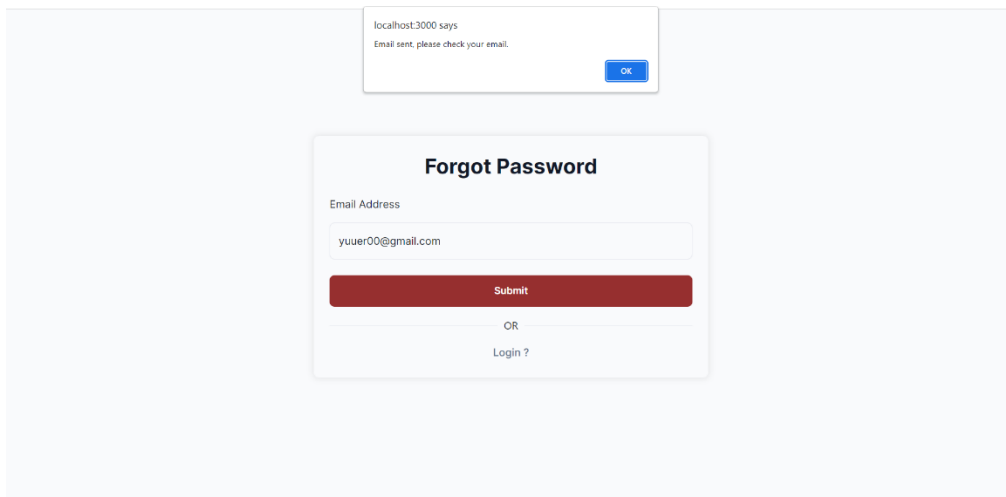
Reset Password Page



The screenshot shows a web form titled "Forgot Password". It contains a text input field labeled "Email Address" which is currently empty. Below the input field is a red "Submit" button. Underneath the button, there is a horizontal line, followed by the text "OR" and a link labeled "Login ?".

Figure 4.33: Forgot Password Page

Admins can only change their own passwords. They need to submit an email to receive the reset link. Other than that, the account email is not editable and the account name can only be edited by the highest priority admin.



The screenshot shows the "Forgot Password" page after a successful submission. At the top, there is a notification box that says "localhost:3000 says" and "Email sent, please check your email." with an "OK" button. The form below has the "Email Address" field filled with "yuser00@gmail.com". The "Submit" button is now greyed out, and the "OR" and "Login ?" links are visible below it.

Figure 4.34: Successfully submitted email

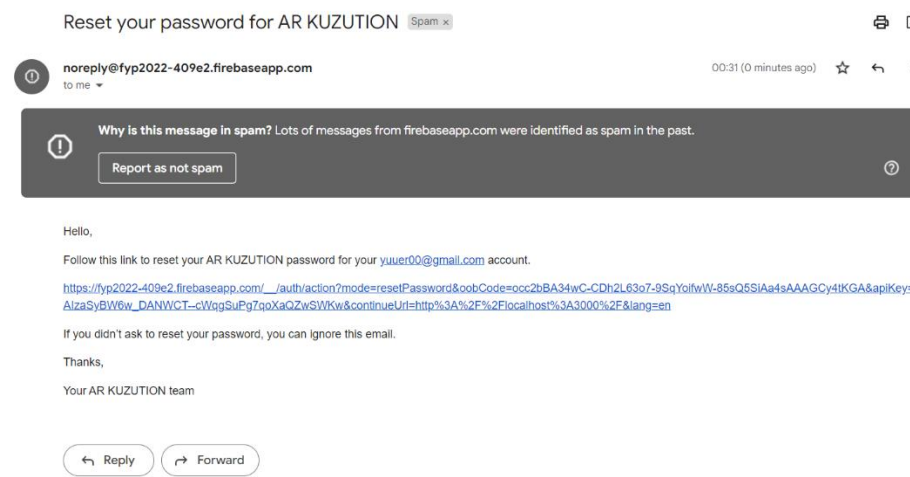


Figure 4.35: Rest password email

An email with a reset link will be sent to the submitted email. Admins can be directed to the reset page via this link.

Reset your password

for yuuer00@gmail.com

New password

SAVE

Figure 4.36: Rest password page

Password changed

You can now sign in with your new password

CONTINUE

Figure 4.37: Successfully reset password

Warning in Reset Password

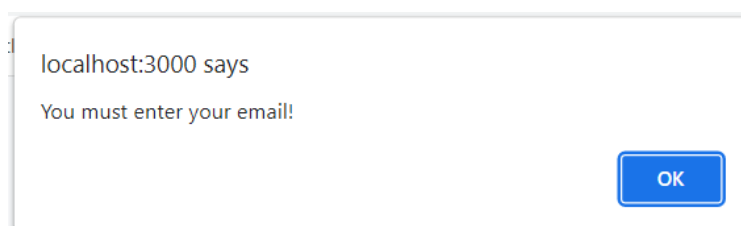


Figure 4.38: Alert of empty email

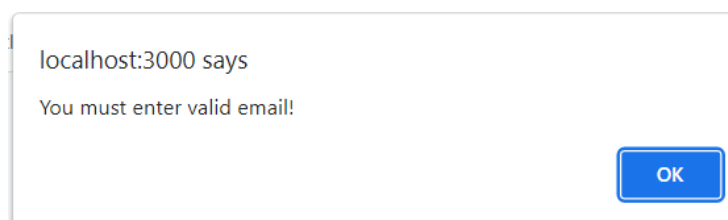


Figure 4.39: Alert of invalid email

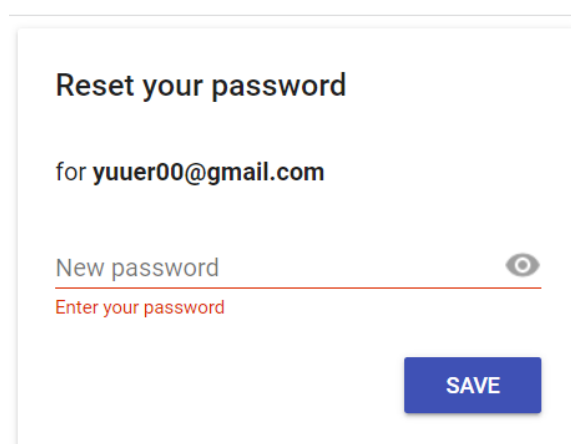
A form titled "Reset your password" for the email "yuuer00@gmail.com". It features a "New password" input field with a red underline and a red error message "Enter your password" below it. A toggle icon is visible to the right of the input field. A blue "SAVE" button is located at the bottom right of the form.

Figure 4.40: Alert of empty password

Admin must proceed without leaving any blank text fields.

Dashboard

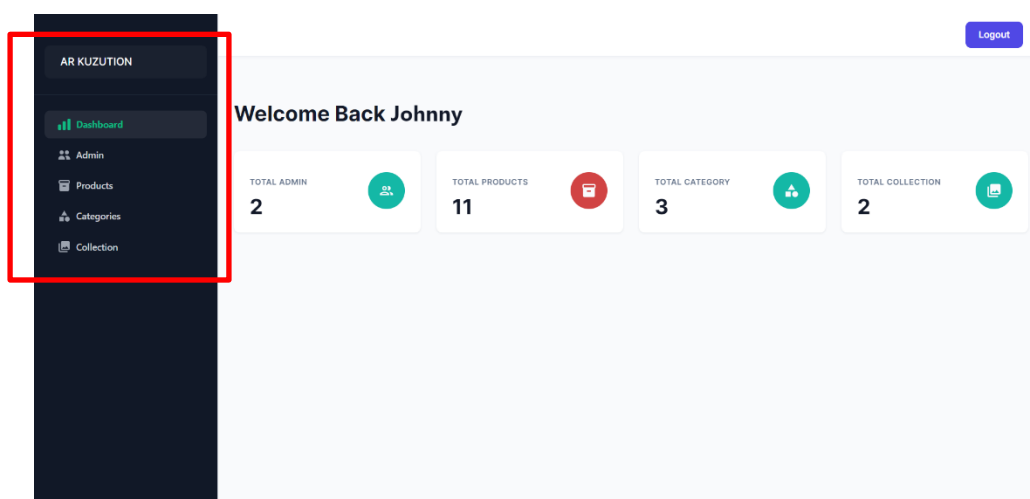


Figure 4.41: Dashboard page

After an admin has logged in successfully, they will be directed to the dashboard. The dashboard displays the total number of each section, admin, products, categories, and collections. The dashboard allows the admins to view all the available information more quickly and clearly. The sidebar next to it has access to different pages, and different functions can be performed inside.

Admin Page

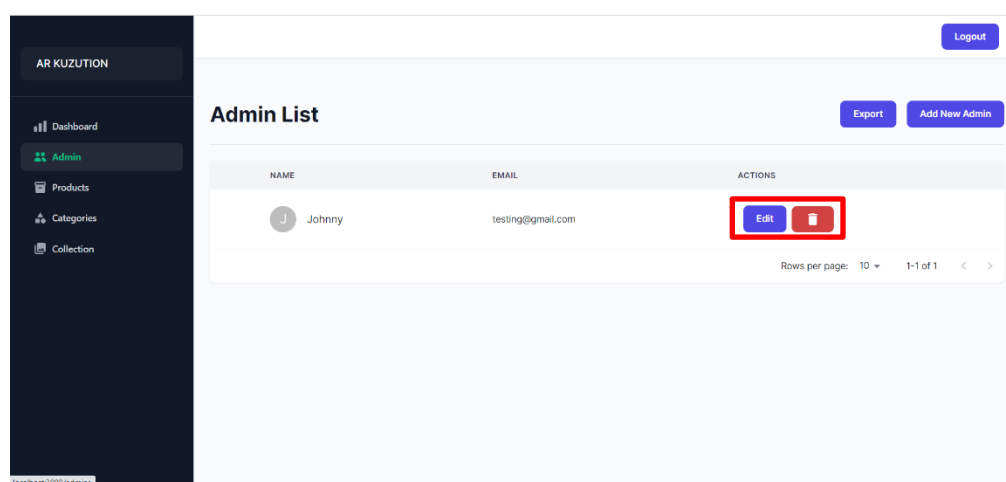


Figure 4.42: Admin page

In the admin page, all the admin information is displayed initially. As there are only three attributes which is email, name, password, so the admin page will

directly display email and name in the table. Admins can either add a new admin account, modify the names of other admins or delete them.

Then, in the same row of the heading, there are “export” and “add new admin”. By clicking export, admin can directly export all the admins’ information in a excel file.

Add new Admin

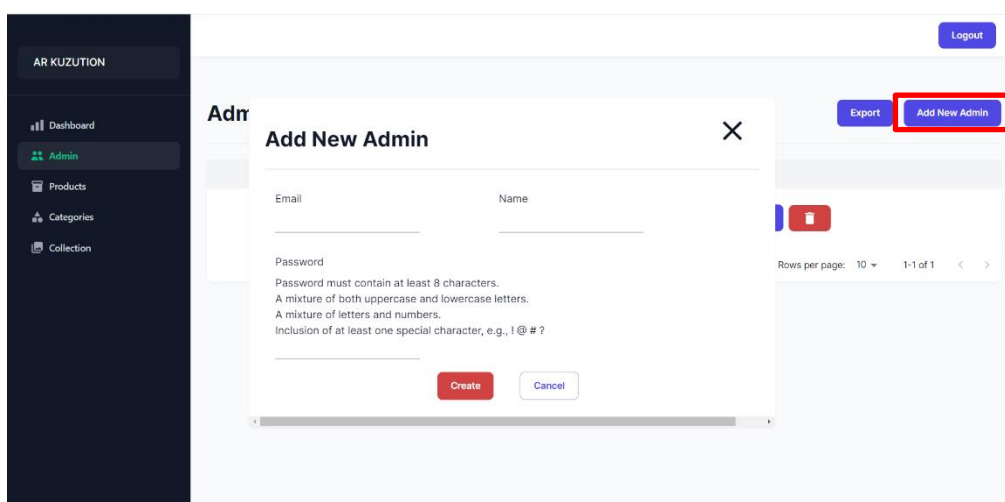


Figure 4.43: Add new admin modal

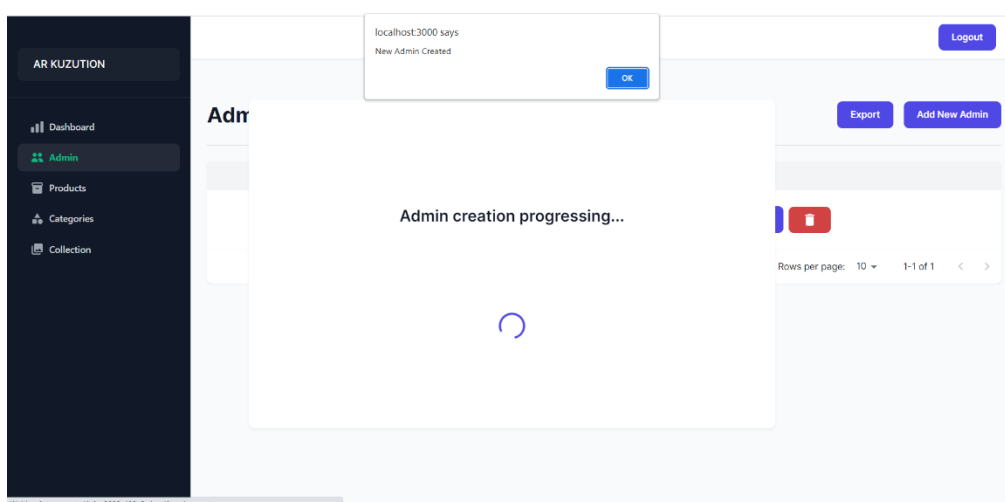


Figure 4.44: Successfully add new admin

While the creation progress is loading, the loading page will appear. Therefore, if the progress is complete, an alert will prompt to alert the admin the progress is completed successfully.

Warning during Add new admin

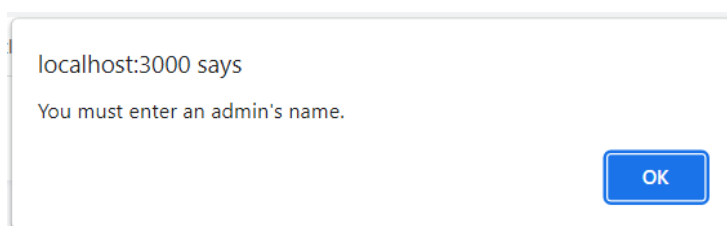


Figure 4.45: Alert of empty admin name

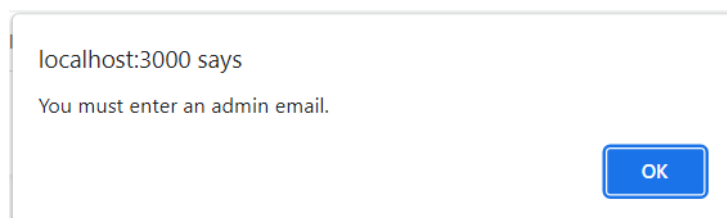


Figure 4.46: Alert of empty admin email

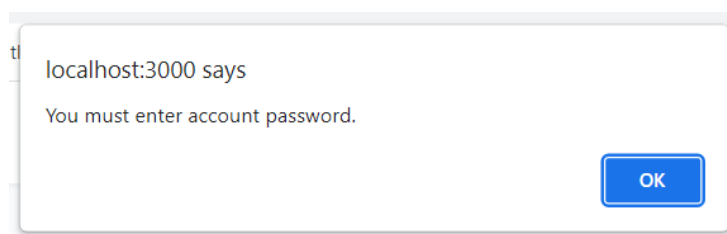


Figure 4.47: Alert of empty admin password

There are three text fields name, email and password, during add new admin. Empty text fields are not permitted. Admin must proceed without leaving any blank text fields.

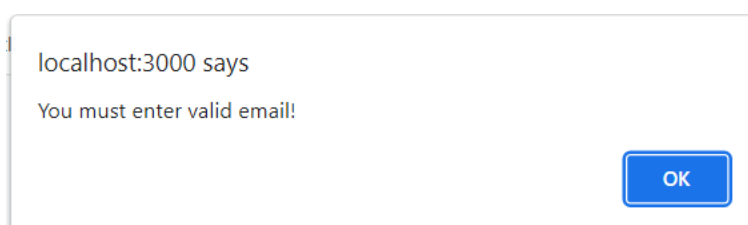


Figure 4.48: Alert of empty invalid email

It is also possible that the admin entered the incorrect email format, such as by omitting the @ sign or the domain name.

Password requirement

For different conditions, alert will prompt with different text.

- Password must contain at least 8 characters.

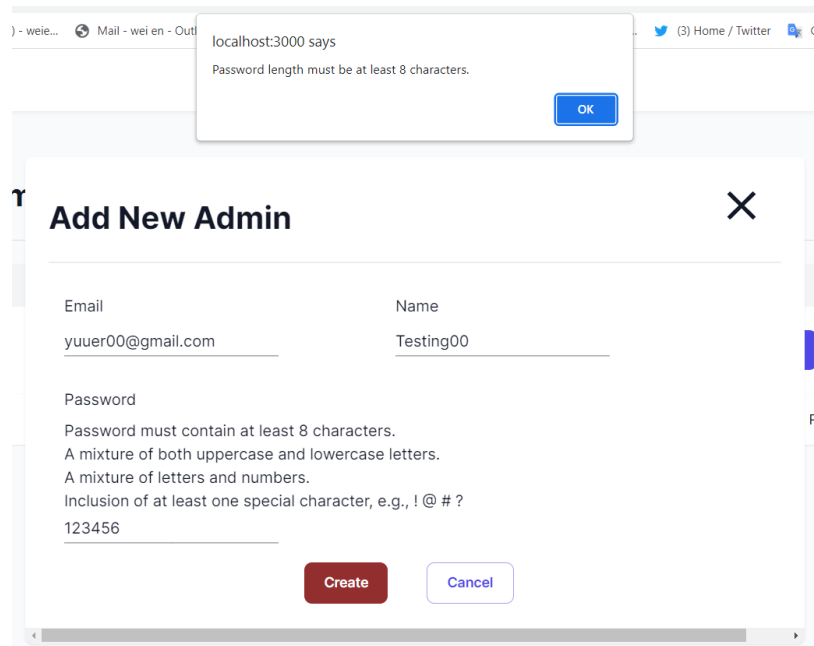


Figure 4.49: Alert of password less than 8 charaters

- A mixture of both uppercase and lowercase letters.

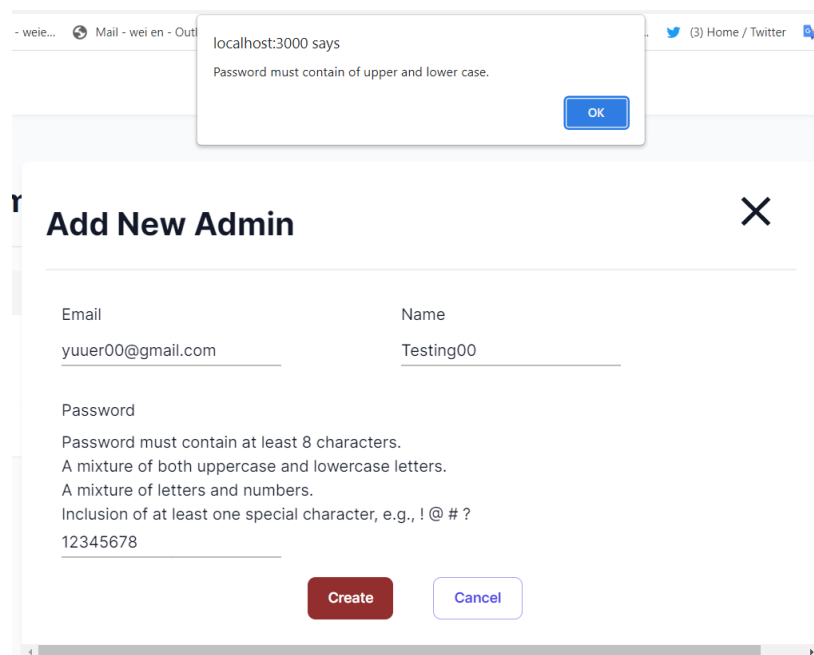


Figure 4.50: Alert of password must contain upper and lower case

- A mixture of letters and numbers.

localhost:3000 says
Password must contain of letters and numbers.

Add New Admin

Email: yuuer00@gmail.com Name: Testing00

Password: abcdefGH

Password must contain at least 8 characters.
A mixture of both uppercase and lowercase letters.
A mixture of letters and numbers.
Inclusion of at least one special character, e.g., ! @ # ?

Create Cancel

Figure 4.51: Alert of password must contain letter and number

- Inclusion of at least one special character, e.g., ! @ # ?

localhost:3000 says
Password must contain at least one special character, e.g., ! @ # ?

Add New Admin

Email: yuuer00@gmail.com Name: Testing00

Password: abCD5678

Password must contain at least 8 characters.
A mixture of both uppercase and lowercase letters.
A mixture of letters and numbers.
Inclusion of at least one special character, e.g., ! @ # ?

Create Cancel

Figure 4.52: Alert of password must contain special charater

Edit admin name

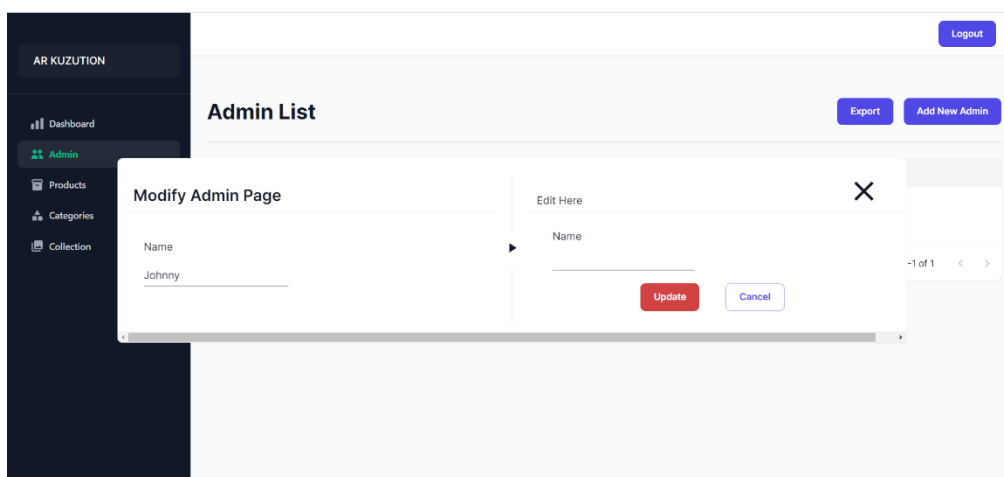


Figure 4.53: Edit admin modal

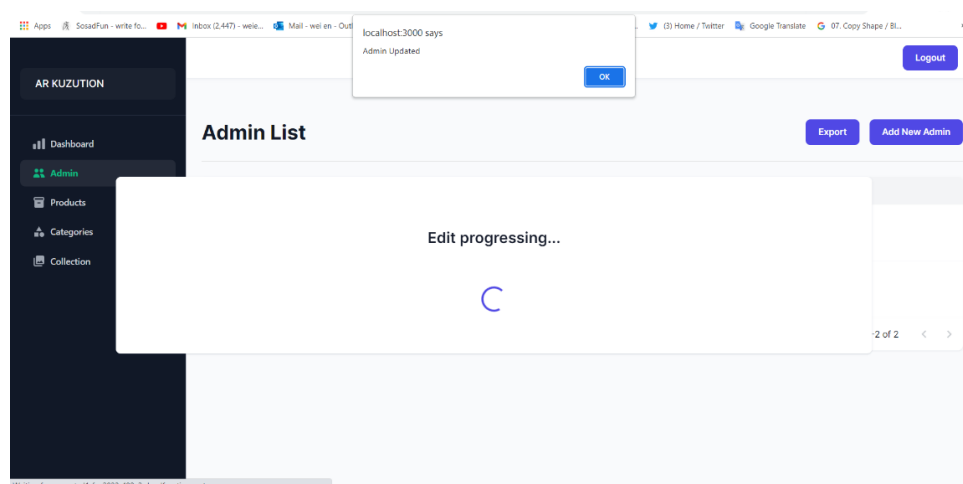


Figure 4.54: Successfully edit admin

While the update progress is loading, the loading page will appear. Therefore, if the progress is complete, an alert will prompt to alert the admin the progress is completed successfully.

Warning during Edit admin name

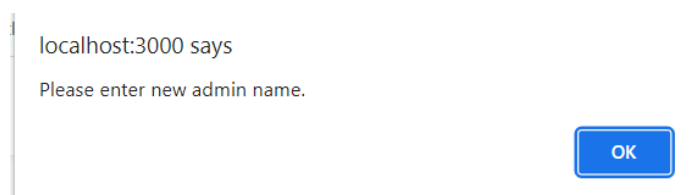


Figure 4.55: Alert of empty admin name

There only one text fields which is name.

Delete admin

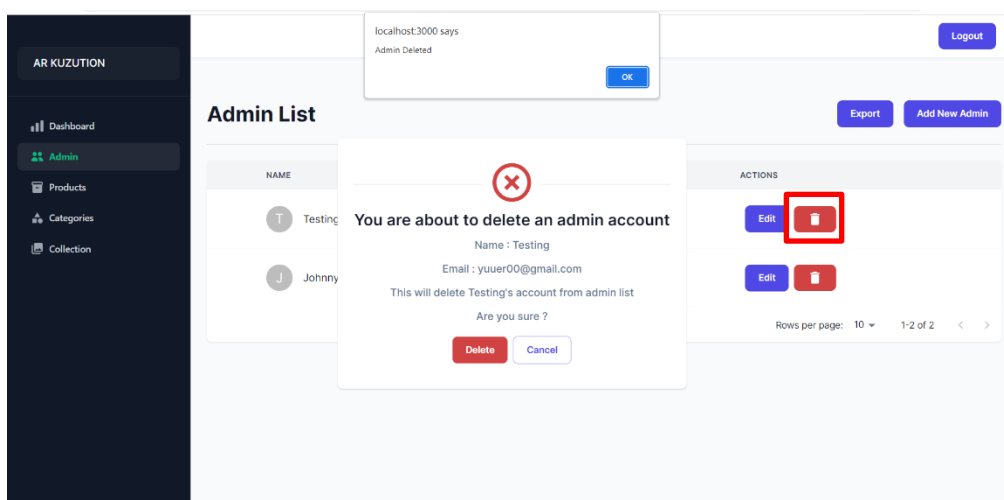


Figure 4.56: Delete admin modal

When an admin intends to delete a admin, an delete modal will be presented to determine the admin's current action. The admin may select the red delete key to insist on the deletion. An alert will then appear to remind the process has been completed.

Export admin list

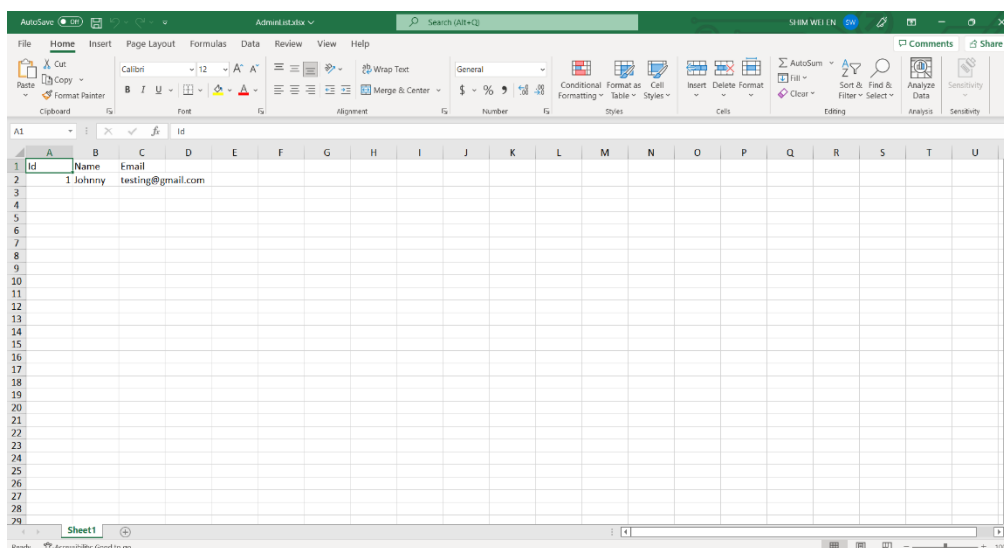


Figure 4.57: Admin list excel

The exported file includes all admin records.

Category Page

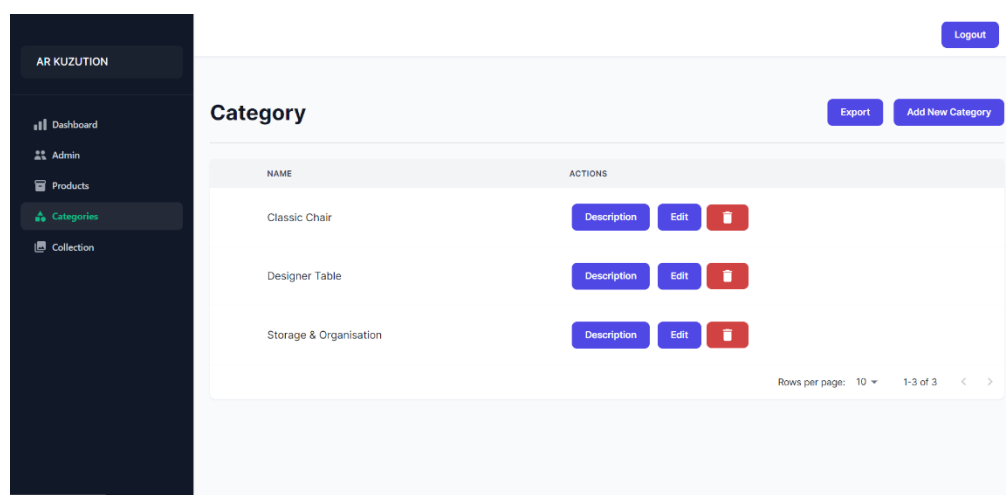


Figure 4.58: Category page

In the category page, all category records are initially displayed. As the category have more attributes, therefore there is a description modal to make it easier for the admin to have an overview. Admins can view category descriptions, add new category, modify category attributes or delete them.

Then, on the same line of the header, there is “export” and “add new category”. By clicking Export, the administrator can export all the category information directly to an Excel file.

Category description

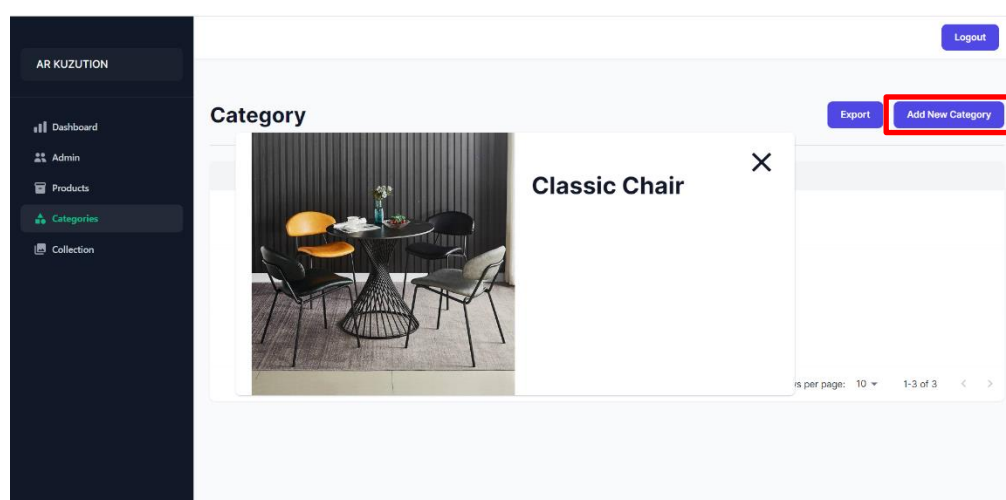


Figure 4.59: Category description modal

In description modal, all attributes are displayed.

Add new category

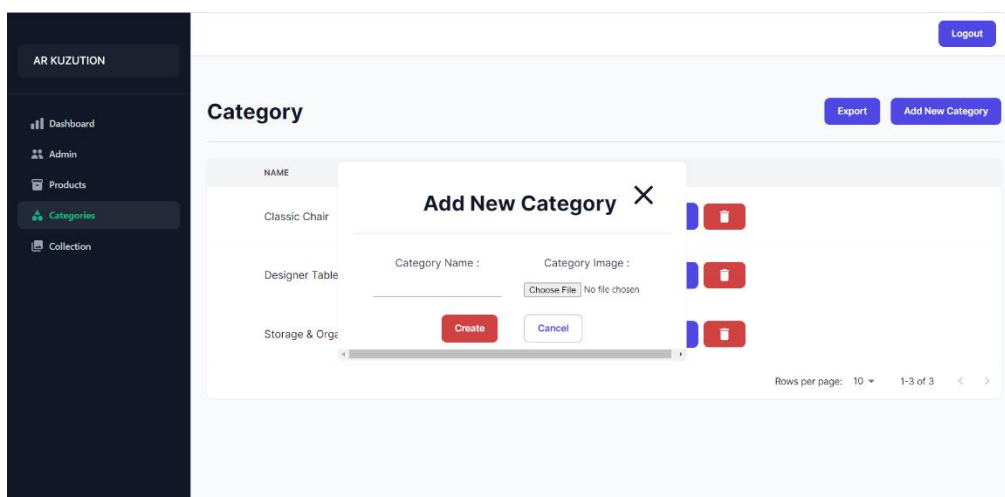


Figure 4.60: Add new category modal

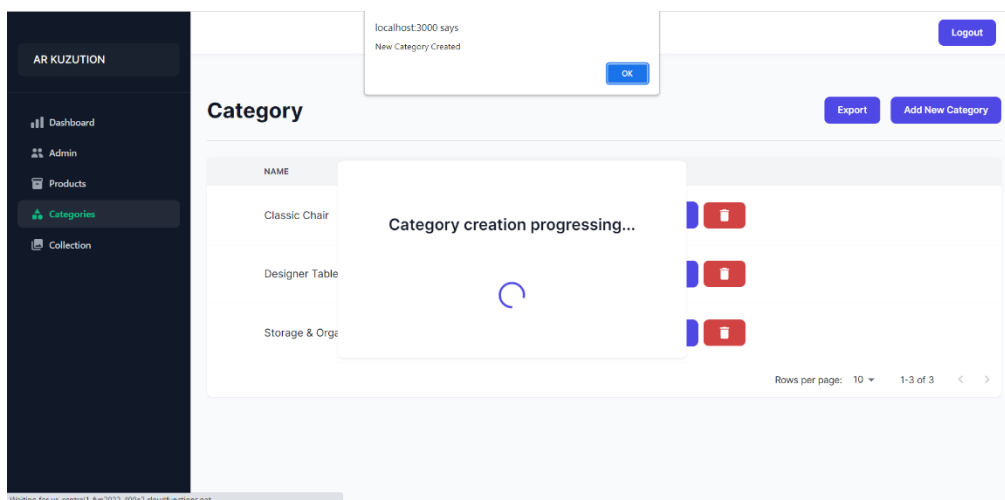


Figure 4.61: Successfully add new category

While the creation progress is loading, the loading page will appear. Therefore, if the progress is complete, an alert will prompt to alert the admin the progress is completed successfully.

Warning during adding new category

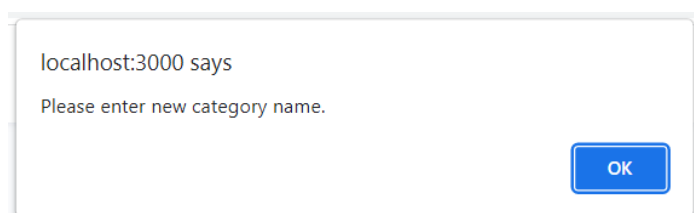


Figure 4.62: Alert of empty category name

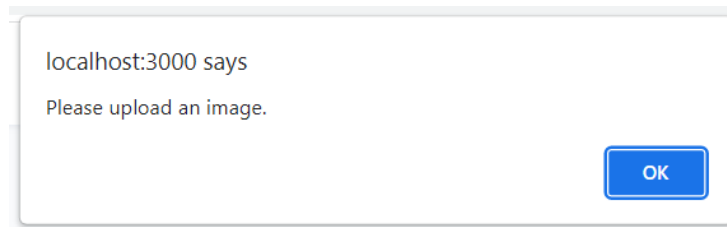


Figure 4.63: Alert of empty category image

There are two text fields name and image, during add new category. Empty text fields are not permitted. Admin must proceed without leaving any blank text fields.

Edit category

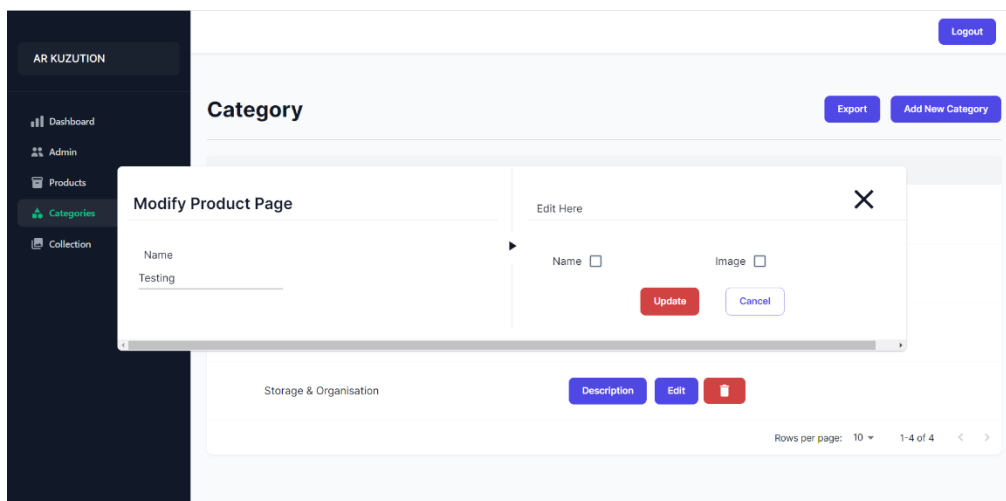


Figure 4.64: Edit category modal

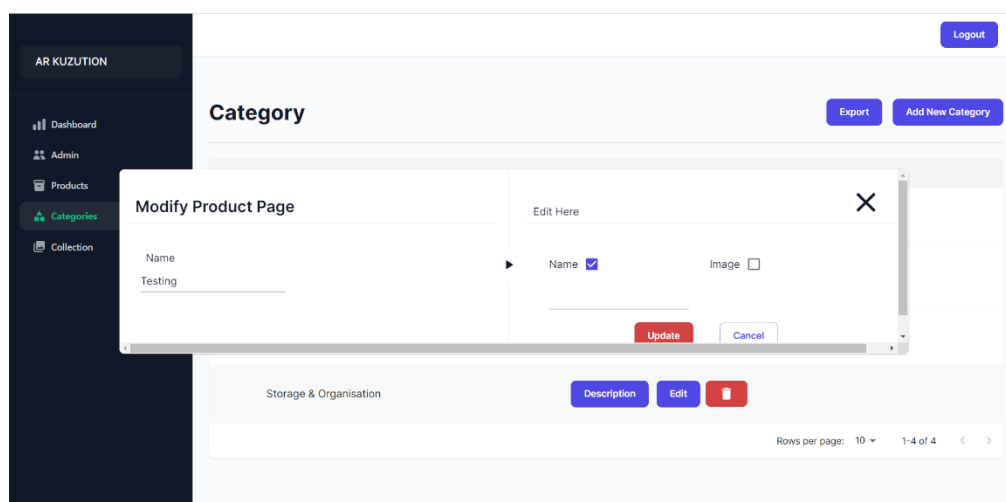


Figure 4.65: Edit category modal with checked

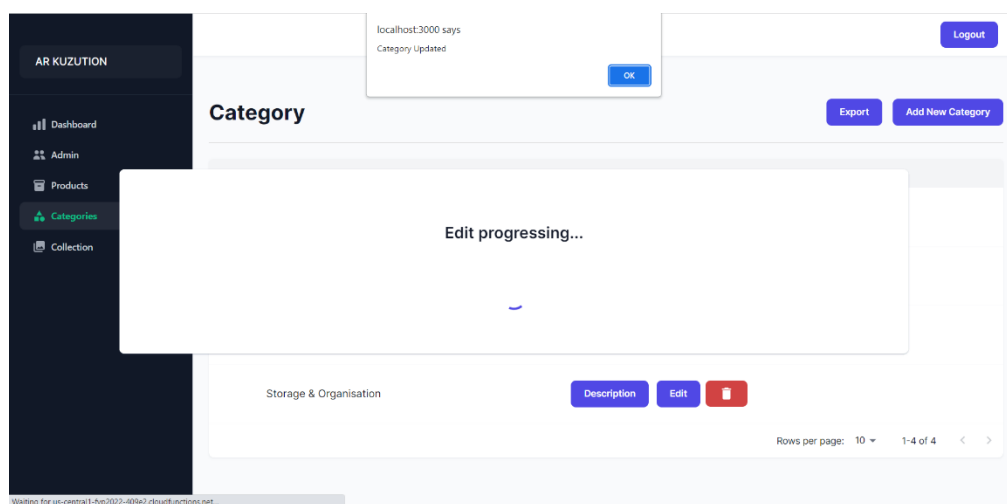


Figure 4.66: Successful edit category

In all edit pages, this web application uses checkboxes to selectively modify attributes. Except for the Edit admin, because it has only one property that can be edited.

Admin only needs to check the checkbox of the attribute that needs to be modify, and then the corresponding text field will appear, after that admin is able to enter the modify data This will lessen the admin's difficulties since they frequently only modify a small portion of the data rather than all of it. Additionally, this makes it evident which alternatives the admin has selected. It is more convenient for the admin to operate.

There is two attributes can be edit of a category.

Warning during edit category

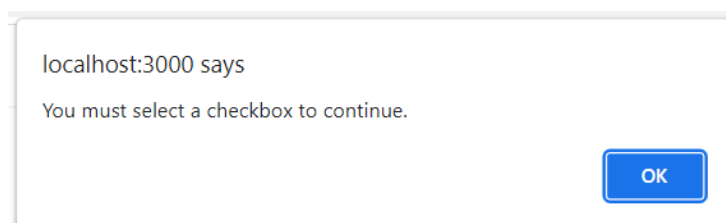


Figure 4.67: Alert to check checkbox

If the admin performs the update without any checkboxes checked, there will be a alert. Update operations cannot be performed with an empty checkbox and an empty text field.

The rest of the warnings will be similar to the warnings for adding collection, as the attribute and text field is the same.

Delete category

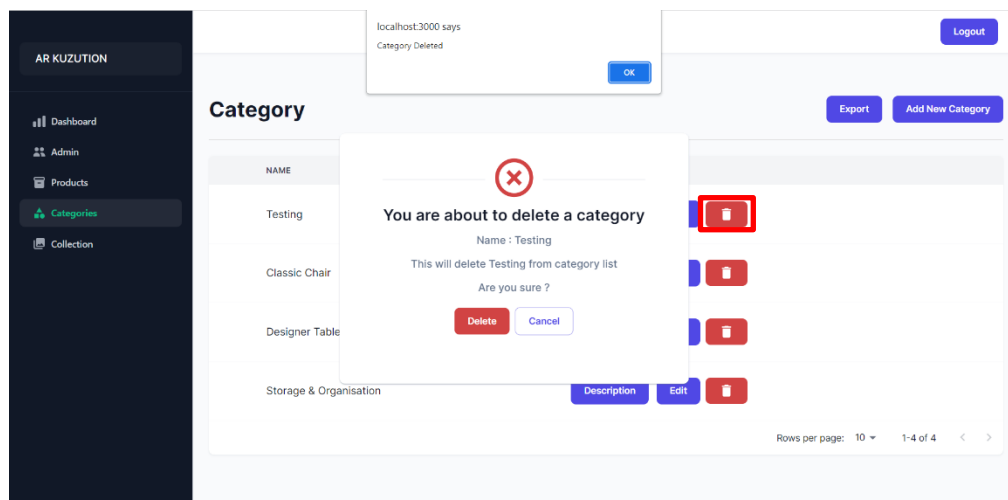


Figure 4.68: Delete category modal

When an admin intends to delete a category, a delete modal will be presented to determine the admin's current action. The admin may select the red delete key to insist on the deletion. An alert will then appear to remind the process has been completed.

Export category

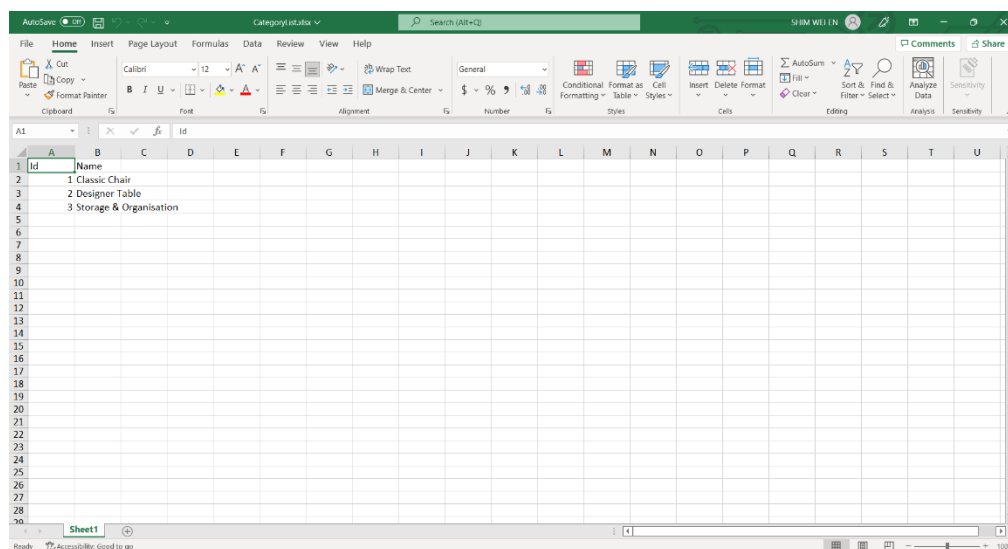


Figure 4.69: Category list excel

The exported file includes all category records.

Collection page

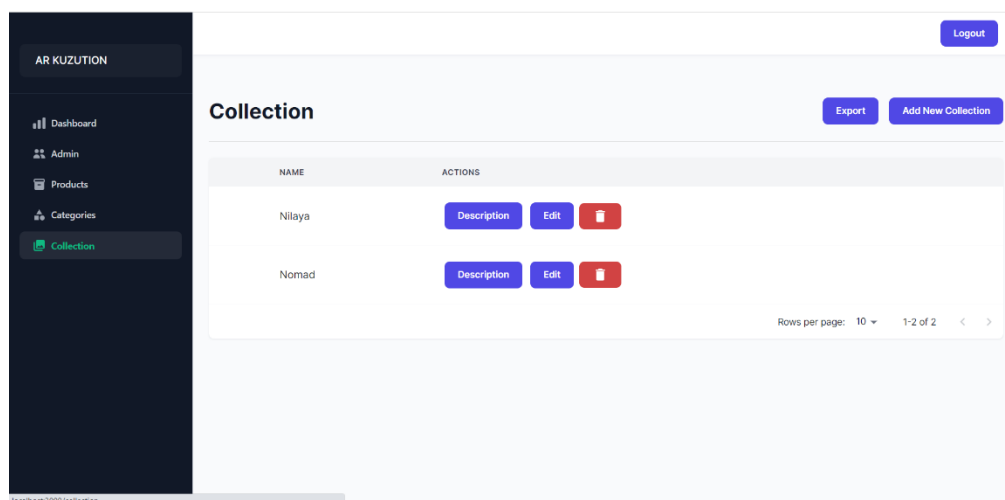


Figure 4.70: Collection page

In the collection page, all product records are initially displayed. As the products have more attributes, therefore there is a description modal to make it easier for the admin to have an overview. Admins can view collection descriptions, add new collection, modify collection attributes or delete them.

Then, on the same line of the header, there is “export” and “add new collection”. By clicking Export, the administrator can export all the collection information directly to an Excel file.

Collection description

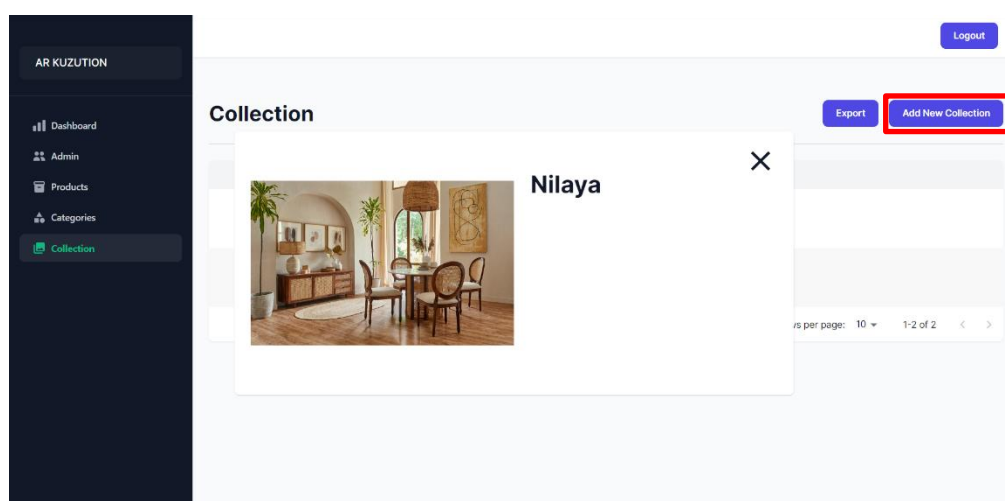


Figure 4.71: Collection description modal

In description modal, all attributes are displayed.

Add new collection

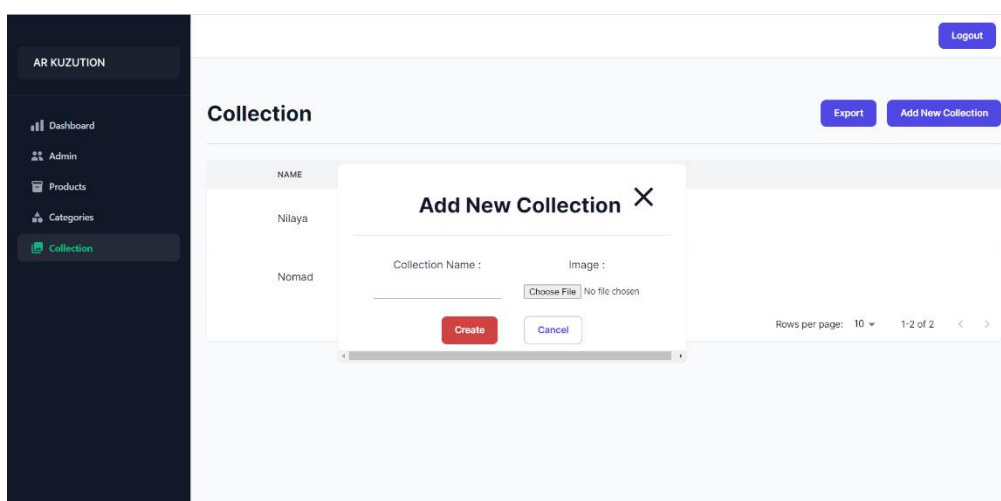


Figure 4.72: Add new collection modal

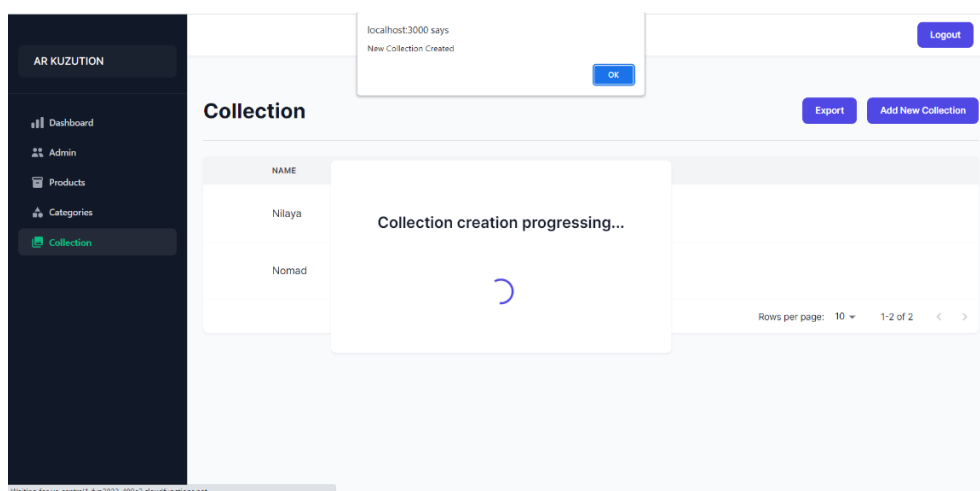


Figure 4.73: Successfully add new collection

While the creation progress is loading, the loading page will appear. Therefore, if the progress is complete, an alert will prompt to alert the admin the progress is completed successfully.

Warning during adding new collection

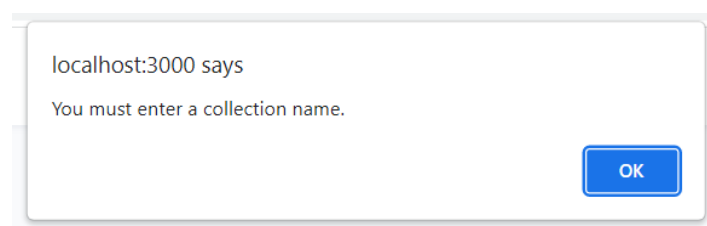


Figure 4.74: Alert of empty collection name

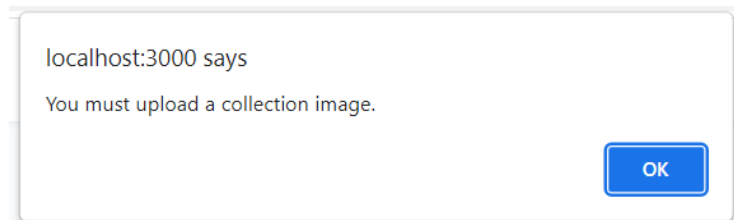


Figure 4.75: Alert of empty collection image

There are two text fields name and image, during add new collection. Empty text fields are not permitted. Admin must proceed without leaving any blank text fields.

Edit collection

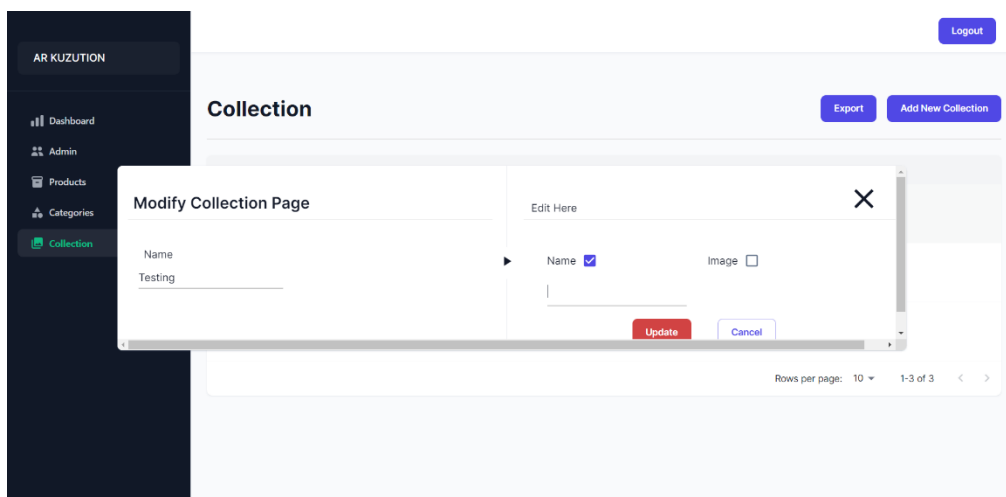


Figure 4.76: Edit collection modal

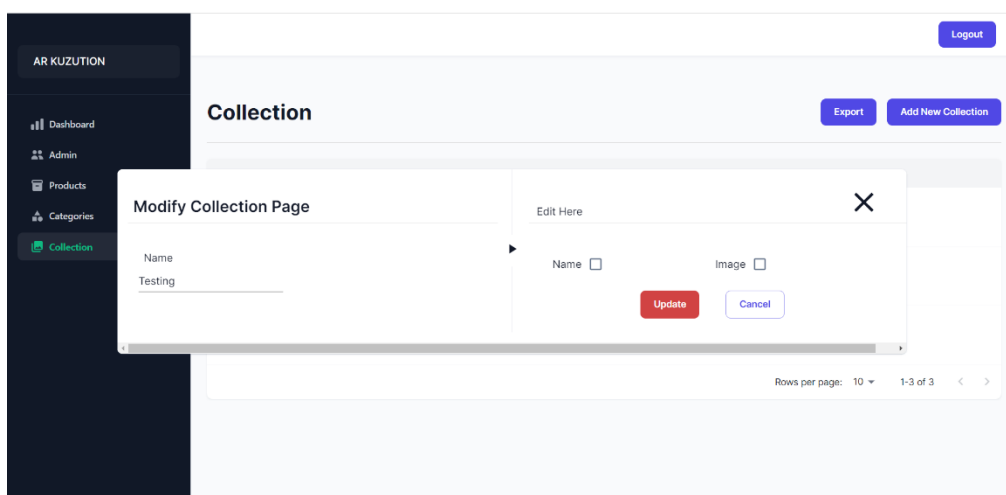


Figure 4.77: Edit collection modal with checked

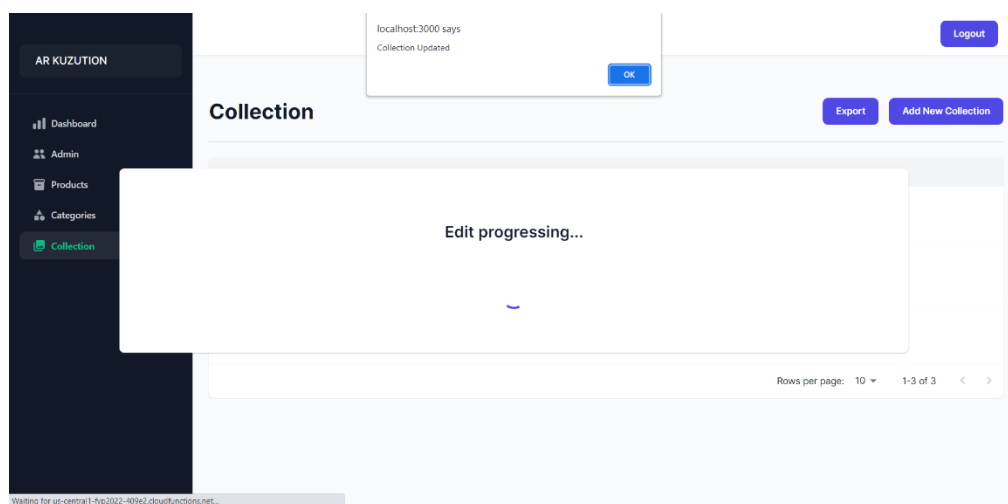


Figure 4.78: Successful edit collection progress

There is two attributes can be edit of a collection. As with category, admins can optionally check the checkboxes. However, the update operation must be performed without an empty checkbox and an empty text field.

Warning during edit collection

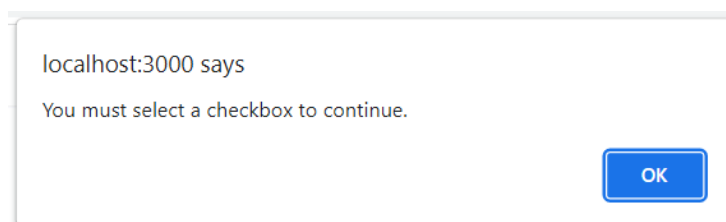


Figure 4.79: Alert to check checkbox

If the admin performs the update without any checkboxes checked, there will be an alert.

The rest of the warnings will be similar to the warnings for adding collection, as the attribute and text field is the same.

Delete collection

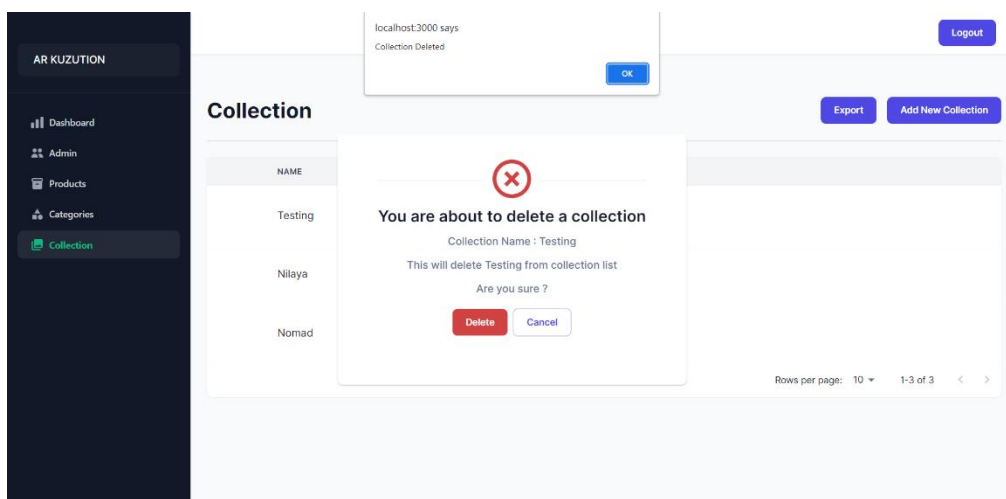


Figure 4.80: Delete collection modal

When an admin intends to delete a collection, a delete modal will be presented to determine the admin's current action. The admin may select the red delete key to insist on the deletion. An alert will then appear to remind the process has been completed.

Export collection

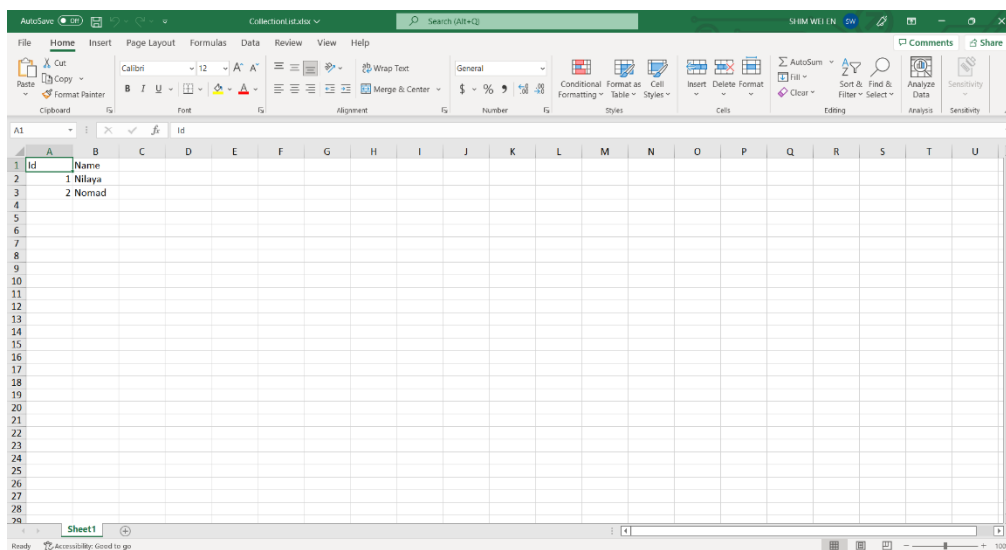


Figure 4.81: Collection list excel

The exported file includes all collection records.

Product page

NAME	CATEGORY	TRENDING	NEW	ACTIONS
FRIHETENN	chair	<input type="checkbox"/>	<input type="checkbox"/>	Description Edit Delete
BILLY / OXBERG	storage	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Description Edit Delete
EKEDALEN / EKEDALEN	table	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Description Edit Delete
LIDÁS	chair	<input type="checkbox"/>	<input type="checkbox"/>	Description Edit Delete
JANINGE	chair	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Description Edit Delete

Figure 4.82: Product page

In the product page, all product records are initially displayed. As the products have more attributes, therefore there is a description modal to make it easier for the admin to have an overview. Admins can view product descriptions, add new products, modify product attributes or delete them.

Then, on the same line of the header, there is “export” and “add new product”. By clicking Export, the administrator can export all the product information directly to an Excel file.

Product description

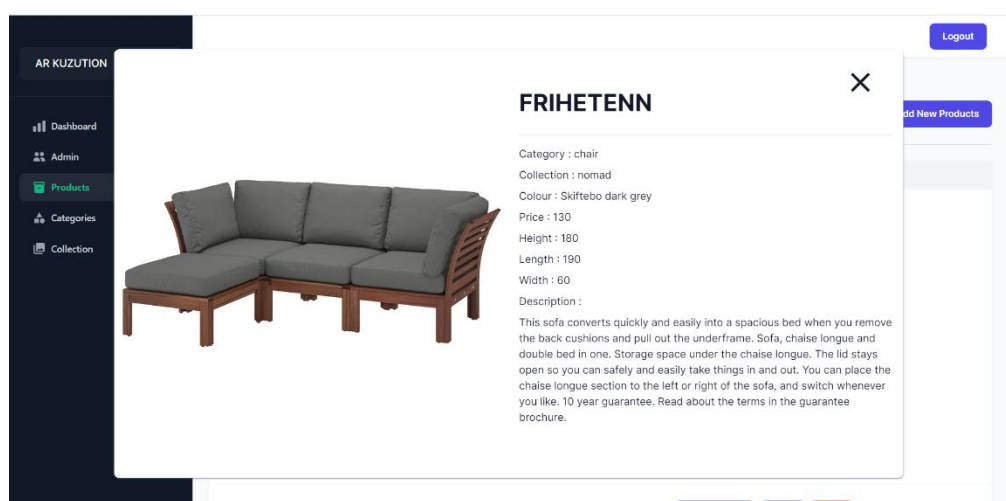


Figure 4.83: Product description modal

In description modal, all attributes are displayed.

Add new product

The screenshot shows the 'Add New Product' modal form. On the left is a dark sidebar with navigation options: Dashboard, Admin, Products (highlighted), Categories, and Collection. The main form area is titled 'Add New Product' and contains the following fields and controls:

- Name:** A text input field with a checkbox for 'Trending'.
- Height, Length, Width:** Three separate text input fields.
- Price, Colour:** Two separate text input fields.
- Category, Collection:** Two dropdown menus, each with a 'Select...' placeholder.
- Description:** A large text area.
- Form Controls:** A 'Logout' button at the top right, an 'Export' button, and a red-bordered 'Add New Products' button.
- Product List:** A table on the right side of the modal showing existing products, each with an 'Edit' button and a delete icon.

Figure 4.84: Add new product modal (1)

This screenshot shows the 'Add New Product' modal form at a different stage. The fields visible are:

- Price, Colour:** Two text input fields.
- Category, Collection:** Two dropdown menus.
- Description:** A large text area.
- Image, Model:** Two 'Choose File' buttons, both showing 'No file chosen'.
- Form Controls:** A 'Logout' button at the top right, an 'Export' button, and a red-bordered 'Add New Products' button.
- Product List:** A table on the right side of the modal showing existing products, each with an 'Edit' button and a delete icon.
- Bottom Buttons:** 'Create' and 'Cancel' buttons are visible at the bottom of the form.

Figure 4.85: Add new product modal (2)

To create a product there is 13 attributes including, name, height, length, width, price, colour, category, collection, description, image, model, is new product and is trending product. Among the 13 attributes, there are three that are not mandatory, that is, collection, new, trending. Admin can simply select whether the product belongs to a collection, whether the product is a new product or a trending product. This indicates that even if the textfield for any of these three is empty, there won't be an alert.

The category and collection lists will be used in this category and collection selector. All products are under a category, but can also be selected under a collection.

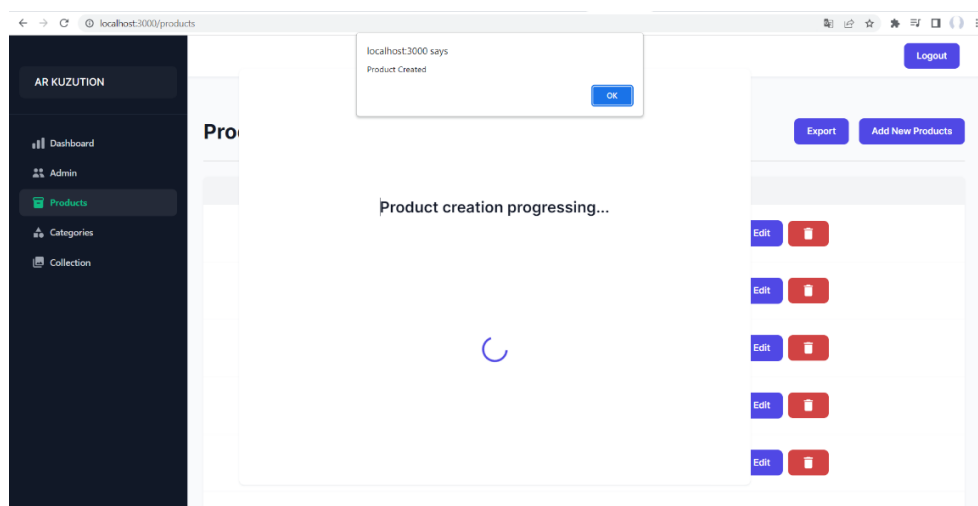


Figure 4.86: Successfully add new product

While the creation progress is loading, the loading page will appear. Therefore, if the progress is complete, an alert will prompt to alert the admin the progress is completed successfully.

Warning during add new product

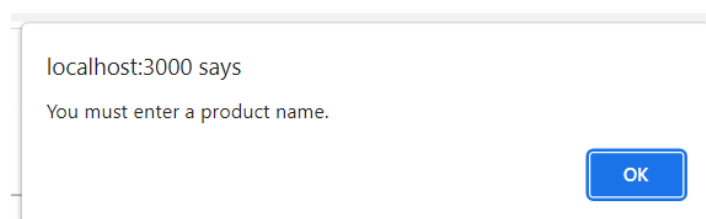


Figure 4.87: Alert of empty product name

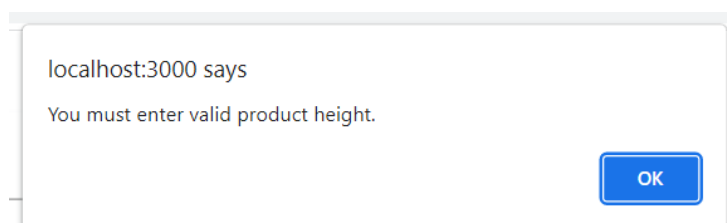


Figure 4.88: Alert of empty or invalid product height

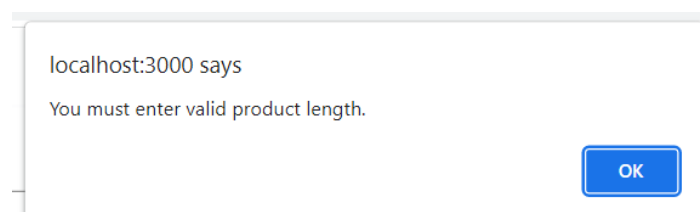


Figure 4.89: Alert of empty or invalid product length

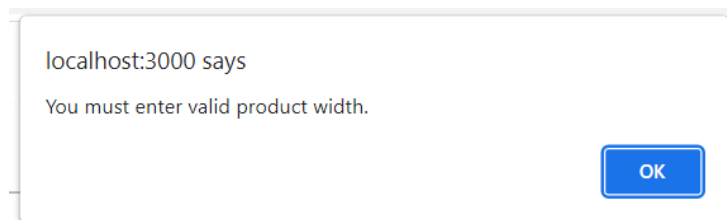


Figure 4.90: Alert of empty or invalid product width

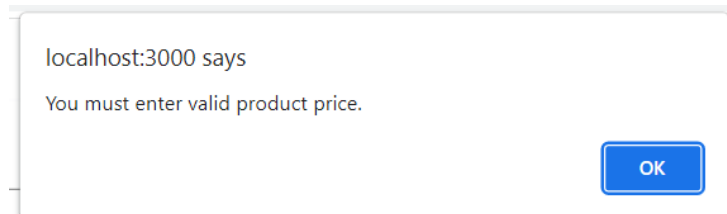


Figure 4.91: Alert of empty or invalid product price

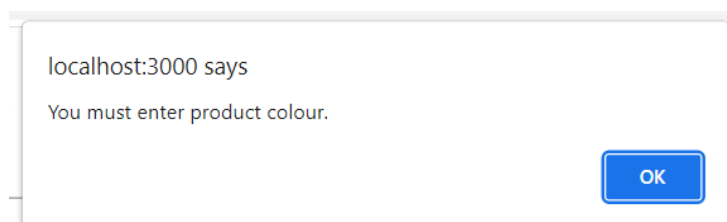


Figure 4.92: Alert of empty product colour

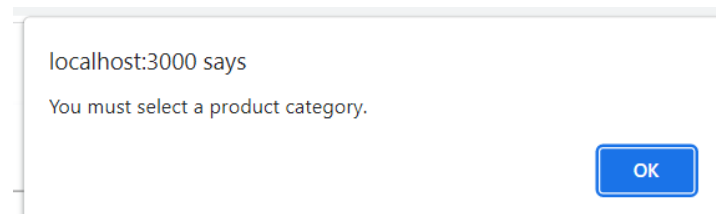


Figure 4.93: Alert of empty product category

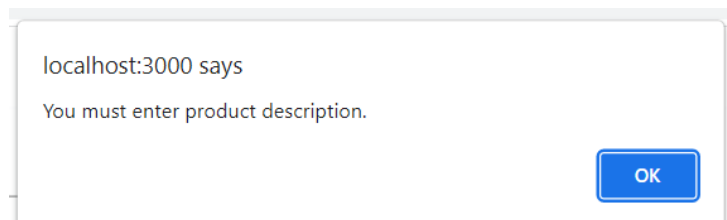


Figure 4.94: Alert of empty product description

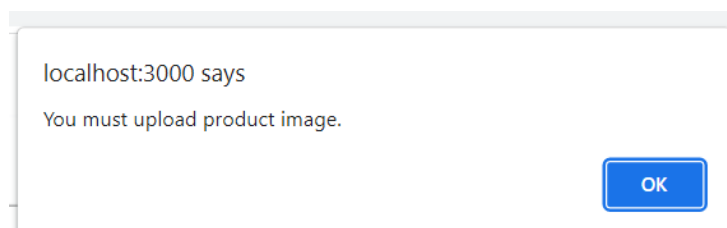


Figure 4.95: Alert of empty product image

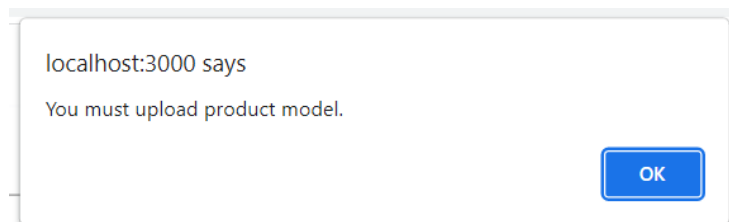


Figure 4.96: Alert of empty product model

There are ten text fields compulsory to be enter, during add new product. Empty text fields are not permitted. Admin must proceed without leaving any blank text fields.

Edit product

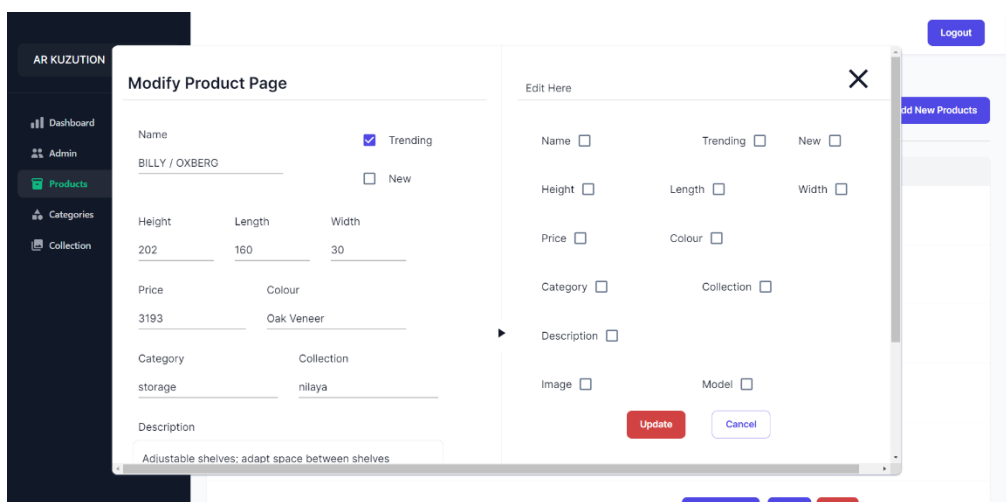


Figure 4.97: Edit product modal

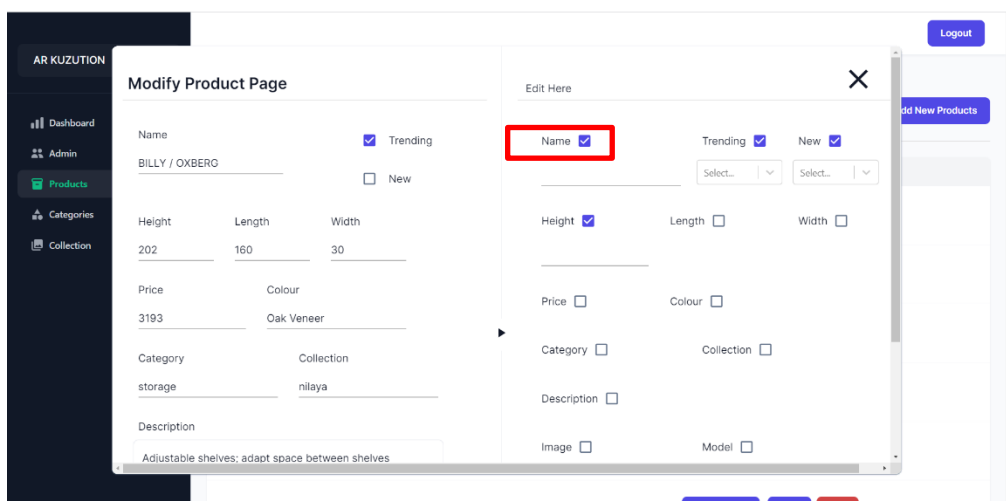


Figure 4.98: Edit product modal with checked

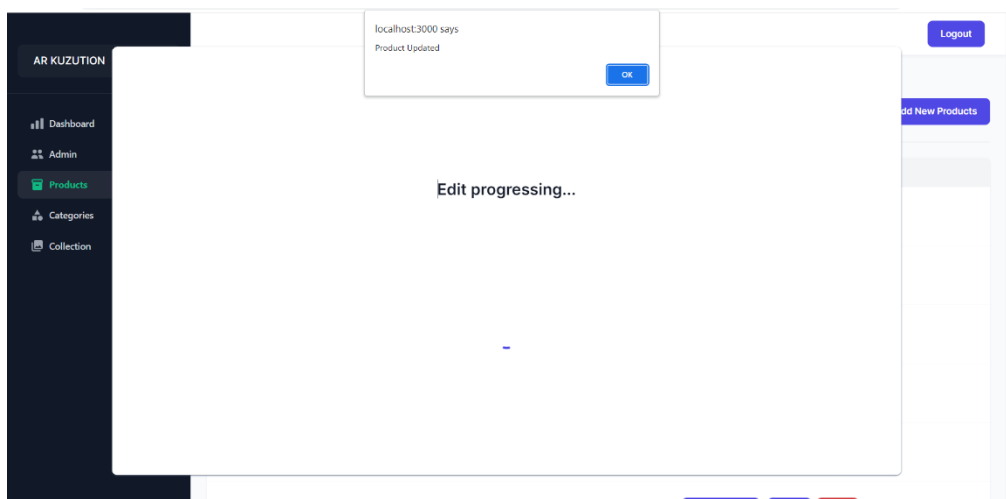


Figure 4.99: Successful edit product

There is thirteen attributes can be edited of a product. As with category and collection, admins can optionally check the checkboxes. However, the update operation must be performed without an empty checkbox and an empty text field.

Warning during edit product

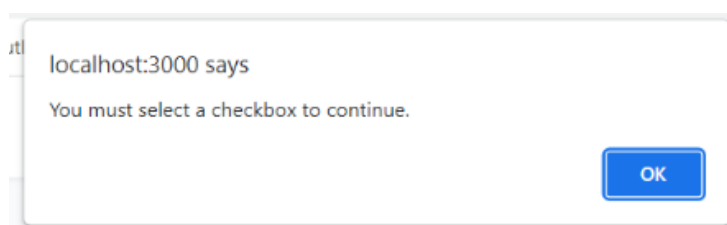


Figure 4.100: Alert to check checkbox

If the admin performs the update without any checkboxes checked, there will be an alert.

The rest of the warnings will be similar to the warnings for adding collection, as the attribute and text field is the same.

Delete product

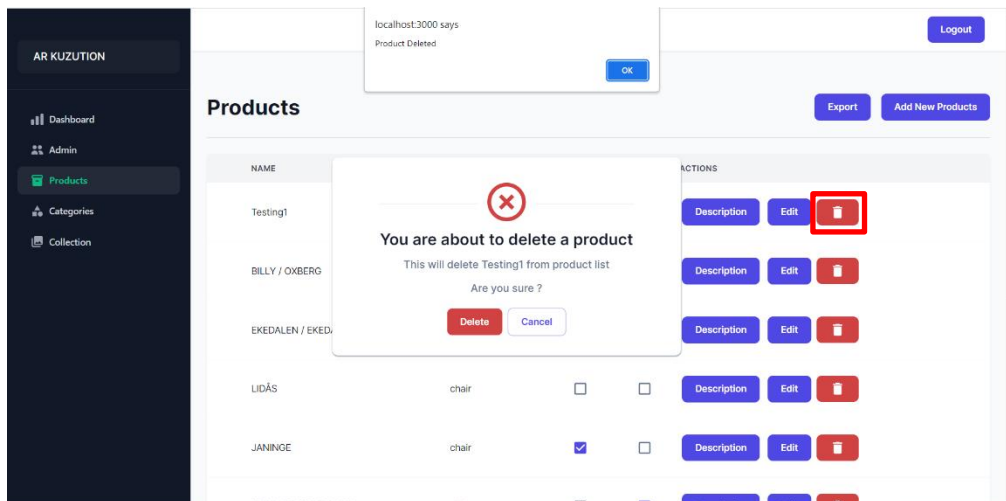


Figure 4.101: Delete product modal

When an admin intends to delete a product, a delete modal will be presented to determine the admin's current action. The admin may select the red delete key to insist on the deletion. An alert will then appear to remind the process has been completed.

Export product

Id	Name	Trending	New	Category	Collection	Colour	Price	Height	Length	Width	Description
1	FRIHETENI	FALSE	FALSE	chair	nomad	Skiftebo d	130	180	190	60	This sofa converts quickly and easily into a spacious bed when you remove the back cushions and pull out
2	BILLY / OX	TRUE	FALSE	storage	nilaya	Oak Veneer	3193	202	160	30	Adjustable shelves; adapt space between shelves according to your needs. Adjustable hinges allow you to
3	EKEDALEN	FALSE	TRUE	table	-	Dark Brown	1828	45	105	25	Every table is unique, with varying grain pattern and natural colour shifts that are part of the charm of wo
4	LIDÅS	FALSE	FALSE	chair	nomad	White	98	100	40	40	You decide the style of your chair. The seat shell is available in different colours, and the underframe SEFF
5	JANINGE	TRUE	FALSE	chair	-	Black-Red	649	70	55	45	You sit comfortably thanks to the scooped seat. Easy to adjust in heights with only one hand. With footr
6	EKEDALEN	FALSE	TRUE	table	-	Brown	88	75	180	80	Every table is unique, with varying grain pattern and natural colour shifts that are part of the charm of wo
7	PELLO	FALSE	FALSE	chair	-	Wooden E	296	70	100	50	PELLO armchair has a bent shape that is slightly resilient when you're seated and provides comfortable ba
8	BALTSAR	TRUE	FALSE	chair	nomad	White	523	100	50	50	The practical and comfortable swivel function allows you to easily get up from the dining table without m
9	VOXLÖV /	FALSE	TRUE	table	nilaya	light gold	1650	75	180	90	Comfortable to sit on thanks to the bowl-shaped seat and rounded shape of the backrest. No tools are re
10	HEMNES	TRUE	TRUE	storage	nomad	Black	529	75	160	50	Of course your home should be a safe place for the entire family. That's why a safety fitting is included so
11	BILLY / OX	FALSE	FALSE	storage	-	Black Brov	1982	202	160	30	Glass doors keep your favourite items free from dust but still visible. Adjustable shelves; adapt space bet

Figure 4.102: Product list excel

The exported file includes all product records.

4.5.2 Mobile Application

Main Screen – Trending Screen



Figure 4.103: Home Screen

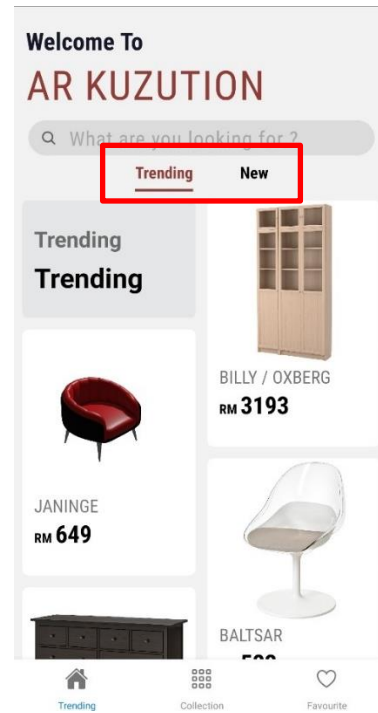


Figure 4.104: Home Screen - Trending

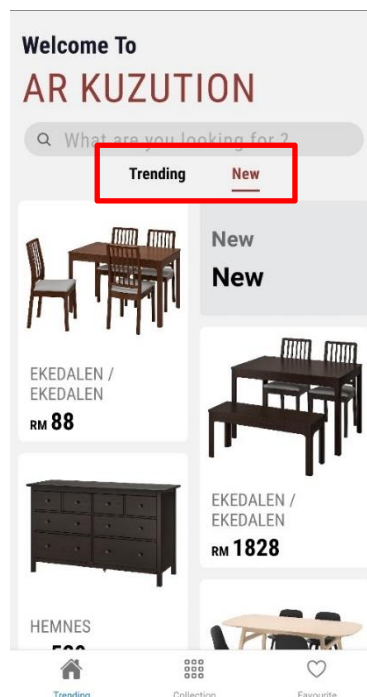


Figure 4.105: Home Screen - New

There are three tabs in this application: Trending, Collection, Favourite. The user is first taken to the trending screen. There is no login screen since this application doesn't demand that the user log in.

Moreover, there is a search bar at the top of the trending page for users to perform search operations. In the middle of the trends page are tabs for trends and new products, allowing users to view new or trending items directly.

Search Modal

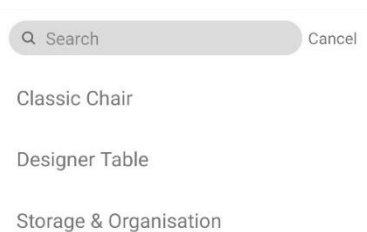


Figure 4.107: Search modal



Figure 4.106: Result Page

When clicked on the search bar, a search modal will open. Here there is a text field and a flat list containing the available categories. In search modal, users can either type keywords into a text field or select from the available categories. In short, the user has two search options: keywords and categories. Immediately after the keyword search, a results page appears.

Category Screen

Even though the name of the tab is category, it actually contains both categories and collections. There are two sections, collections and categories. Available collections and categories will be displayed respectively. All collections and categories will contain a bunch of products. Users can access the result page by simply clicking on the image and then all related products will be displayed.

Collection



Figure 4.108: Collection Screen



Figure 4.109: Collection Result Screen

Category



Figure 4.110: Category Screen

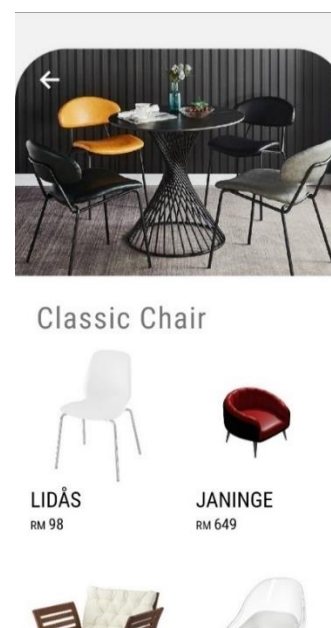


Figure 4.111: Category Result Screen

Product Page

In the result page, a bunch of products are displayed. Users can view more information about a specific product by selecting it, and then users will be directed to the product detail page.

Product page



Figure 4.112: Product Screen

On the product page there is some basic information about the product such as picture, name and price. In addition, there are two options at the bottom, namely product details and support.

Product Details Page

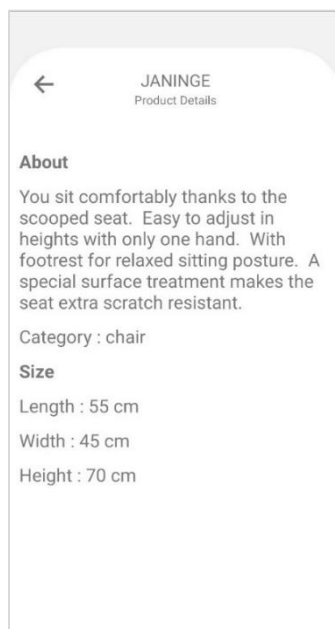


Figure 4.113: Product Details Screen

The Product Details Page obviously contains all the information about this product.

Support page

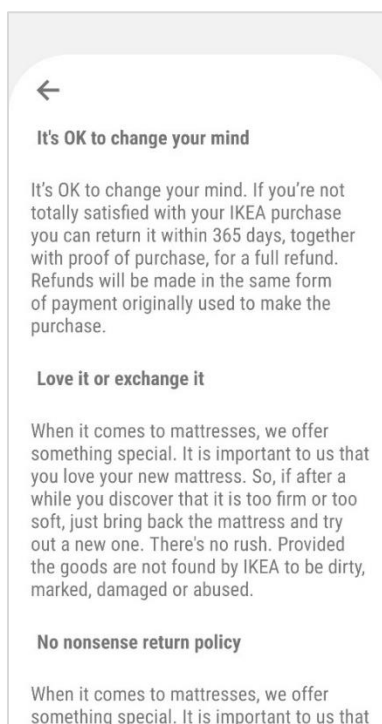


Figure 4.114: Support Screen

Support Page is a list of general considerations.

Favourite Screen

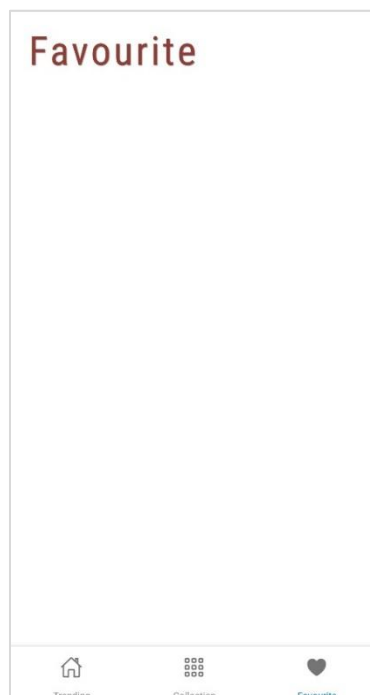


Figure 4.115: Favourite Screen - Empty

This is a empty favourite screen.

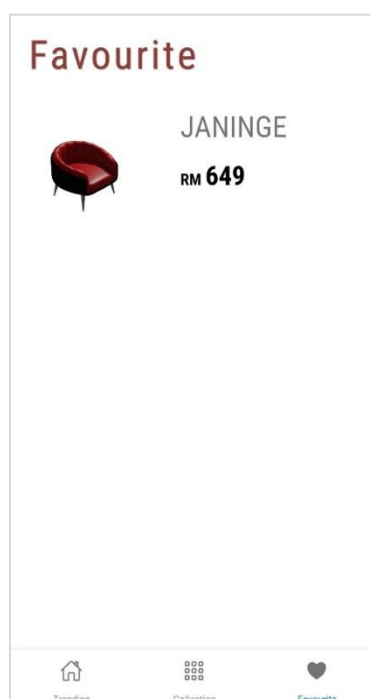
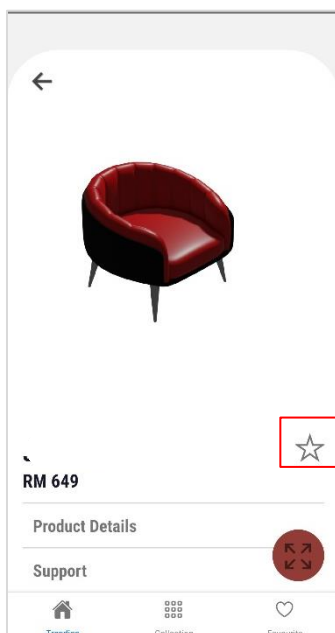


Figure 4.116: Favourite Screen

Favourite a product



This is a normal product screen. The star icon is outlined.

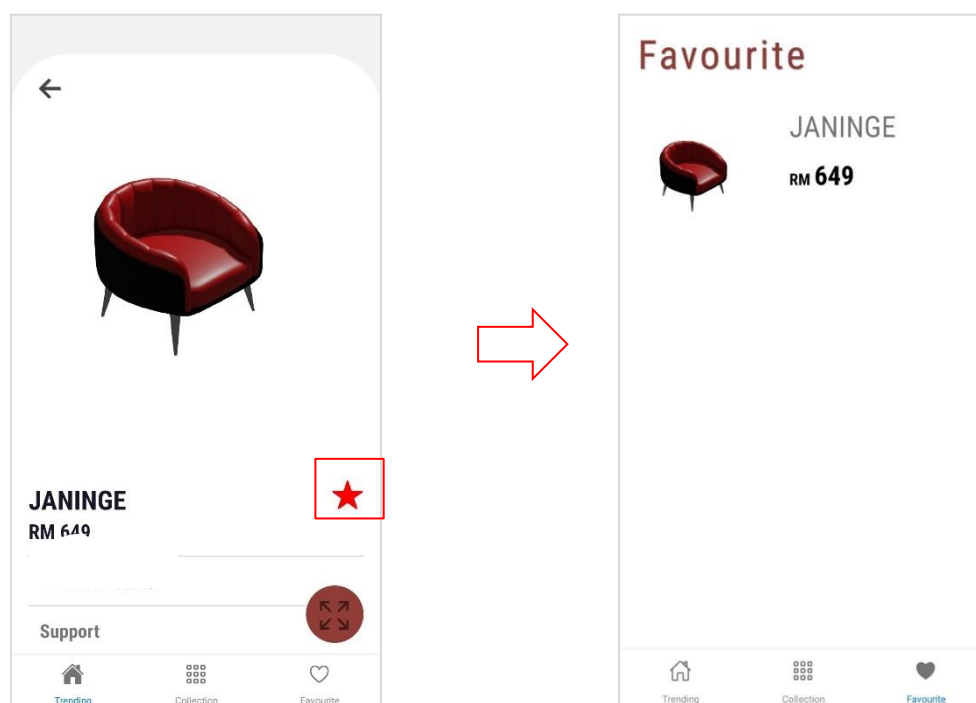


Figure 4.117: To favourite product

In addition to this, users can also favourite product. User can only favourite a product in the product page. In normal situation, the star icon is transparent. When the product is favourited, the star will turn red. Then, the item will also appear in the favorite list.

On the contrary, user can unfavourite the product in product page or in favourite screen. In the case of a product page, the user can unfavourite a product by clicking on the red star icon, which will then transform back into an outline icon.



Figure 4.118: Favourite Screen – Remove button

Alternatively, in the favorites list, the user swipes left on the product and a red delete button will appear. Thus, the product can be deleted via this button.

AR Function

View product in AR mode



Select the button to launch ar function.

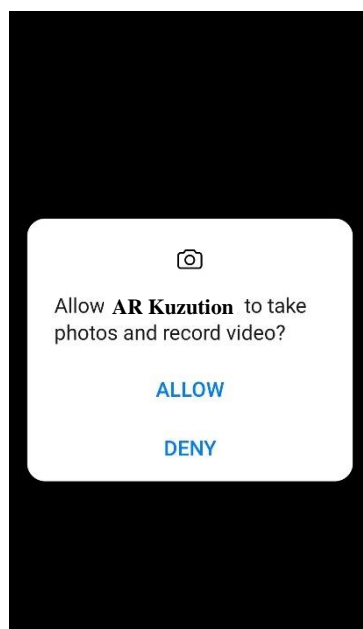




Figure 4.119: To launch AR mode

The plane will be detected and the model will be projected onto the selected plane. “Go back” is a clickable text that allows the user to return to the product page.

Since arcore is already allowed, there will be no alert, but if a new phone is used, then the alert will indicate

Model in AR mode



Figure 4.120: AR Table1



Figure 4.121: AR Table2



Figure 4.122: AR Tv Table



Figure 4.123: AR Table3



Figure 4.125: AR Dresser



Figure 4.124: AR Baby Bed



Figure 4.126: AR Chair1



Figure 4.127: AR Chair2

Models

There are total 10 model.



Figure 4.128: Sofa



Figure 4.129: Table1



Figure 4.130: Table2



Figure 4.131: Table3



Figure 4.133: Tv Table

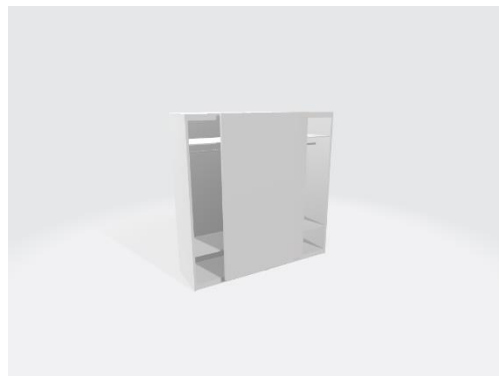


Figure 4.132: Wardrobe

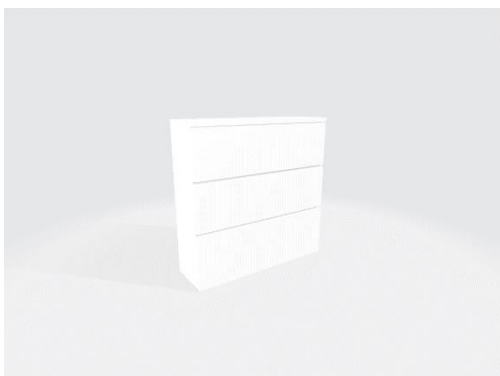


Figure 4.134: Dresser



Figure 4.135: Baby Bed

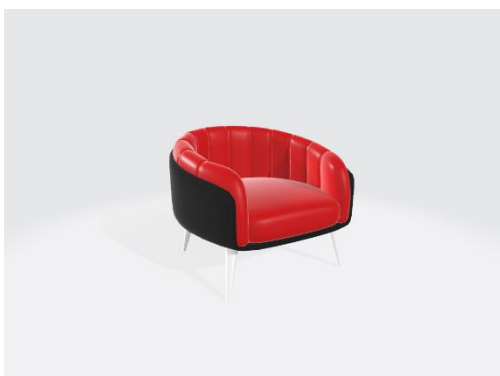


Figure 4.137: Chair1



Figure 4.136: Chair2

CHAPTER 5

DESIGN & TESTING

5.1 Introduction

Chapter 4 discusses the functionality and use cases of web application and mobile application. Consequently, this chapter will discuss the modeling diagram of the entire implementation. Furthermore, the system architecture design will facilitate a better understanding by clearly illustrating the communication between the components, which are the front-end application and the back-end server. Also, interface design and flowcharts are created to visualize the design of the system and function.

5.2 System architecture design

Three-tier architecture was used in this system. It is made up of three layers which are the front-end layer, back-end layer, and database layer.

The front part is the front-end layer, which is the interface of the application. It is the presentation layer of the application, as it is accountable for the system's visualization for the end user. Next will be the back-end layer. It is sandwiched in the middle of the front-end and database layer. It concentrates heavily on business logic and the handling of data transactions. It will be receiving commands and inputs from the front-end layer, seeking information from the database layer based on the commands, and finally passing it back to a once it has been processed according to the logic. The presentation layer would have no access to retrieve data from the database without the backend layer. Lastly, the database layer will hold a large amount of data and will be used to process it in the back-end layer and display it in the front-end layer according to the command.

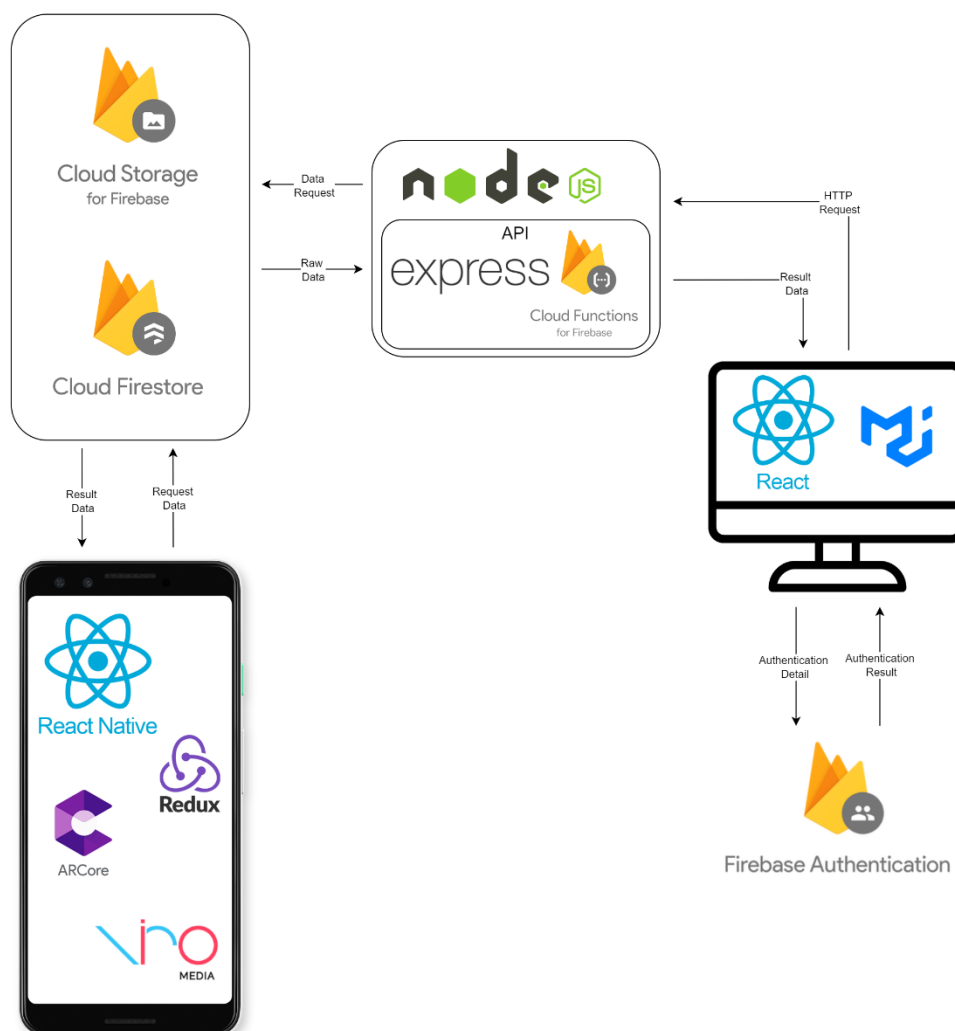


Figure 5.1: System architecture design

NodeJS, ExpressJS, and Firebase were utilized to implement it at the backend layer. Certain risks will arise when the data is interchanged between the system and the database directly. Hence there is a demand for the existence of API, it will ensure a certain level of security for data exchange between the system and the database. ExpressJS's ability to handle requests sent by the front-end as it enables the construction and creation of APIs. In the backend, Firebase was integrated with ExpressJS to provide database connectivity. HTTP triggered Cloud Functions are designed to use the same APIs as the popular/most-common web frameworks for the language they support. For instance, Python HTTP Cloud Functions have Request and Response objects compatible with the Flask web framework. Similarly, Node.js Cloud Functions use the Express.js API.

In the web application front-end layer, Firebase Authentication will be used as the guard of admin login to control by authenticating the admin access with connection to Firebase. Also, while adding a new admin, the account detail will be recorded into the firebase. It handled the registration of a new account as well. All the display item information was triggered by the backend server to request from firebase through the frontend applications.

For the interface design, React Native is used for mobile front-end applications, while React is used for web front-end applications. the web front-end applications are built using the Material-UI library. It provides a lot of ready-mades, good-looking CSS Components along with the use of third-party libraries. users reduce the time of challenging the creation of CSS and thus it improved the process of developing applications quickly and simply.

Compared with the web, mobile will have an additional function for project AR model. This is why ViroReact is needed in the mobile application. ViroReact is a library intended for the creation of AR applications using React Native. Besides that, ViroReact is not sufficient on its own. Viroreact is incapable of projecting the model, so behind the scenes, it needs the help of ARCore. With ARCore, it's possible to construct new augmented reality experiences by seamlessly blending the digital and physical worlds. ARCore empowers the end user's phone to sense its surroundings, understand the real world, and interact with information. Also, since the list of favourite items should be stored locally, redux is used here.

5.3 Database Design

The physical model of the system's data structure is described in this section. It provides a clearer illustration of the data structure and the connections between the collections. Additionally, it enhances development efficiency and lessens the possibility of confusion during the installation of data structures.

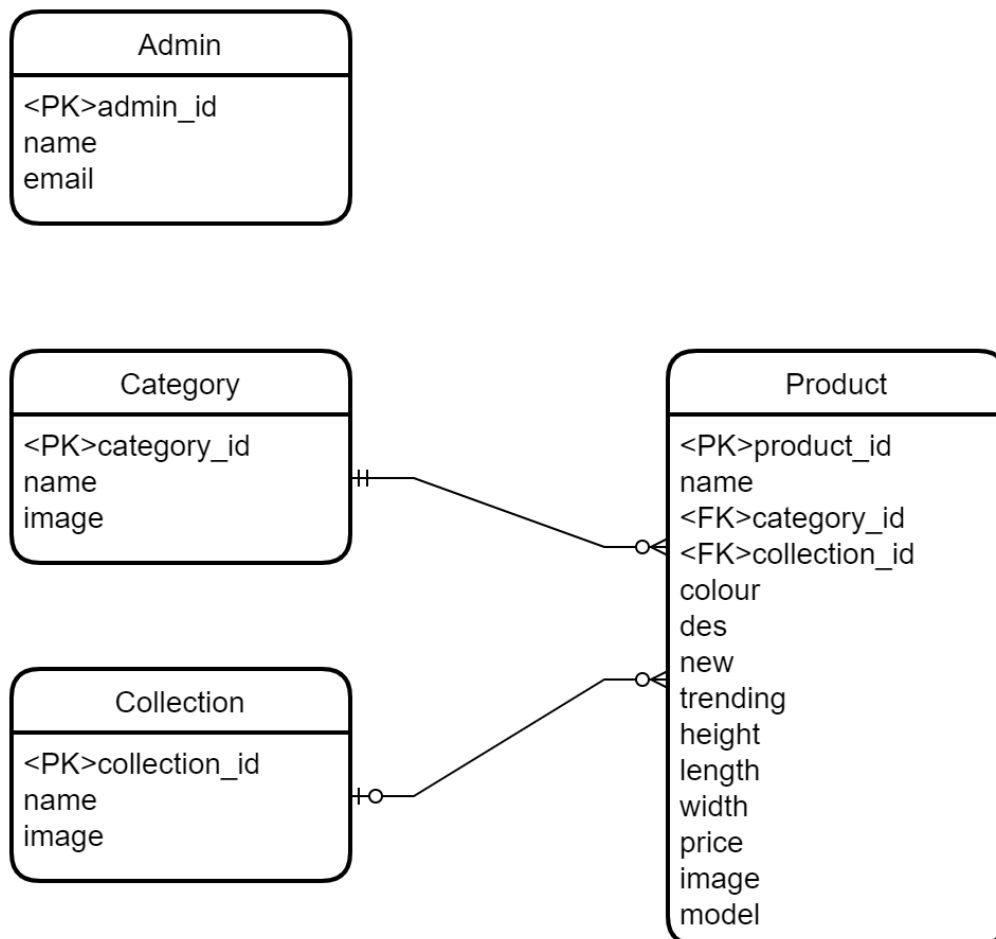


Figure 5.2: Physical entity relationship diagram

5.4 API List

Because there is a firebase function, there will be links.

No	Endpoint	Description	Parameters
1	/api/admin/getAll	To retrieve all the admin data	-
2	/api/admin/create	To insert a new admin data	name, email
3	/api/admin/update/:id	To update a admin data	name
4	/api/admin/delete/:id	To remove a admin data	Id
5	/api/category/getAll	To retrieve all the category data	-
6	/api/category/create	To insert a new category data	name, image
7	/api/category/update/:id	To update a category data	Id, name, image
8	/api/category/delete/:id	To remove a category data	Id
9	/api/collection/getAll	To retrieve all the collection data	-
10	/api/collection/create	To insert a new collection data	name, image
11	/api/collection/update/:id	To update a collection data	Id ,name, image
12	/api/collection/delete/:id	To remove a collection data	Id
13	/api/product/getAll	To retrieve all the product data	-
14	/api/product/create	To insert a new product data	name, height, length, width, colour, category, collection

			description, image, model, new, trending
15	/api/product/delete/:id	To update a product data	Id, name, height, length, width, colour, category, collection description, image, model, new, trending
16	/api/product/update/:id	To remove a product data	Id

Table 5.1: API List

5.5 Testing

In this project, manual testing is used. The Ref No is referring to the functional requirement.

No	Ref No	Test Case ID	Test Case Title	Status
1.	1	Admin-01	Test Case of Admin Login	PASS
2.	2	Admin-02	Test Case of Account rest password	PASS
3.	-	Admin-03	Test Case of fetch all Admin account record	PASS
4.	3.1	Admin-04	Test Case of Admin account creation and update	PASS
5.	3.3	Admin-05	Test Case of Admin account removal	PASS
6.	-	Category-01	Test Case of fetch all Category record	PASS
7.	4.1	Category-02	Test Case of Category creation and update	PASS
8.	4.4	Category-03	Test Case of Category removal	PASS
9.	-	Collection-01	Test Case of fetch all Collection record	PASS
10.	5.1	Collection-02	Test Case of Collection creation and update	PASS

11.	5.4	Collection-03	Test Case of Collection removal	PASS
12.	-	Product-01	Test Case of fetch all Product record	PASS
13.	6.1	Product-02	Test Case of Product creation and update	PASS
14.	6.4	Product-03	Test Case of Product removal	PASS

Table 5.2: Test Case List

5.5.1 Test Case

Test Case ID	Admin-01	Status	PASS
Test Case Title	Test Case of Admin Login		
Test Case Description	This is to test the login of admin account		
Test Steps	Test Data	Expected Result	Actual Result
The admin enters valid email and password.	Valid email, valid password	Admin be direct to dashboard.	Admin be direct to dashboard.
The admin enters invalid email and password.	Invalid email, invalid password	Alert with "Please enter valid email and password.	Alert with "Please enter valid email and password.

Table 5.3: Test Case Admin-01

Test Case ID	Admin-02	Status	PASS
Test Case Title	Test Case of Account reset password		
Test Case Description	This is to the ability to reset admin account password.		
Test Steps	Test Data	Expected Result	Actual Result
The admin enters valid email	-	-	-
The Firebase tried to send a email with reset link to the mailbox	-	A new email with reset link is in the mailbox. And admin be direct to the reset password page by the link.	A new email with reset link is in the mailbox. And admin be direct to the reset password page by the link.
The admin enters new password	New account password	Alert with "Password	Alert with "Password

		changed” is prompt.	changed” is prompt.
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Table 5.4: Test Case Admin-02

Admin

Test Case ID	Admin-03	Status	PASS
Test Case Title	Test Case of fetch all Admin account record		
Test Case Description	This is to the ability to retrieve all of the admin records from the admin collection.		
Test Steps	Test Data	Expected Result	Actual Result
The admin selects admin page	-	-	-
The server tried to get all the admin’s accounts via endpoint “/api/admin/getAll/”	-	Returned array of item with a size larger than one. And show in admin list.	Returned array of item with a size larger than one. And show in admin list.

Table 5.5: Test Case Admin-03

Test Case ID	Admin-04	Status	PASS
Test Case Title	Test Case of Admin account creation and update		
Test Case Description	This is to the ability to create a new admin account and update the attributes		
Test Steps	Test Data	Expected Result	Actual Result
The admin selects “create admin” button	-	-	-
The admin enters all the needed information	-	-	-

The send the account information to endpoint “/api/admin/create”	1. New admin information	An object with property “response” and value of “Insert successfully” is returned. The user record been created in firebase with attributes. The new record shows in the admin list	An object with property “response” and value of “Insert successfully” is returned. The user record been created in firebase with attributes. The new record shows in the admin list.
The admin can select and enter new information of a admin.	1. Updated admin information	-	-
The server update admin name	1. The ID of the admin to be update 2. Updated admin information	An object with property “response” and value of “Update successfully” is returned. The user record been update in firebase with attributes.	An object with property “response” and value of “Update successfully” is returned. The user record been update in firebase with attributes.

Table 5.6: Test Case Admin-04

Test Case ID	Admin-05	Status	PASS
Test Case Title	Test Case of Admin account removal		
Test Case Description	This is to the ability to delete a admin account		
Test Steps	Test Data	Expected Result	Actual Result
The admin selects an admin to delete.	-	-	-
The server deletes others admin account via endpoint “api/admin/delete”	The ID of the admin to be delete	An object with property “response” and value of “Delete successfully” is returned. And the record disappears from the admin list.	An object with property “response” and value of “Delete successfully” is returned. And the record disappears from the admin list.

Table 5.7: Test Case Admin-05

Category

Test Case ID	Category-01	Status	PASS
Test Case Title	Test Case of fetch all Category record		
Test Case Description	This is to the ability to retrieve all of the admin records from the admin collection.		
Test Steps	Test Data	Expected Result	Actual Result
The admin selects admin page	-	-	-
The server tried to get all the admin’s accounts via endpoint “/api/admin/getAll”	-	Returned array of item with a size larger than one. And show in admin list.	Returned array of item with a size larger than one. And

			show in admin list.
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Table 5.8: Test Case Category-01

Test Case ID	Category-02	Status	PASS
Test Case Title	Test Case of Category creation and update		
Test Case Description	This is to the ability to create a new admin account and update the attributes		
Test Steps	Test Data	Expected Result	Actual Result
The admin selects “create admin” button	-	-	-
The admin enters all the needed information	-	-	-
The send the account information to endpoint “/api/category/create”	New category attributes	An object with property “response” and value of “Insert successfully” is returned. The user record been created in firebase with attributes. The new record shows in the category list	An object with property “response” and value of “Insert successfully” is returned. The user record been created in firebase with attributes. The new record shows in the category list.
The admin can select and enter new	Updated category attributes	-	-

attributes of a category.			
The server update category attributes	<ol style="list-style-type: none"> 1. The ID of the admin to be update 2. Updated category attributes 	An object with property “response” and value of “Update successfully” is returned. The category record been update in firebase with attributes.	An object with property “response” and value of “Update successfully” is returned. The category record been update in firebase with attributes.

Table 5.9: Test Case Category-02

Test Case ID	Category-03	Status	PASS
Test Case Title	Test Case of Category removal		
Test Case Description	This is to the ability to delete a category		
Test Steps	Test Data	Expected Result	Actual Result
The admin selects an category to delete.	-	-	-
The server deletes category via endpoint “api/category/delete”	The ID of the category to be delete	An object with property “response” and value of “Delete successfully” is returned. And the record disappears from the category list.	An object with property “response” and value of “Delete successfully” is returned. And the record disappears from the category list.

Table 5.10: Test Case Category-03

Collection

Test Case ID	Collection-01	Status	PASS
Test Case Title	Test Case of fetch all Collection record		
Test Case Description	This is to the ability to retrieve all of the collection records from the admin collection.		
Test Steps	Test Data	Expected Result	Actual Result
The admin selects admin page	-	-	-
The server tried to get all the admin's accounts via endpoint "/api/collection/getAll/"	-	Returned array of item with a size larger than one. And show in collection list.	Returned array of item with a size larger than one. And show in collection list.

Table 5.11: Test Case Collection-01

Test Case ID	Collection-02	Status	PASS
Test Case Title	Test Case of Collection creation and update		
Test Case Description	This is to the ability to create a new collection and update the attributes		
Test Steps	Test Data	Expected Result	Actual Result
The admin selects "create collection" button	-	-	-
The admin enters all the needed information	-	-	-
The send the account information to endpoint "/api/collection/create"	New collection attributes	An object with property "response" and value of	An object with property "response" and value of

		<p>“Insert successfully” is returned. The user record been created in firebase with attributes. The new record shows in the collection list</p>	<p>“Insert successfully” is returned. The user record been created in firebase with attributes. The new record shows in the collection list.</p>
The admin can select and enter new attributes of a collection.	Updated collection attributes	-	-
The server update collection attributes	<ol style="list-style-type: none"> 1. The ID of the collection to be update 2. Updated collection attributes 	<p>An object with property “response” and value of “Update successfully” is returned. The category record been update in firebase with attributes.</p>	<p>An object with property “response” and value of “Update successfully” is returned. The collection record been update in firebase with attributes.</p>

Table 5.12: Test Case Collection-02

Test Case ID	Collection-03	Status	PASS
Test Case Title	Test Case of Collection removal		

Test Case Description	This is to the ability to delete a collection		
Test Steps	Test Data	Expected Result	Actual Result
The admin selects an collection to delete.	-	-	-
The server deletes collection via endpoint “api/collection/delete”	The ID of the collection to be delete	An object with property “response” and value of “Delete successfully” is returned. And the record disappears from the collection list.	An object with property “response” and value of “Delete successfully” is returned. And the record disappears from the collection list.

Table 5.13: Test Case Collection-03

Product

Test Case ID	Product-01	Status	PASS
Test Case Title	Test Case of fetch all Product record		
Test Case Description	This is to the ability to retrieve all of the product records from the product collection.		
Test Steps	Test Data	Expected Result	Actual Result
The admin selects admin page	-	-	-
The server tried to get all the admin’s accounts via endpoint “/api/product /getAll/”	-	Returned array of item with a size larger than one. And show in product list.	Returned array of item with a size larger than one. And show in product list.

Table 5.14: Test Case Product-01

Test Case ID	Product-02	Status	PASS
Test Case Title	Test Case of Product account creation and update		
Test Case Description	This is to the ability to create a new product and update the attributes		
Test Steps	Test Data	Expected Result	Actual Result
The admin selects “create product” button	-	-	-
The admin enters all the needed information	-	-	-
The send the account information to endpoint “/api/product /create”	New product information	An object with property “response” and value of “Insert successfully” is returned. The user record been created in firebase with attributes. The new record shows in the product list	An object with property “response” and value of “Insert successfully” is returned. The user record been created in firebase with attributes. The new record shows in the product list.
The admin can select and enter new attributes of a product.	Updated product attributes	-	-
The server update product attributes	<ol style="list-style-type: none"> 1. The ID of the product to be update 2. Updated product attributes 	An object with property “response” and value of “Update	An object with property “response” and value of

		successfully” is returned. The product record been update in firebase with attributes.	“Update successfully” is returned. The product record been update in firebase with attributes.
--	--	--	--

Table 5.15: Test Case Product-02

Test Case ID	Product-03	Status	PASS
Test Case Title	Test Case of Product account removal		
Test Case Description	This is to the ability to delete a product		
Test Steps	Test Data	Expected Result	Actual
			Resuccccccccclt
The admin selects an product to delete.	-	-	-
The server deletes product via endpoint “api/product/delete”	The ID of the product to be delete	An object with property “response” and value of “Delete successfully” is returned. And the record disappears from the product list.	An object with property “response” and value of “Delete successfully” is returned. And the record disappears from the product list.

Table 5.16: Test Case Product-03

CHAPTER 6

CONCLUSION

6.1 Conclusion

In summary, this project consists of two applications, the web application and the mobile application. The mobile application is the main application proposed by the project title and the web application is the support for the management of the admin.

As the main objective of the project is augmented reality, the mobile application will be the most important part. In the mobile application, users can browse and search for products by their name, keyword, category or collection. All products are under categories, but collections are optional. Products come with a product page where there is a product detail page and a support page. The product detail page includes all relevant information about the specific product such as width, length, height, price, description, etc. There is a star icon on the product page, which is to enable the user to like the product. In addition, there is an extended icon button which is used to launch the ar function.

On the admin side, there is a web application. Unlike the mobile app, the web app has a login page so the admins need to log in to the application. In the application, there is a dashboard to make it easy for the admins and it will show the total number of admins, products, categories and collections. As the highest priority admin, they can add new admins, edit the names of other admins and delete admins. This is to prevent people from registering random admin accounts. All records will be displayed in a list on each page. In addition to this, the admin can create products, categories and collections. Edit the properties of products, categories and collections. It is also possible to delete products, categories or collections. It's all about CRUD. On each set of data, the records are able to be exported to excel format.

Finally, this graduation project enabled me in testing and understanding the limits of my technical abilities. The experience was a good learning experience and definitely a stepping stone for my future career as I was

able to test the limits of my skills and allow me to explore new techniques. It has prepared me to handle real world challenges outside of University.

6.2 System Strengths and Limitations

The strength of this mobile application as proposed is that it is combined with augmented reality features that can superimpose products in the application into a real-world environment, thereby delivering a better better visual understanding of product detail to the user. In addition, it will have a favourite list feature that will allow user to put their favourite products in the list.

Nevertheless, the proposed mobile application also has some limitations. The 3D models of some products are not sufficiently realistic. And then, the 3D models lack surface drawing and therefore, it will lack realistic due to the lack of knowledge of art design. In addition, the test device may not be good enough and therefore, the surface of projected model is not that good.

6.3 Recommendations for Future Work

Just like every other, this part mobile application and web application also has its own limitations. This section will briefly describe the limitations in terms of performance, lack of features and flexibilities of this application. This section will also offer a few recommendations and suggestions for additional research.

Web application

No	Recommendation	Description
	Data encryption so that there is greater safety when transmitting data	Methods for encryption that can be used include AES and RSA.
	Enable records import	The web application should enable admins to import product, category or collection records into the system. As a result, it can enhance the admin's performance by reducing the need for data re-entry.
	Multiple product image for a product	Currently the products have only one photo, which may not provide a more

		comprehensive image for the user to have a look at. So it is recommended that a product can have one or more than two images. Admin can also upload one or more than two images for a product.
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Mobile application

No	Recommendation	Description
	E-commerce ability	<p>Online purchase and selling function is great for the mobile application user , with this feature integrated into the mobile application as this project's application is not included such function. User are able to make order, purchase product, upload product to sell in no time. Payment gateway such as Stripe can be easily integrated into this mobile application to perform e-payment. This can also motivate users to adapt and join the e-payment movement.</p> <p>Moreover, combined with the merchant model, users can also become merchants and set up their own stores. Users can also start their business more easily.</p> <p>Overall the application will be more comprehensive and attractive to users.</p>
	Enable user account	Having the buy and sell features will require a user account and a login function. This allows users to have a more comprehensive view of their information, browsing history, purchase history, etc.
	Conduct In-Depth study on the user experience	Since this is project is not conducted any user experience test such as user

		<p>acceptance test. The interaction interfaces, as well as the user experience, it may not follow the standard. Hence, it should be studied in depth to improve it so that the user experience can reduce the drop off rate rate of application users. In addition, the actual UX/UI designer's experience and knowledge will be prioritized in order to deliver better applications to users.</p>
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